JUSTUS-LIEBIG-
UNIVERSITÄT
GIESSEN

Barbara E. Weißenberger

Effects of Real versus Phantom Stock Option Plans on Shareholder Wealth

Working Paper 2 / 2002

(Revised Version, December 2003)

– Arbeitspapiere Industrielles Management und Controlling –

Herausgeber: Professur für Betriebswirtschaftslehre mit dem Schwerpunkt Industrielles Management und Controlling (Prof. Dr. Barbara E. Weißenberger)
Justus-Liebig-Universität, Gießen
http://wiwi.uni-giessen.de/controlling/

JEL-Classification: C72, M52

Vortrag auf der Pfingsttagung des Verbands der Hochschullehrer für Betriebswirtschaft e.V., 23. Mai 2002

Effects of Real versus Phantom Stock Option Plans on Shareholder Wealth

Revised Version, December 2003

Abstract

The paper compares the effects of real versus phantom stock option plans as different types of executive compensation on shareholder wealth. So far, literature presupposes that apart from tax effects both types of plans are equivalent from the shareholders' point of view. This question is discussed based on a two-period model that includes a straightforward sequential moral hazard game in the first period after which the agent is remunerated via real vs. phantom stock options.

It can be shown that if strictly positive abnormal earnings are expected in the second period, real stock option plans dominate phantom plans as the new shares provide the agent with an investment opportunity with a positive net present value. This becomes part of the agent's remuneration and thus reduces the loss in wealth the original shareholders have to sustain by capital dilution compared to the implicit capital dilution induced by cash payments made under phantom stock option plans.

Keywords: Executive Compensation, Incentives, Real Stock Option Plans, Phantom Stock Option Plans, Stock Appreciation Rights

JEL Classification: C72, M52

Acknowledgments:

I would like to thank Nils Crasselt, Joachim Gassen, Leonhard Knoll, Michael Löbig, Christian Riegler, Hilke Stromann and Andreas Trautwein as well as seminar participants at the 2nd GEABA conference, Vallendar, and the 25th EAA conference, Kopenhagen, for helpful comments and discussion on an earlier version of this paper. Financial support of the Arthur Andersen Foundation is gratefully acknowledged.

Effects of Real versus Phantom Stock Option Plans on Shareholder Wealth

Overview

- The following paper discusses if a firm's shareholders who have decided on implementing a stock option plan as a means of executive compensation should be indifferent with regards to the implementation as a real versus a phantom stock option plan.
- Based on a two-period model that includes a straightforward sequential moral hazard game in the first period we show that under certain conditions real stock option plans dominate phantom plans if strictly positive abnormal returns are expected in future periods.
- This result sheds new light on the discussion of the reasons for the increasing use of real stock option plans as an executive compensation tool in the last years.
- Additionally, the result supports the notion that once the present corporate governance problems with regards to balance sheet frauds and insufficient disclosure of stock option expense have been resolved, real stock option plans will remain an essential part of the executive compensation package.

A Introduction

The use of stock option plans as a share price-based executive compensation tool, which has gained widespread application in the US and other Anglo-Saxon countries since their inception in the 1920s, has been enjoying increasing popularity in Germany since 1996[1] as well. Here, this development is due not only to the prevalence of value-based management concepts which unanimously recommend stock option plans as a means of executive compensation, but also to the elimination of several legal impediments to the emission of stock option plans through new corporate governance regulation (KonTraG) in 1998.

Only very recently, the use of stock options as a remuneration tool has been subject to a certain decline. This has been due not only to several balance sheet fraud cases during the last years,[2] but also to shareholders suspecting highly inflated management compensation with small or even zero incentive effects, and finally to the stock market crises since 2001 making any types of share price-based incentives less attractive. Nevertheless, stock option plans remain an essential part of the executive compensation package, together with base salaries, annual bonus plans and other long-term incentive plans[3] and therefore are subject to economic discussion.

Amongst the different research questions related to stock option plans, the following paper focuses on the question whether a firm's shareholders are indifferent regarding the implementation of stock option plans as a real plan or as a so-called phantom plan. In the case of real plans, warrants are given out to a manager-employee, who exercises the respective options on the firm's shares after a waiting period if the strike price is below the current share price. The manager may then either hold or sell the new shares according to his own

discretion. His economic benefit equals either zero (if the options are not exercised at all) or the difference between share price and strike price multiplied by the number of new shares that are called. In the case of phantom plans, no options and – more important – no new shares are issued. Instead, the manager receives stock appreciation rights. These entitle him to a cash payment reflecting the economic consequences of a real stock option plan, i.e. the conditional exercise of an option if the specific conditions are met and the underlying shares sold at the exercise date.

The research question whether stock option plans should be implemented as real or phantom plans has been addressed mainly by German literature in an institutional context. Here, the implementation of stock option plans as phantom plans is recommended strongly, due (a) to insufficient accounting and disclosure regulation of real stock option plans inducing severe moral hazard problems if real stock option plans are implemented and (b) to German taxation legislation that actually favors phantom plans.[4] Economic analyses that exclude both institutional effects as well as any additional behavioral aspects find that both real and phantom stock option plans are equivalent executive compensation tools.[5]

In the following, we will look for conditions under which this equivalence does not hold. The discussion is based on a two-period model including a simple sequential agency game. In the first period, an investment project is chosen and implemented by a manager-agent. The project generates positive expected accounting rates of return during the first and second period. As the risk-free interest rate is set at zero, this implies positive expected abnormal earnings. In the second period, the manager's input is not necessary any more for the generation of the returns. At the end of the second period, the firm is liquidated.

The decision variable in this model is the choice of a real versus a phantom stock option plan as a means of executive compensation after the first period. The shareholders will choose in $t = 0$ whichever type maximizes at that time the expected liquidation share price. Note that the model does neither aim at determining the optimal amount of capital to be raised with respect to a given return structure, nor does it deal with question whether stock option plans are per se an efficient executive compensation tool. Instead, the focus of attention is put on the exogenously given ways of executive compensation represented by real versus phantom stock option plans and their respective effects on shareholder wealth.

It will be shown that in the context of this model a real stock option plan leads to a higher expected liquidation share price and therefore to higher shareholder wealth compared to a phantom plan. The result holds even if the phantom plan is combined with a regular capital increase, but not if the real plan is serviced by a stock repurchase at the time of the stock options' exercise. The intuition behind the dominance of real plans can be explained due to a so-called investment effect: The new shares given out to the manager if the real plan is serviced by a capital increase represent an investment opportunity with a positive net present value which may be exploited by the firm's original shareholders during contract negotiation.

These results are important for two reasons. First, they give additional insight into the dominance of real versus phantom stock option plans in Germany. For example, an analysis of 70 stock option plans of German companies in 1999 and 2000 shows that 66 are real stock option plans, none are phantom types and only four are combined types, i.e. the issuing

company may decide whether to serve the options by real shares or by an equivalent cash premium.[6]

Second, the results also shed some light on the increasing relevance of stock option plans compared to cash-based annual bonus plans, as could be observed in the United States for the last thirty years.[7] As a favorable tax treatment of stock option plans until the 1970s only serves as a weak explanation, the investment effect in particular may provide an empirically testable hypothesis on why (real) stock option plans continue to be used for management compensation purposes: if the expected marginal abnormal returns of future periods are sufficiently high, the investment effect makes real stock option plans a cheaper and therefore more attractive means of remuneration than cash-based payments from the shareholders' point of view.

The paper is organized as follows. Section B provides an overview on the literature relating to the topic discussed in this paper. Section C establishes the two-period model based on which section D compares real versus phantom stock option plans. In section E modifications of real and phantom plans are analyzed. The results are discussed in the concluding section F that also gives some caveats that have to be taken into account regarding the interpretation of our results.

B Literature overview

For several years now, stock option plans have been in the focus of economic discussion. The broad body of literature does not only deal with the question of stock option plans as an executive compensation tool per se, but also with related topics in finance, capital market research, accounting, or taxation. In the following overview, we will focus on those papers that bear a close relationship to the research question stated above.

The papers of Knoll (1999) and Hanke/Poetzelberger (2000) both compare real vs. phantom stock option plans. Knoll shows that in a neoclassical setting both real and phantom stock option plans are equivalent from the shareholders' point of view if tax effects are excluded from the discussion. Hanke/Poetzelberger replicate Knoll's (1999) analysis and show that share price volatility caused by random share price movements affects the incentive effectiveness of both real and phantom stock option plans to the same extent. In the following paper we extend the setting used by Knoll and Hanke/Poetzelberger by assuming a second period after the stock option plan (either real or phantom type) has been exercised.

As tax effects are one of the most apparent features determining the effectiveness of stock option plans as an executive compensation tool, several papers focus on this topic. In German literature, e.g. Wenger/Knoll (1999) or Winter (2000) point out that under the current German tax system, phantom plans are favorable compared to real stock option plans. This is because the payments resulting from phantom stock option plans are accounted for as personnel expenses and therefore reduce the firm's taxable income, whereas this does not necessarily apply to the loss in wealth the firm's original shareholders have to sustain as a result of capital dilution. Jasper/Wangler (1999) show that with regards to manager's taxable income, differences between real and phantom stock option plans are irrelevant if the options can be duplicated on the capital market.

In the United States, tax effects are discussed mainly with regards to real stock option plans. Whereas Yermack (1995) assumes a strong empirical relevance of tax regulation on stock option plan design, Long (1992) points out that tax effects only partially explain the use of stock option plans as an executive compensation tool. In our analysis, tax effects are basically excluded from the analysis. However, in section F the results are evaluated with regards to the German tax system.

With regards to the incentive-effectiveness of stock option plans, a body of literature discusses whether stock option plans are inferior compared to stock plans, i.e. if the manager has to invest in the firm's shares instead of receiving simple warrants. The discussion starts with Haugen/Senbet's (1981) seminal paper on the use of managerial stock options to resolve agency problems. Hemmer/Kim/Verrecchia (1999) prove that convex components such as stock options are introduced to an optimal managerial contract e.g. if the relative levels of managerial risk aversion are moderate.

Wenger/Knoll (1999) point out that the effects of a stock plan on the manager's welfare are difficult to establish as stock plans – in contrast to stock option plans - require an up-front investment whose relevance to the manager depends on his individual set of assets, his liquidity constraints and preferences, and/or his risk aversion. Kürsten (2001), on the other hand, shows that stock options do not necessarily provide managers with optimal incentives from a comprehensive stakeholder perspective. Feltham/Wu (2001) state that stock option plans dominate stock plans with regards to incentive purposes if the manager's influence on the firm's operating risk is rather high. In the following paper, we do not analyze the difference of stock plans versus stock option plans, focusing instead on the latter. Additionally, we assume that the manager is risk-neutral and that any costs and benefits resulting from transactions with stakeholders other than the shareholders are covered by the relevant market prices.

Empirical studies analyzing the incentive-effectiveness of stock option plans in a moral hazard context derive divergent results. Brickley/Bhagat/Lease (1985) find that stock option plans are not necessarily superior to other long-term remuneration plans. Bizjak/Brickley/Coles (1993) observe that excessive concern over current stock price may motivate managers to use observable investment decisions to manipulate the market's inferences about the firm. Bens/Nagar/Wong (2002) give evidence that stock option plans may motivate managers to share repurchases in an attempt to mitigate EPS dilution from stock option exercise rather than choose profitable investment effects. On the other hand, DeFusco/Zorn/Johnson find supporting (1990), but also rejecting (1991) empirical evidence for positive capital market reaction to the introduction of stock option plans. Morgan/Poulsen (2001) also observe that shareholders gain at the announcement of stock option plans. Jensen/Murphy (1990) state a performance puzzle, as the extent of performance-based payments, e.g. via stock option plans, is lower than predicted by traditional agency theory. Nonetheless, neither of these papers differentiates the results with regards to the implementation of real vs. phantom stock option plans.

Finally, with reference to the setting of our model, which is based on a very simple two-action structure and assumes perfect *Modigliani-Miller* capital markets, a comparable model has been put forward by Pirchegger (2002) who focuses not on stock option plan design per se,

but rather on stock option repricing decisions in a moral hazard context. In this paper, stock option repricing is not introduced as an action variable as it is not in the focus of our analysis.[8]

C The model

In the following, we assume a two-period model. At the beginning of the first period ($t = 0$), a firm is established by a group of shareholders (principal) who contribute an exogenously given amount I of equity. A share is given out at the nominal value of 1, so that I also represents the initial number of shares. During the first period, the shareholders employ a manager-agent to invest this equity in a project P that has to be identified and implemented by the manager. Aside from P, the expected profit of the invested equity is zero, which also represents the risk-free rate of interest. As the model does not deal with questions relating to the firm's capital structure, we exclude the procurement of debt.[9]

The manager has a given reservation utility $V = 0$ and may choose between two effort levels: a high level of effort e_H and a low level of effort e_L. We assume the manager's cost of effort to be $c(e_H) = c_H > 0$ and $c(e_L) = c_L = 0$. If the manager supplies e_H, a project P with an expected rate of return $E[r_t|e_H] = \rho_t|e_H > 0$ with $t = 1, 2$ will be implemented;[10] otherwise, the expected rates of return are zero, i.e. $E[r_t|e_L] = \rho_t|e_L = 0$ with $t = 1, 2$.

The rationale behind this output structure is the following. If the manager supplies only a low level of input, he will invest in an arbitrary project and the expected rate of return over all available projects equals zero. If, on the other hand, the manager chooses a high level of effort, he is able to identify a more profitable investment opportunity set that comprises a larger number projects with expected positive net present values.[11] The average expected profits from this more profitable investment opportunity set are $\pi_1 > 0$ and $\pi_2 > 0$ and are both common knowledge. Exhibit 1 describes this output structure graphically.

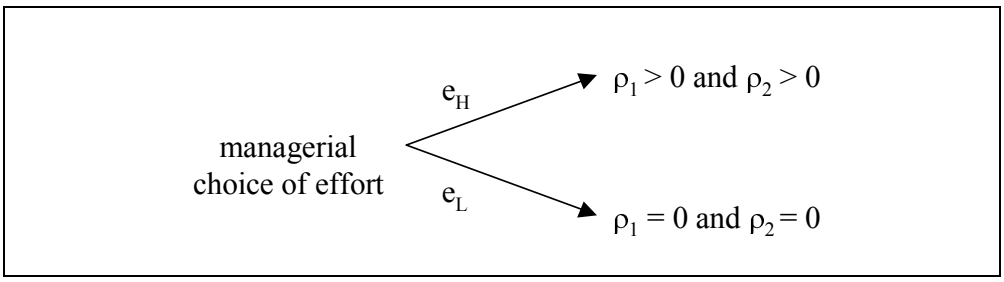

Exhibit 1: Output structure of managerial effort

Any expectations on positive abnormal returns during the second period result from time lag effects out of the project choice, resulting in unrecorded goodwill built up during the first period.[12] For example, the manager's project choice may increase the firm's reputation during the second period, it may provide access to new markets or an additional set of investment opportunities, it may result in experience curve effects, or it may even help to keep potential competitors out of a market built up in period 1 so that the firm can reap monopoly rents in period 2.

With regards to the following analysis, some additional properties of the assumed rates of return are of importance. The rate of return is in all cases calculated as an accounting rate of return, i.e. the profit divided by the invested capital: $r_t = G_t/C_{t-1}$ or expressed in expectancy values $\rho_t = \pi_t/C_{t-1}$. The invested capital C_{t-1} at the beginning of period t comprises the equity I together any additional capital deposits and retained profits or losses charged against equity.

We furthermore assume that the expected abnormal profits vary with the capital invested at the beginning of the period, i.e. $d\pi_t/dC_{t-1} > 0$. This is especially important with regards to the second period and implies that the time lag effects resulting from the project choice and implementation in the first period can increasingly be exploited with the amount of invested capital C_1 invested at the beginning of that period. Note that the model does not aim to determine the optimal level of C_1 but rather focuses on identifying the effects of different types of executive compensation on shareholder wealth.

Depending on the actual type of time lag effects, $d\pi_2/dC_1$ itself may either be decreasing, increasing, or constant, i.e. the value of the second derivative may be negative, positive or zero. To make the following analysis straightforward, we assume that $d^2\pi_2/dC_1^2 = 0$ so that ρ_2 is constant. However, the results become more pronounced in either direction if $d^2\pi_2/dC_1^2 \neq 0$ and ρ_2 is therefore either decreasing ($d^2\pi_2/dC_1^2 < 0$) or increasing ($d^2\pi_2/dC_1^2 > 0$) with the amount of capital invested.

Regarding the contract design, we assume that the realized rate of return is supported by the same range of values in both cases e_L and e_H. In other words, the shareholders can observe whether a project has been chosen, but they are under asymmetric information on whether the manager has taken up the effort to identify a project from the more attractive investment opportunity set. It is therefore impossible for the shareholders to draw up an explicit contract enforcing e_H on the manager: the observations regarding a given project (e.g. its expected or realized rates of return) do not allow a conclusion on the level of effort that has been chosen. Hence, a conditional remuneration scheme R(•) has to be specified that induces the manager to choose the high level of effort e_H.

We further assume that both the manager and the shareholders are risk-neutral. Risk-neutrality implies not only that any dysfunctional incentive effects caused by inefficient risk sharing are excluded from our analysis. It also leaves the manager indifferent between risk-free and risky income if the expected risky income equals the risk-free income. Therefore, the problem of financial hedging or restricting the manager's access to capital markets need not be discussed. Furthermore, we do not have to make any risk adjustments to the risk-free interest rate for discounting purposes. Finally, risk-neutrality implies that the manager's risk-utility function is additively separable with respect to effort disutility and income: $E[U] = E[R]\text{-}c(e)$.

At the end of the first period, in $t = 1$, the profit G_1 of the project P is realized. We assume that the investment I is fully amortized during the first period, so that G_1 does not only reflect the profit from an accrual point of view but also from a cash-based type of accounting. G_1 therefore can also be interpreted as free cash flow generated during the first period.[13] Amortizing the investment I during the first period also implies that the project's life cycle comprises only one period. Nevertheless, positive time lag effects may still remain at the end

of the first period if e_H has been chosen, causing a positive expected accounting rate of return for the second period as well.

After the remuneration has been paid to the manager in $t = 1$ according to the agreed-upon contract R, any remaining profit is kept as retained earnings or – in case of a loss – charged against equity.[14]

During the second period, the manager's input is no longer necessary. This may be the case, for instance, because it consists mainly in defining the firm's strategic position by making the project choice. More formally, in the context of our two-period-model, we assume that the remaining activities consist only in closing down the firm and harvesting any results from time lag effects induced during the first period.[15] As the original investment has fully been amortized during the first period, any expectations on abnormal profits π_2 during the second period reflect not only the net income that is expected to show in the income statement but also that period's free cash flow.

At the end of the second period, in $t = 2$, a profit or loss G_2 is realized. All remaining assets are divided among the existing shareholders in proportion to their respective shares and the firm is closed down. Exhibit 2 summarizes the model's timeline.

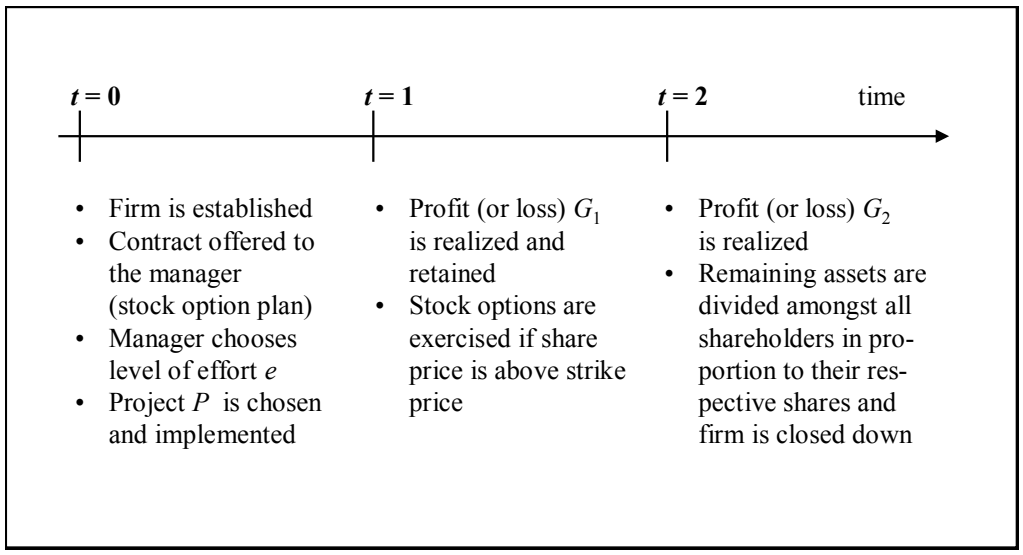

Exhibit 2: The timeline of the model

The original shareholders' objective is to maximize the expected cash flow from their investment, which would be the liquidation share price minus the equity investment per share times the respective shares a shareholder possesses.

Since the manager is employed only during the first period, the basic conditions for his remuneration scheme, which will determine the possible implementation as a real or phantom stock option plan, will have to be discussed only with respect to this period's parameters.

The manager will agree to the contract if, and only if, the expected remuneration E[R] at least equals his reservation utility plus his cost of effort, i.e. E[R] $\geq V + c(e)$ (participation constraint). As the shareholder's are under asymmetric information regarding the level of

effort actually chosen by the manager, the remuneration scheme R also must fulfill an incentive constraint, i.e. $E[R] - c(e_H) \geq E[R] - c(e_L)$.

Because of the manager being risk-neutral, the relevant features of R can easily be determined according to the standard results of agency theory: R has to be made contingent on the first period's output and the expected remuneration does not exceed the cost of effort of the induced action, i.e. $E[R] = c(e)$, so that in any case, the manager receives only his reservation utility V, which is set at zero. These results are implied by the typical "take-it-or-leave-it"-structure of a straightforward sequential agency game: the principal offers a contract, the agent decides to accept or to reject, in the case of acceptance he chooses a level of effort and receives a remuneration based on the agreements made in the contract.

As it is the objective of this paper to compare both real and phantom stock option plans, we assume that these are the only ways to implement a contingent contract resolving the existing moral hazard problem. We do not question whether stock option plans per se are an effective means for executive compensation. Nevertheless, the existence of time lag effects that are not accounted for in the firm's books but only recognized as unrecorded goodwill, i.e. a difference between the shares' market value and book value, is an argument in favor of share price-based compensation.

Assuming that the managerial action choice is not a discrete but a continuous variable, any share price-based compensation that incorporates the time lag effects expressed by unrecorded goodwill (market value added) as early as the first period is a means to avoid under-investment in goodwill if the contract may be specified only for one period. Cash-based or accrual-based compensation schemes that do not account for this goodwill, on the other hand, may lead to under-investment, i.e. an inefficient action choice by the manager.

The stock options given out to the manager at the beginning of the first period may be exercised only at the end of the first period ($t = 1$, European type of stock option). The option character of the remuneration scheme also implies that the manager's realized remuneration is $R \geq 0$, i.e. $R > 0$ in the case of the option's exercise and otherwise $R = 0$, so that the manager does not have to share any losses.

Finally, we assume perfect *Modigliani-Miller* capital markets, which are characterized at least by a semi-strong form of information efficiency: share prices always represent the firm's value, i.e. the sum of expected discounted dividends, which in our model equals the expected liquidation value because all profits are retained and the risk-free interest rate is zero. This simplifies the valuation of stock options in our model greatly as share prices are not subject to any additional randomness.[16] Consequently, the only relevant feature for valuating the stock options is the expected share price at the exercise date compared to the predetermined strike price.

In the following, we will compare the liquidation share price realized by the shareholders at the end of the second period under the existence of real versus phantom stock option plans. For the sake of the argument, we will start with the discussion of phantom stock option plans as a benchmark against which real stock option plans are compared.

D Results

I. Phantom stock option plan

If a phantom stock option plan is implemented with a fictitious strike price of 1. i.e. the nominal value of the shares before the contract has been made, the contract specifies that the manager is to receive α stock appreciation rights. If the share price at the end of the first period $w_{P,1} > 1$, each stock appreciation right entitles the manager to a cash payment of $w_{P,1} - 1$, i.e. the difference between the share price in $t = 1$ and the fictitious strike price of 1. If, on the other hand, the share price $w_{P,1} \leq 1$, the manager will refrain from exercising the stock appreciation rights, i.e. his remuneration will be zero.

As $\rho_t|e_L = 0$ and $\rho_t|e_H > 0$, the manager may expect the stock appreciation rights' exercise and a remuneration $E[R] = c_H$ only if e_H is chosen. Thus, both the participation and the incentive constraint are met. As soon as the contract between the original shareholders and the manager has been made and thus becomes known to the capital market, the observed share price changes from $w_0 = 1$ to $w_{P,0'}$ with

$$(1) \quad w_{P,0'} = \frac{I + \pi_1 - c_H}{I}\theta \quad \text{with} \quad \theta = 1 + \rho_2$$

The change in share prices is due to the following effects:

- On the capital market, the type of stock option plan chosen by the original shareholders is observed. In the case of a phantom plan, the expected cash payments to the manager amounting to $E[R] = c_H$ in $t = 1$ is anticipated in the share price.
- It is also anticipated in the share price that the manager is induced to choose a high level of effort which leads to positive expected profits π_1 and π_2 (or positive expected accounting rates of return ρ_1 and ρ_2) in $t = 1, 2$.

As the risk-free interest rate is zero so that neither amount has to be discounted, $w_{P,0'}$ equals share price expected for $t = 1$. It also equals the liquidation share price that is expected in $t = 0$ for the end of the second period and which represents the firm's original shareholders decision variable.

$$(2) \quad w_{P,0'} = \omega_{P,1} = \omega_{P,L}$$

To ensure that the manager may expect a remuneration $E[R] = c_H$ so that his expected gain out of the contract just equals his reservation utility $V = 0$, the number $\alpha > 0$ of stock appreciation rights offered in the phantom stock option contract is calculated by the original shareholders via

$$(3) \quad E[R] \overset{!}{=} c_H \Leftrightarrow E[R] = \alpha(\omega_{P,1} - 1) \quad \text{s.t.} \quad \omega_{P,1} = \frac{I + \pi_1 - c_H}{I}\theta > 1$$

$$\Leftrightarrow \alpha = \frac{c_H I}{\pi_1 + \pi_{P,2} - c_H} \quad \text{with} \quad \pi_{P,2} = (I + \pi_1 - c_H)\rho_2$$

As $\alpha > 0$, the denominator reflects the feasibility condition for setting up the firm: the denominator – and therefore α – is a positive number only if the sum of expected profits exceeds the cost of high effort, i.e. $\pi_1 + \pi_{P,2} > c_H$. Additionally, an expected loss $\pi_1 < 0$ at the

end of the first period does not necessarily lead to an expected share price $\omega_{P,1} < 1$ if it is offset by a sufficient expected rate of return ρ_2 expected to be realized during the second period.

With regards to the stock appreciation rights' exercise it can be shown that if in $t = 1$ the realized share price $w_{P,1}$ is above the strike price of 1, the manager will always exercise the maximum number $a = \alpha$ of stock appreciation rights.[17]

Lemma 1: The manager will exercise all stock appreciation rights if the share price is above the strike price of 1, otherwise he will exercise none of the stock appreciation rights allocated to him: If $w_{P,1} > 1$, then $a = \alpha$, otherwise $a = 0$.

(Proof: see appendix)

Based on the formula for R developed in the proof of lemma 1, the remuneration R the manager receives in $t = 1$ in case of the stock appreciation rights' exercise can be calculated as

$$(4) \quad R = a\frac{I\rho_2 + G_1\theta}{I + a\theta} \qquad \text{s.t. } a = \alpha = \frac{c_H I}{\pi_1 + \pi_{P,2} - c_H}$$

$$\Leftrightarrow R = \frac{G_1 + (I + G_1)\rho_2}{\pi_1 + (I + \pi_1)\rho_2} c_H$$

Formula (4) shows that R is also based on the expected return rate ρ_2. If all expectations are met, i.e. if $G_1 = \pi_1$, the manager just receives his cost of high effort c_H.

II. Real stock option plan

In the case of a real stock option plan, in $t = 0$ a contract of the following structure is implemented: in $t = 1$ the manager may call a number of up to β shares at a strike price of 1 and keep or sell them at his own discretion. The manager will exercise this option only if the share price $w_{R,1} > 1$. Once again, this agreement guarantees that the manager participates and chooses the high level of effort e_H at cost c_H.

The share price $w_{R,0'}$ observed in $t = 0$ after the contract has been made and become public knowledge depends on the equity I invested by the original shareholders, the first period's expected profit π_1, the expected number β of new shares issued in the case of the options' exercise and the expected rate of return ρ_2 in the second period. In analogy to the case of phantom plans, $w_{R,0'}$ also equals the expected share price $\omega_{R,1}$ in $t = 1$ as well as the expected liquidation share price $\omega_{R,L}$.

$$(5) \quad w_{R,0'} = \omega_{R,1} = \omega_{R,L} = \frac{I + \pi_1 + \beta}{I + \beta}\theta \qquad \text{with} \quad \theta = 1 + \rho_2$$

As the manager once again just may expect gains $E[R] - c_H$ out of the contract amounting to his reservation utility $V = 0$ in case of the high effort choice, it can be shown that under the

given assumptions the number β of options issued under a real plan is strictly lower than the number α of options issued under a phantom plan.

Lemma 2: The number β of stock options issued under a real plan is strictly lower than the number α of stock appreciation rights issued under a phantom plan, i.e. $\beta < \alpha$.

(Proof: see appendix)

With the expression given for β in the proof to lemma 2, the amount of β can be explicitly determined as

$$(6) \quad \beta = \frac{\sqrt{4\rho_2 c_H I + \mathrm{E}^2[G]} - \mathrm{E}[G]}{2\rho_2}$$

with E[G] representing the expectations in $t = 0$ on total gross profits after the necessary expected payment to the manager, i.e. $\mathrm{E}[G] = \rho_2 I + \pi_1\theta - c_H$.

As in the case of the phantom plan, it can be shown that the manager will always exercise all real stock options if the share price is above the strike price and otherwise none.

Lemma 3: The manager will always exercise all real stock options if the share price is above the strike price of 1: if $w_{R,1} > 1$, then $b = \beta$, otherwise $b = 0$.

(Proof: see appendix)

Comparing the restated condition for the realized share price in $t = 1$ being above the strike price of 1, which is in the case of phantom plans $I\rho_2/\theta > -G_1$ and in the case of real plans $(I + b)\rho_2/\theta > -G_1$[18], we can define an interval for G_1 with

$$(7) \quad G_1 \in \left]-\frac{\rho_2}{\theta}(I+b); -\frac{\rho_2}{\theta} I\right[$$

This indicates that if a loss in the interval described in formula (7) occurs, the manager will receive a positive remuneration in the case of a real plan but not in the case of a phantom plan. By reverting to $t = 0$ and replacing G_1 and b by the respective expectancy values, the difference between the upper and lower bound of the interval is $\beta\rho_2/\theta$. In other words, the feasibility condition for setting up the firm which is relevant for the original shareholders is relaxed up to an amount of $\beta\rho_2/\theta$ in the case of a real plan.[19]

From Lemma 3 follows immediately the paper's main result. The expected liquidation share price which is the firm's original shareholders' decision variable for implementing a real vs. phantom type of stock option plan, is strictly higher under a real stock option plan than under a phantom stock option plan. Exhibit 3 indicates the underlying question graphically.

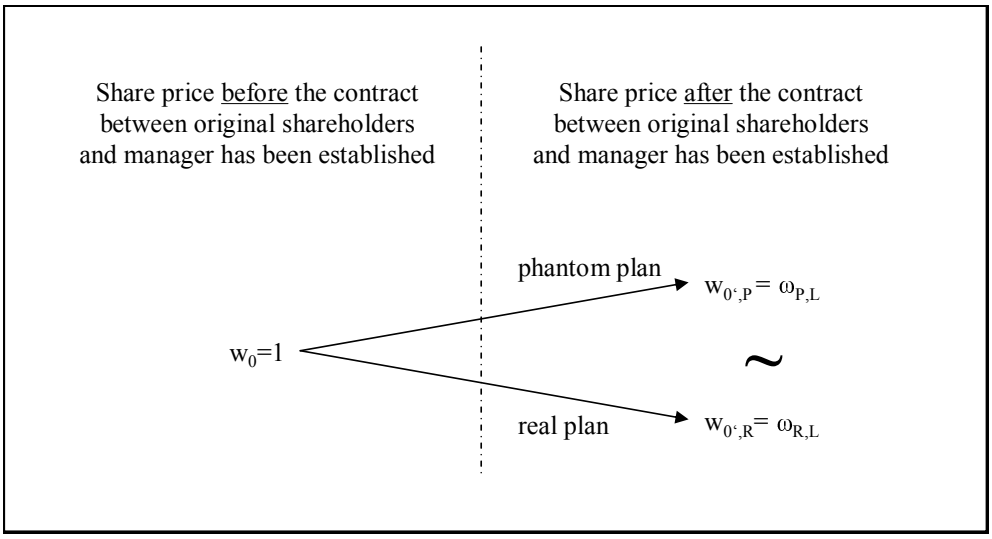

Exhibit 3: Sequence of share prices before and after the contract

Proposition 1: After the contract has been established between original shareholders and manager, the expected liquidation share price in case of a real stock option plan is strictly higher than the expected liquidation share price in the case of a phantom stock option plan, i.e. $\omega_{R,L} > \omega_{P,L}$.

(Proof: see appendix)

The main driver of this result is the expectation of a positive (abnormal) accounting rate of return ρ_2 during the second period that provides the manager with an investment opportunity with a positive net present value if, and only if, he exercises his real stock options. The manager has no other access to such an investment opportunity, as the risk-free rate of interest is zero and if the manager buys the firm's shares on the capital market he has to pay the shares' market value which reduces the net present value of such an undertaking to zero as well

.

It is crucial to this result that the expected profit of the second period varies with the amount of capital invested, i.e. with the additional equity provided by the manager. It can easily be seen that if $\rho_2 = 0$ or if $d\rho_2/dC_1 = 0$, the liquidation share price is equal under real and phantom stock option plans and the shareholders are indifferent on which type of contract is to be implemented.[20]

The economic intuition from proposition 1 becomes more clearly in corollary 1. It proves that the expected capital dilution under a real plan is strictly lower than the expected cash payment c_H of a phantom plan.

Corollary 1: The expected dilution of the original shareholders' invested equity is lower than the manager's cost c_H of high effort, i.e. $E[D_R] < c_H$, with $c_H - E[D_R] = \beta\rho_2$.

(Proof: see appendix)

As the expected cash payment c_H to the manager reduces the share price under a phantom plan, c_H is also called implicit capital dilution[21]. It describes the loss of wealth the firm's shareholders have to undergo under a phantom plan, as the share price falls when the firm has to transfer some of its assets, i.e. c_H, to the manager.

The difference between the implicit dilution c_H and the 'real' dilution $E[D_R]$ is $\beta\rho_2$, which is the expected return ρ_2 on the amount β the manager has to pay for his new shares under the real stock option plan. The result of corollary 1 therefore can be interpreted as an investment effect[22]: Via the exercise of the real stock options, the manager gains access to an attractive investment opportunity with positive expected abnormal returns compared to the risk-free interest rate of zero to which he is subject regarding all other investments. This increases managerial wealth and is therefore exploited by the shareholders during the negotiation process where the manager is "beaten down" to his reservation utility. Therefore, the remaining capital dilution $E[D_R]$ the shareholders have to undergo under a real plan is the difference between c_H and the investment effect $\beta\rho_2$.

E Extensions

After having compared two basic structures of real and phantom stock option plans, the question is whether these results are also valid for modified stock option plan structures.

I. Phantom stock option plan combined with a capital increase

In some cases, phantom stock option plans are combined with a capital increase to make up for the loss of capital induced by the cash payment to the manager. In other words, new shares are offered on the capital market to finance the cash payment made to the manager. The question arising in this context is whether this might make a phantom stock option plan equally attractive to a real stock option plan.

Discussing this point, it is first important to note that the effects of stock option plan design and (additional) capital increase have to be separated in the theoretical analysis. The reason is the following: The dominance of real plans shown in proposition 1 and corollary 1 is *not* due to the fact that the exercise of a real stock option plan leads to a de facto capital increase.

Rather, the real stock option's exercise transfers an investment opportunity with a positive net present value to the manager. The net present value can be determined by the number of stock options exercised β and the expected rate of return ρ_2, i.e. $\beta\rho_2$. As this net present value represents additional value flowing to the manager, it is anticipated by the original shareholders (principal) during the contract negotiation ("take-it-or-leave-it"). The remaining expected wealth transferred from the original shareholders to the manager via capital dilution $E[D_R]$ is consequently reduced by exactly that amount $\beta\rho_2$ (corollary 1). Compared to a real plan, the original shareholders are worse off in a phantom plan, because they have to transfer the expected amount $c_H > E[D_R]$ to the manager.

Introducing a capital increase by offering new shares to outside investors at the beginning of the second period adds "fresh money" to the firm. If the capital increase is non-diluting (as we would expect from the *Modigliani-Miller* assumption), all profits from the capital increase

flow to the original shareholders. On the other hand, the new shareholders' profit from the capital increase is zero, as the opportunity cost of other investments is represented by the risk-free interest rate of zero. As can easily be seen, the original shareholder's profit from the capital increase is independent of the loss $c_H - E[D_R]$ made by choosing a phantom over a real stock option plan.

If now a phantom plan is combined with a capital increase, the resulting profit to the original shareholders may at some point balance the loss $E[D_R] - c_H$ from the suboptimal contract design. But then, the comparison of a real plan *without* a capital increase and a phantom plan *combined* with a capital increase is not viable, as also the real plan can be combined with an additional capital increase of the same amount as the phantom plan. In other words: Combining a phantom plan with a capital increase makes the original shareholders under the given assumptions well off compared to a phantom plan without capital increase. Nevertheless, by combining a real plan with an additional capital increase, the original shareholders would be even better off.

Consequently, only two comparisons are viable: real vs. phantom plans both without capital increase or real vs. phantom plans both with additional capital increase of the same amount. Stock option plan design on the one hand and the decision to make a capital increase on the other hand represent two different decision variables that must not be mixed.

II. Real stock option plan combined with a stock repurchase

Finally, we will analyze a modified type of real stock option plans in which the capital dilution effects are avoided by repurchasing the necessary number of shares on the stock market instead of issuing new shares to service the stock options. However, this way of structuring a real stock option plan is used only rarely.[23]

As can readily be observed, the expected liquidation share price $\omega_{RR,L}$ under a real stock option plan combined with a stock repurchase equals the expected liquidation share price under a simple phantom plan, $\omega_{P,L}$.

Proposition 2: The expected liquidation share price $\omega_{RR,L}$ of a real stock option plan combined with a stock repurchase equals the liquidation share price of a phantom plan $\omega_{P,L}$, i.e. $\omega_{RR,L} = \omega_{P,L}$.

(Proof: see appendix)

In the light of the investment effect discussed before, proposition 2 follows intuitively. The manager is still provided with an investment opportunity that has a positive net present value, so that the investment effect is still working. But in the case of a stock repurchase, this positive net present value has to be compensated to the selling shareholders as the repurchase transaction takes place at market prices.

As a result, even though there is no capital dilution, the original shareholders' economic position under a real stock option plan combined with a stock repurchase is equal to the position under a phantom plan, i.e. the original shareholders are worse off than under a real stock option plan in which new shares are issued to the manager.

F Discussion

Summarizing the main result of our model we find that, in a setting of positive time lag effects beyond the stock option plan's exercise period that can be exploited by using the invested capital to reap abnormal earnings, real stock option plans are superior to phantom stock option plans. This result holds if the phantom plan is combined with an additional capital increase, but not if the real plan is serviced by a stock repurchase.

The economic reason behind these results is the following: if time lag effects occur, the share prices in $t = 1$ reflect the resulting expected abnormal earnings $\rho_2|e_H > 0$. The new shares given out under a real plan therefore represent an investment opportunity with a positive net present value, as the strike price is below the current share price. Providing the manager with such an investment opportunity forms part of his remuneration, so that the remaining capital dilution, which represents the cost the original shareholders have to carry, will be lower than the manager's cost of effort c_H.

In the case of phantom plans however, the manager does not receive such an investment opportunity but only a cash payment whose expectancy value has to equal his cost of effort. Even if the manager buys new shares, he will have an investment with a net present value of only zero because he will have to pay the higher market price instead of the lower strike price under a real plan. The necessary expected transfer of wealth from the original shareholders to the manager is therefore higher under a phantom plan (c_H) than under a real plan ($E[D_R]$). The difference is the positive net present value of the manager's investment opportunity ($\beta\rho_2$).

This investment effect is the reason presented in the context of our model why real stock option plans dominate phantom plans. It is a singular feature that can never be introduced into phantom plans, so the dominance of real versus phantom stock option plans still holds if a phantom plan is combined with a capital increase.

On the other hand, if a real plan is serviced not by a capital increase but by a stock repurchase, the positive investment effect is set off by a disproportionate negative liquidity effect in the case of the stock repurchase. This is due to the fact that with the stock repurchase, the positive net present value investment opportunity provided to the manager has to be bought at current market prices from other shareholders. As the expected value of the manager's remuneration is his cost of effort, the expected payment the firm has to make during the stock repurchase equals the expected cash payment induced by a phantom stock option plan. Therefore, the shareholders would be indifferent between a phantom plan and a real plan combined with a stock repurchase.

Our economic results thus tend to support the empirical observations in which real stock option plans without stock repurchase plans prevail. However, the connection between our model and the economic reality has to be made very carefully not only because of the technical assumptions used in the model but also because several aspects that play an important role in the use of stock option plans have been excluded from our analysis.

Starting with the latter, we assume, for example, equivalent moral hazard effects with both real and phantom plans. Nonetheless, excessive amounts of managerial remuneration have passed unobserved by the shareholders under several real plans mainly due to intrinsic value

accounting for stock option expense. Comprehensive managerial discretion is therefore supposed to be a much stronger explanation for the use of real stock option plans. On the other hand, if accounting regulation forces firms more clearly to disclose the value of options granted to management as well as the relevant characteristics of stock option plans, this discretion might be reduced.[24] In that case, real stock option plans are still supposed to prevail if an investment effect can be expected.

We have also excluded from our analysis several other empirical features of stock option plans that may swing the balance toward phantom plans. For example, under German regulation the manager may not sell the new shares obtained under a real plan immediately but only after a holding period. As such regulatory restrictions do not exist for cash premiums paid under a phantom plan, this may reduce the incentive effectiveness of real plans compared to phantom plans.

Additionally, tax effects of real versus phantom plans have to be taken into account. Without providing an in-depth tax discussion under German law, we will sketch some of the relevant points in the following.

With respect to the taxation of managerial income, German tax law is developing towards an equivalent taxation of income resulting from real vs. phantom stock option plans.[25]

With regards to the original shareholders, however, the cash payments resulting under a phantom plan lead to tax-deductible personnel cost, whereas the capital dilution effects the shareholders have to bear under real plans cannot be made tax-deductible. However, this argument looses at least some of its power if the original shareholders are able to realize taxable speculative gains and losses with respect to the diluted share price, e.g. by selling the diluted shares at their lower price and therefore receiving a smaller taxable gain or higher taxable loss with respect to the shares' acquisition cost.

Moreover, as real plans are strictly preferable for the shareholders in a setting with positive time lag effects, the question is whether such tax effects are large enough to make up for the disproportionate cash premium. In more formal terms, the expected tax saving in the case of real plans must be higher than the expected reduction in capital dilution, i.e. $c_H s > \beta\rho_2$ with s representing the applicable tax rate.

Regarding the technical assumptions included in our model, we find that it is mainly the strictly sequential "take-it-or-leave-it" structure of the basic moral hazard game, which is crucial to the results because only in that case the manager is beaten down to his reservation utility during the negotiation process. If, on the other hand, some negotiation power is transferred from the firm's original shareholders to the manager, the manager may himself reap part of the investment effect.

Compared to the model's structure, other technical assumptions are of only moderate relevance. This is the case e.g. with the agent being risk-neutral, as relaxing this assumption results in an expected remuneration $E[R] > c_H$ to be met, but with $E[R]$ still being the same amount for both real versus phantom stock option plans: under both types of plans, the agent carries an identical amount of risk and is motivated to choose an identical level of effort, e.g. $E[R] = c_H$ + risk premium. As can easily be seen, the argument no longer holds if the manager is risk averse and the specific firm risk, i.e. $Var[\pi_2]$, changes with the amount of

capital invested. In that case, if the firm risk increases with a higher capital base, phantom stock option plans become more favorable and may at some point even prevail. On the other hand, if the specific risk decreases with a higher capital base, this would once again favor real stock option plans.

Another technical assumption is the risk-free interest rate being zero. In the first place, this assumption keeps the model straightforward. As both real and phantom stock options imply similar return structures (per share investment of 1 in $t = 0$, liquidation share price in $t = 2$) in our comparison, discounting at a rate above zero will not change the results' directions.

Furthermore, it should be noted that an interest rate of zero in our model by no means implies that capital is not scarce. Instead, it is more plausible to assume that the number of projects that can be implemented is restricted compared to the available capital so that the interest rate is comparatively low (or negligible). Additionally, the model does not aim at all at determining the optimal amount of investment with regards to the original shareholders. Instead, the discussion focuses on the fact that the shareholders have to achieve an expected remuneration $E[R] = c_H$ if they want to induce e_H and seek to do so at the lowest possible cost.

Furthermore, we have assumed that the expected abnormal profits of the second period increase at a constant scale with the amount of capital invested at the beginning of the second period. This results in a positive expected rate of abnormal return, which is itself independent of the amount of capital invested. The effects of ρ_2 varying with the amount of capital invested C_1 depend on the type of variation. If, for example, ρ_2 is strictly increasing, i.e. $d\rho_2/dC_1 > 0$, e.g. because the firm is becoming a more powerful market player due to additional investment opportunities or because the reduction of equity in the course of phantom stock option plans leads to increased cost of debt, real stock option plans are clearly favored. If, on the other hand, ρ_2 is strictly decreasing, i.e. $d\rho_2/dC_1 < 0$, e.g. because the number of feasible projects is limited, the results tend to favor real plans only to a lesser degree. If the sign of $d\rho_2/dC_1$ is not determined, ρ_2 also depends on growth barriers, and the results become ambiguous as well. Finally, in the light of the arguments presented above, it is quite plausible that if $d\pi_2/dC_1 = 0$, that is if the amount of expected profit in the second period is independent of the invested capital, both real and phantom plans once again become equivalent executive compensation tools, because the marginal investment induced by the exercise of a real plan then has a net present value of zero.

In addition to the detailed discussion of these assumptions, several other caveats finally have to be taken into account with respect to the evaluation of our results. To name some of them, the paper for one does not discuss whether stock option plans are per se an effective incentive instrument. Additionally, some capital market effects have not been considered. For example, real stock option plans may be beneficial from an information point of view if the employees' exercise makes insider information public.[26]

Even though the caveats mentioned above indicate that the results of our model have to be translated into economic practice very carefully, we still feel that some conclusions can be made.

First, the paper gives a tentative explanation of the prevalence of real stock option plans in economic practice. This might also help to understand the increasing growth rate of share-

based (real type) payments compared to traditional annual bonus plans since the early eighties. As traditional bonus plans are in some respects quite similar to phantom plans, the long-term bull market structure that could be observed during the last decades has put increasing weight on the investment effect.

Second, the paper adds an additional element to the comparison of real versus phantom plans, which until now focuses mainly on taxation issues. Instead, a comprehensive evaluation of both real and phantom stock option plans has to take into account the fact that the new shares provide the manager with an investment opportunity of positive present value. This investment effect is clearly in favor of real stock option plans, which implies that even under a tax system that favors stock appreciation rights from the original shareholders' point of view, phantom plans cannot in general be considered superior.

Notes

[1] In 1996, Deutsche Bank and Daimler-Benz were within the first German companies to implement incentive tools based on share prices via stock option plans. Escpecially on the Neuer Markt, the stock market segment for technology and growth companies, many firms followed. In 1999, the number of stock option plans implemented in German firms exceeded 100 (Löwe/Sieber, 2000, p. 50).

[2] E.g. Enron, Worldcom, Xerox, or – in Germany – Comroad.

[3] See Murphy (1999), p. 2487.

[4] See e.g. Wenger/Knoll (1999), p. 580.

[5] See Wenger/Knoll, (1999), p. 573.

[6] See Leuner/Rattler/Schmidt (2002), p. 23.

[7] See Hall (1999), p. 99, Murphy (1999), p. 2487.

[8] We suppose that the possibility to reprice stock options or stock appreciation rights affects both real and phantom plans to the same extent. Nevertheless, this is a field where future research might gain interesting additional insights.

[9] The latter restriction is not detrimental to our discussion as we assume a perfect (*Modigliani-Miller*) capital market.

[10] We assume that the returns are high enough to cover the shareholders' expenses for employing the agent; otherwise they would not set up the firm at all.

[11] Note that still some of the projects in the profitable set may have zero or negative expected net present values so that the manager – even though he chooses a high level of effort – may be so unlucky as to choose a non-profitable project.

[12] The goodwill is unrecorded because it is not reflected in the firm's books. Even if an investment I with specific accounting rates of return $\rho_t > 0$ is undertaken, the amount of equity in the firm's balance sheets does not change, but only with realized profits. The only reflection of the unrecorded goodwill is found in the share price increase after the project has been undertaken.

[13] This assumption reflects the recommendation to align the waiting period for the stock options' exercise with the strategic planning cycle time of the firm, see e.g. Lehner (1997), p. 33. In our model, the strategic planning cycle comprises the employment period of the manager which lasts from $t = 0$ to $t = 1$.

[14] This implies that with respect to the dividend policy we assume a *Modigliani-Miller* scenario of dividend irrelevance.

[15] As $d\pi_2/dC_{t-1} > 0$, this harvesting is assumed to be the more profitable the more capital remains in the firm.

[16] This simplification does not taint our results, as Hanke/Poetzelberger (2000) have shown that share price volatility caused by random share price movements affects the incentive effectiveness of both real and phantom stock option plans to the same extent.

[17] This is not necessarily intuitive, as the individual share price and therefore the managerial profit from each stock appreciation right decreases as the the number of stock appreciation rights exercised and the resulting cash outflow increases.

[18] See the proofs for both lemma 1 and 3 in the appendix.

[19] $\beta\rho_2/\theta$ also implies that any expected loss in the first period can be covered by a high enough number of stock options if $\rho_2 > 0$. Even though this effect does not get in the way of our basic argument, a feasibility condition should restrict the number of real stock options the manager may receive.

[20] In that case, the number β of options issued under a real plan is $\alpha = c_H I/(\pi_1 - c_H)$ and equals the number α of stock appreciation rights issued under a phantom plan.

[21] See Knoll (1999), p. 7.

[22] The notion that a firm benefits from the additional cash inflow realized under real-type stock-based executive compensation plans has been described as liquidity effect Drukarczyk/Schwetzler (1990), p. 1778. As the driver of our results is not the additional liquidity brought into the firm, but rather the manager's access to an attractive investment opportunity compared to the risk-free interest rate of zero, we feel that the designation as investment effect is more appropriate.

[23] For example, in a sample of 43 stock option plans implemented in Germany in September 1998, Winter (2000), p. 244, finds none that uses a real stock option plan combined with a stock repurchase

[24] Until today, neither in Germany nor under IAS explicit accounting regulations dealing with stock option plans exist, even though standard drafts (E-DRS 11, IASB discussion paper) contain ample disclosure rules as well as making fair value accounting of stock option expense mandatory. Under US-GAAP, SFAS 123 requires fair value accounting, but still allows alternatively the application of intrinsic value accounting under APB 25.

[25] See the Federal Fiscal Court's decisions (BFH-Beschluesse) from VI B 116/99, I R 100/98 and I R 119/98. A detailed discussion of the recent developments is also given by Jacobs/Portner (2003).

[26] See, e.g., Huddart/Lang (2001).

Appendix

List of variables

α	=	number of stock appreciation rights offered to a manager under a phantom stock option plan
a	=	number of stock appreciation rights exercised by the manager in $t = 1$ under a phantom stock option plan
β	=	number of stock options offered to a manager under a real stock option plan
b	=	number of stock options exercised by the manager in $t = 1$ under a real stock option plan
c(e)	=	cost of effort incurred by the manager
c_H	=	cost of high effort e_H, i.e. c(e_H)
c_H	=	cost of low effort e_L, i.e. c(e_L)
C_{t-1}	=	amount of capital invested in t–1
δ	=	number of real stock options offered to a manager under a real stock option plan combined with a stock repurchase
E[D_R]	=	capital dilution expected by the original shareholders under a real stock option plan
e_H	=	high level of managerial effort
e_L	=	low level of managerial effort
G_t	=	realized absolute accounting profit generated by project P in t
I	=	amount of equity invested by the original shareholders in $t = 0$, equalling the number of shares given out to the original shareholders
P	=	project chosen and implemented by the manager
R	=	managerial remuneration
s	=	applicable tax-rate
t	=	time
V	=	the manager's reservation utility (set at zero)
π_t	=	expected absolute accounting profit generated by project P in t
$\pi_{P,2}$	=	expected absolute accounting profit generated by project P in $t = 2$ under a phantom stock option plan
$\pi_{R,2}$	=	expected absolute accounting profit generated by project P in $t = 2$ under a real stock option plan
ρ_t	=	expected accounting rate of return generated by project P in t
θ	=	$1 + \rho_2$
$\omega_{P,t}$	=	expected share price in t under a phantom stock option plan
$\omega_{R,t}$	=	expected share price in t under a real stock option plan
$\omega_{P,L}$	=	expected liquidation share price under a phantom stock option plan after the contract with the manager has been made and observed by the capital market
$\omega_{R,L}$	=	expected liquidation share price under a real stock option plan after the contract with the manager has been made and observed by the capital market

$\omega_{RR,L}$ = expected liquidation share price under a real stock option plan combined with a stock repurchase after the contract with the manager has been made and observed by the capital market

$w_{P,t}$ = observed share price in t under a phantom stock option plan

$w_{R,t}$ = observed share price in t under a real stock option plan

w_0 = observed share price in $t = 0$ before a contract between shareholders and manager has been made with $w_0 = 1$

$w_{P,0'}$ = observed share price in $t = 0$ under a phantom stock option plan after the contract with the manager has been made and observed by the capital market

$w_{R,0'}$ = observed share price in $t = 0$ under a real stock option plan after the contract with the manager has been made and observed by the capital market

Proofs

Lemma 1: The manager will exercise all stock appreciation rights if the share price is above the strike price of 1, otherwise he will exercise none of the stock appreciation rights allocated to him: If $w_{P,1} > 1$, then $a = \alpha$, otherwise $a = 0$.

Proof: As any stock option plan is designed so that (a) the managerial remuneration is positive if and only if the share price is above the strike price and (b) the manager does not have to share any losses in case the share price does not exceed the strike price, we will only have to discuss that if $w_{P,1} > 1$, then $a = \alpha$.

The realized share price $w_{P,1}$ reflects an equilibrium in which the expected cash outflow resulting from the phantom stock option plan equals the realized cash outflow. Stock market participants easily anticipate the latter as all relevant parameters of the stock option plan and the managerial utility function are common knowledge.

Therefore, $w_{P,1} > 1$ implies that the realized managerial remuneration R cannot exceed $I\rho_2/\theta + G_1$, as

$$w_{P,1} = \frac{I + G_1 - R}{I}\theta > 1 \Leftrightarrow \frac{I\rho_2}{\theta} + G_1 > R$$

As any stock option plan implies that in case of the plan's exercise the realized managerial remuneration R is positive, the left hand side of the last condition also has to be positive. Hence, from $w_{P,1} > 1$ it also follows that

$$\frac{I\rho_2}{\theta} > -G_1$$

The amount of R depends on the number a of stock appreciation rights with $0 \le a \le \alpha$ exercised by the manager. Based on

$$R = a(w_{P,1} - 1) \qquad \text{s.t.} \quad w_{P,1} = \frac{I + G_1 - R}{I}\theta$$

the managerial remuneration function $R(a)$ is determined as

$$\mathrm{R}(a) = a\frac{I\rho_2 + G_1\theta}{I + a\theta}$$

The manager chooses a number a of stock appreciation rights to be exercised with $a = \arg\max \mathrm{R}(a)$. Having a closer look at the first order condition, i.e.

$$\frac{\mathrm{d}R}{\mathrm{d}a} = I\frac{\left(I\rho_2 + G_1\theta\right)}{\left(I + a\theta\right)^2} > 0 \qquad \text{if} \quad \frac{I\rho_2}{\theta} > -G_1$$

we find that it is strictly positive, i.e. R is monotonously increasing in a, if $I\rho_2/\theta > -G_1$ which we have shown above to follow immediately from $w_{\mathrm{P},1} > 1$ as the basic condition for the stock appreciation rights' exercise. Consequently, $I\rho_2/\theta > -G_1$ is satisfied and the manager will maximize his remuneration by choosing the maximum number of stock appreciation rights $a = \alpha$.

q.e.d.

Lemma 2: The number β of stock options issued under a real plan is strictly lower than the number α of stock appreciation rights issued under a phantom plan, i.e. $\beta < \alpha$.

Proof: As β depends on the manager's cost c_{H} of high effort, we have

$$E[R] \overset{!}{=} c_H = \beta(\omega_{R,1} - 1) \qquad \text{s.t.} \quad \omega_{R,1} = \frac{I + \pi_1 + \beta}{I + \beta}\theta > 1$$

Introducing $\pi_{\mathrm{R},2} = (I + \pi_1 + \beta)\rho_2$ as expected profit of the second period, we can restate this expression to

$$\beta = \frac{c_H}{\frac{I + \pi_1 + \beta + \pi_{R,2}}{I + \beta} - 1} \Leftrightarrow$$

$$\beta = \frac{c_H I}{\pi_1 + \pi_{R,2} - c_H}$$

Comparing both α (see proof to lemma 1) and β, we find that

$$\beta < \alpha \qquad \text{with}$$

$$\beta = \frac{c_H I}{\pi_1 + \pi_{R,2} - c_H} \quad \text{and} \quad \alpha = \frac{c_H I}{\pi_1 + \pi_{P,2} - c_H}$$

which follows immediately from

$$\pi_{R,2} = (I + \pi_1 + \beta)\rho_2 \qquad > \qquad \pi_{P,2} = (I + \pi_1 - c_H)\rho_2$$

Note that the difference between $\pi_{\mathrm{R},2}$ and $\pi_{\mathrm{P},2}$ is $(c_{\mathrm{H}} + \beta)\rho_2$, i.e. the difference in expected cash flows between real and phantom plans adjusted for the expected rate of return.

q.e.d.

Lemma 3: The manager will always exercise all real stock options if the share price is above the strike price of 1: if $w_{\mathrm{R},1} > 1$, then $b = \beta$, otherwise $b = 0$.

Proof: As in the proof of Lemma 1, we can restrict our analysis to a scenario of $w_{\mathrm{R},1} > 1$. First, we can show that from $w_{\mathrm{R},1} > 1$ immediately follows

$$w_{R,1} = \frac{I + G_1 + b}{I + b}\theta_2 > 1 \Leftrightarrow \frac{\rho_2}{\theta}(I + b) > -G_1$$

The managerial remuneration function R(b) can be determined via

$$R = b(w_{R,1} - 1) \qquad \text{s.t. } w_{R,1} = \frac{I + G_1 + b}{I + b}\theta_2$$

resulting in

$$R(b) = b\frac{G_1 + (I + G_1 + b)\rho_2}{I + b}$$

The derivative of R with respect to b leads to the first order condition

$$\frac{dR}{db} = \frac{I(I\rho_2 + G_1\theta + \rho_2 b)}{(I + b)^2} > 0 \qquad \text{if} \quad \frac{\rho_2}{\theta}(I + b) > -G_1$$

As the condition for the first order condition showing R to be monotonously increasing in b follows from $w_{R,1} > 1$, it also follows that the manager will in that case exercise all options allocated to him.

q.e.d.

Proposition 1: After the contract has been established between original shareholders and manager, the expected liquidation share price in case of a real stock option plan is strictly higher than the expected liquidation share price in the case of a phantom stock option plan, i.e. $\omega_{R,L} > \omega_{P,L}$.

Proof: Under both real and phantom plans, the manager's expected remuneration has to equal his cost of effort c_H. We therefore have

$$c_H = \alpha(\omega_{P,1} - 1) \Leftrightarrow \omega_{P,1} = \frac{c_H}{\alpha - 1} \quad \text{in the case of phantom plans}$$

$$c_H = \beta(\omega_{R,1} - 1) \Leftrightarrow \omega_{R,1} = \frac{c_H}{\beta - 1} \quad \text{in the case of real plans}$$

As $\alpha > \beta$ according to lemma 3, it follows that

$\omega_{R,1} > \omega_{P,1}$

As $\omega_{P,1} = \omega_{P,L}$ and $\omega_{R,1} = \omega_{R,L}$ proposition 1 holds.

q.e.d.

Corollary 1: The expected dilution of the original shareholders' invested equity is lower than the manager's cost c_H of high effort, i.e. $E[D_R] < c_H$, with $c_H - E[D_R] = \beta\rho_2$.

Proof: Under a real plan, the expected loss of wealth a firm's shareholders have to incur is represented by the expected amount of capital dilution $E[D_R]$, i.e. the expected share price in $t = 1$ without and with the real stock option plan's exercise has to be compared. This yields

$$E[D_R] = \left(\frac{I + \pi_1}{I}\theta - \frac{I + \pi_1 + \beta}{I + \beta}\theta\right)I = \frac{\pi_1\beta}{I + \beta}\theta$$

Under a phantom plan, the expected loss of wealth to be incurred by the firm's shareholders is the expected cash premium equaling c_H to the manager.

Calculating c_H - E[D_R] results in

$$c_H - \mathrm{E}[D_R] = c_H - \frac{\pi_1 \beta}{I + \beta}\theta = \frac{c_H I + c_H \beta - \pi_1 \beta \theta}{I + \beta}$$

We further have $c_H = \beta(\omega_{R,1} - 1)$, which with $\omega_{R,1} = (I + \pi_1 + \pi_{R,2} + \beta)/(I + \beta)$ can be restated as

$$\omega_{R,1} = \frac{c_H + \beta}{\beta} = \frac{I + \pi_1 + \pi_{R,2} + \beta}{I + \beta} \Leftrightarrow c_H I + c_H \beta = \pi_1 \beta + \pi_{R,2} \beta$$

Inserting this result in the restatement of c_H - E[D_R] leads to

$$\begin{aligned}
\frac{c_H I + c_H \beta - \pi_1 \beta \theta}{I + \beta} &= \frac{\pi_1 \beta + \pi_{R,2} \beta - \pi_1 \beta \theta}{I + \beta} \\
&= \beta \frac{\pi_1 + \pi_{R,2} - \pi_1 \theta}{I + \beta} \\
&= \beta \frac{\pi_1 + I\rho_2 + \pi_1 \rho_2 + \beta \rho_2 - \pi_1 \theta}{I + \beta} \\
&= \beta \frac{(I + \beta)\rho_2}{I + \beta} \\
&= \beta \rho_2 > 0
\end{aligned}$$

q.e.d.

Proposition 2: The expected liquidation share price $\omega_{RR,L}$ of a real stock option plan combined with a stock repurchase equals the liquidation share price of a phantom plan $\omega_{P,L}$, i.e. $\omega_{RR,L} = \omega_{P,L}$.

Proof: To ensure an expected remuneration c_H the maximum amount of options δ the manager may call under real plan combined with a stock repurchase is determined via

$$c_H = \delta(\omega_{RR,1} - 1)$$

The expected share price $\omega_{RR,1}$ at $t = 1$, which once again equals the expected liquidation share price $\omega_{RR,L}$, depends on the number of shares I that does not change with the stock option's exercise as well as on the originally invested capital I, the expected profit of the first period π_1, and on the cash outflow from the stock repurchase in $t = 1$ which is $\delta\omega_{RR,L}$ minus the cash inflow δ due to the strike price of 1.

$$\omega_{RR,L} = \frac{I + \pi_1 - \delta\omega_{RR,1} + \delta}{I}\theta \overset{c_H = \delta(\omega_{RR,1} - 1)}{=} \frac{I + \pi_1 - c_H}{I}\theta = \omega_{P,L}$$

q.e.d.

References

Bens, D. A./Nagar, V./Wong, F.M.H. (2002), Real Investment Implications of Employee Stock Option Exercises, in: Journal of Accounting Research, Vol. 40, pp. 371-394.

Bizjak, J.M./Brickley, J. A./Coles, J. L. (1993), Stock-based Incentive Compensation and Investment Behavior, in: Journal of Accounting and Economics, Vol. 19., p. 349-375.

Brickley, J.A./Bhagat, S./Lease, R.C. (1985), The Impact of Long-Range Managerial Compensation Plans on Shareholder Wealth, in: Journal of Accounting and Economics, Vol. 11, p. 115-129.

DeFusco, R.A./Zorn, T.S./Johnson, R.R (1991), The Association Between Executive Stock Option Plan Changes and Managerial Decision Making, in: Financial Management, Vol. 20, p. 36-43.

DeFusco, R.A./Zorn, T.S./Johnson, R.R. (1990), The Effect of Executive Stock Option Plans on Stockholders and Bondholders, in: Journal of Finance, Vol. 45, p. 617-627.

Drukarczyk, J./Schwetzler, B. (1990), Mitarbeiterbeteiligung und Unternehmensfinanzierung, in: Der Betrieb, Vol. 43, p. 1777-1783.

Feltham, G.A./Wu, M.G.H. (2001), Incentive Efficiency of Stock versus Options, Review of Accounting Studies, Vol. 6 (2001), p. 7-28.

Hall, B.J. (1999), The Design of Multi-Year Stock Option Plans, Journal of Applied Corporate Finance, Vol. 12 (1999), p. 97-106.

Hanke, M.\Poetzelberger, K.A. (2000), Auswirkungen virtueller Optionsprogramme auf den Aktienkurs, in: Journal für Betriebswirtschaft, Vol. 50, p. 252-258.

Haugen, R.A./Senbet, L.W. (1981), Resolving the Agency Problem of External Capital through Options, in: Journal of Finance, Vol. 36, p. 629-647.

Hemmer, T./Kim, O./Verrecchia, R.E. (1999), Introducing convexity into optimal compensation contracts, in: Journal of Accounting and Economics, Vol. 25, p. 307-327.

Huddart, S.J./Lang, M.H. (2001), Information Distribution Within Firms: Evidence from Stock Option Exercises. Working Paper.

Jacobs, O.H./Portner, R. (2003), Besteuerung von Stock Options im nationalen deutschen Steuerrecht und im internationalen Kontext, in, Dörner, D./Menold, D./Pfitzer, N./Oser, P. (Eds.), Reform des Aktienrechts, der Rechnungslegung und Prüfung. KonTraG - Corporate Governance - TransPuG, Stuttgart, p. 291-328.

Jasper, T./Wangler, C. (1999), Irrelevanz der steuerlichen Behandlung von Stock Options beim Begünstigten, in: Finanz Betrieb, Vol. 1, p. 113-116.

Jensen, M./Murphy, K. (1990), Performance Pay and Top-Management Incentives. In Journal of Political Economy, Vol. 98., p. 225-264.

Knoll, L. (1999), Anmerkungen zum impliziten Verwässerungseffekt virtueller Optionsprogramme, in: Journal für Betriebswirtschaft, Vol. 49, p. 4-11.

Kürsten, W. (2001), Stock Options, Managerentscheidungen und (eigentliches) Aktionärsinteresse, in: Zeitschrift für Betriebswirtschaft, Vol. 71, p. 249-270.

Lehner, U. (1997), Der Stock Incentive Plan für den Führungskreis 1 der Henkel Gruppe in: Meffert, H./Backhaus, K. (Eds.), Stock Options und Shareholder Value, Münster, p. 28-45.

Leuner, R./Rattler, T./Schmidt, C. (2002), Studie zu Entwicklungen und Tendenzen bei Stock-Option-Modellen anhand von 70 Beteiligungsprogrammen, in: Finanz Betrieb, Vol. 4., p. 12-24.

Long, M.S. (1992), The Incentives Behind the Adoption of Executive Stock Option Plans in U.S. Corporations, in: Financial Management, Vol. 21 (1992), Issue No. 3, p. 12-21.

Löwe, C./Sieber, Ulrich D. (2000), Erfahrungen mit dem Einsatz von Stock Option-Plänen, in: Achleitner, A.-K./Wichels, D. (Eds.), Stock Options, Stuttgart, 2000, p. 47-60.

Morgan, A.G./Poulsen (2001), A.B., Linking pay to performance – compensation proposals in the S&P 500, in: Journal of Finanical Economics,Vol. 62, p. 489-523.

Murphy, K.J. (1999), Executive Compensation, in: Ashenfelter, Orley, Card, David (Eds.), Handbook of Labor Economics. Vol. 3, Amsterdam, p. 2485-2563.

Pirchegger, B. (2002), Costs and Benefits from Repricing Employee Stock Options, Schmalenbach Business Review, Vol. 54 (2002), p. 80-111

Wenger, E./Knoll, L. (1999), Aktienkursgebundene Management-Anreize: Erkenntnisse der Theorie und Defizite der Praxis, in: Betriebswirtschaftliche Forschung und Praxis, Vol. 51, p. 565-591.

Winter, S. (2000), Optionspläne als Instrument wertorientierter Managementvergütung, Frankfurt.

Yermack, D. (1995), Do corporations award CEO stock options effectively?, in: Journal of Financial Economics, Vol. 23., p. 237-269.