E C O N O M I C S B U L L E T I N

Stock option compensation and equity values

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Abstract

I present a model where increasing employee participation in a stock option scheme leads to higher performance but with a cost to shareholders. I show that firms with higher market values per employee are more likely to have an option scheme and they offer stock options to a broader group of employees. The model yields empirical predictions that are consistent with the stock option boom of the late 1990s and their reduced popularity after the stock market decline.

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1 Introduction

The use of equity compensation schemes, such as employee stock ownership plans or broad-based stock options, has increased substantially during the past 20 years or so (Blasi et al., 2003). Consequently, a number of papers have appeared to explain the firm-level determinants of the use of these schemes (e.g. Kruse, 1996; Core and Guay, 2001; Ittner et al., 2003). In this note, I contribute to this literature by proposing a novel hypothesis on how the market value of the firm relative to the number of employees is related to the allocation of equity incentives.

My argument is that stock options are less expensive to use in firms where market value per employee is high. The model is based on the idea that even when employee participation in equity compensation schemes may be good for performance, increased participation also implies increased dilution costs to shareholders, and therefore it may be in the interest of shareholders to limit participation in the program. However, with the same relative increases in share prices, firms with higher absolute levels of market value per employee are able to offer the same incentives with lower dilution than those with lower levels of market value per employee. This hypothesis has testable empirical implications both at the level of the firm and the stock exchange.

2 The model

The key assumption in the paper is that stock options improve performance and therefore enhance firm value (for supportive empirical evidence, see Sesil et al., 2002; Hanlon et al., 2003; Ittner et al., 2003). I assume that stock options do not affect wages and therefore depart from the literature that motivates stock options by wage substitution arguments (Oyer, 2004; Inderst and Müller, 2005).[i] Broad-based stock options have been criticised by exposing employees to excessive risk and having limited incentive effects, due to the free-rider problem (Hall and Murphy, 2003). However, Baron and Kreps (1999) and Appelbaum and Berg (2000) have suggested that broad-based equity schemes may be seen as reciprocal gift exchange arrangements: shareholders give up some of their rights to future income streams to the benefit of employees, and employees in turn reciprocate by exerting more effort, to the joint benefit of shareholders and employees. In this paper, I build on the idea that the performance-enhancing impact of stock options can be motivated by gift exchange arguments. This also gives a rationale why stock options are not matched by corresponding cuts in fixed wages. In that case, options could hardly be considered as gifts, and would fail to elicit any extra effort.[ii]

There are two time periods in the model, 0 and 1. MV_0 and MV_1 denote market values of equity at time 0 and 1, respectively, S_0 and S_1 denote the number of shares at respective points of time, and Opt_0 denotes the number of options the firm distributes at time 0. The options are distributed free of charge. There are two types of players in the model. Shareholders own S_0 shares (all the shares at time 0) and control the decision-making, so an option scheme diluting their ownership share can only be made with their consent. The optionholders are a subset of employees, to whom the shareholders decide to grant options. The optionholders can exchange one option for one share at time 1 for a price of $\frac{MV_0}{S_1}$, which is paid to the shareholders. The number of shares at time 1 equals the initial number of shares plus the shares subscribed by options if the market value at time 1 exceeds the market value at time 0 ($S_1 = S_0 + Opt_0$ if $MV_1 > MV_0$). In that case the pay-off for optionholders collectively is $\frac{S_1 - S_0}{S_1}(MV_1 - MV_0)$. The shareholders, in turn, receive $\frac{S_0}{S_1}(MV_1 - MV_0)$. If MV_1 equals MV_0 or is lower, then the optionholders do not exercise their options, the number of shares remains at S_0, and the options are worthless.

In my model I assume that higher participation rates are related to higher levels of performance with a concave function. To motivate the concavity of the performance function, I assume that stock option schemes are always filled in the order of hierarchical position, beginning from the top of the organization. The concavity implies that the marginal performance impact decreases when new, lower-level employees enter the scheme. The concave shape of the function is supported by the standard notion that stock option schemes provide stronger incentives to managers whose actions can have higher impact on share prices.

I assume that shareholders expect higher employee participation rates to be associated with higher performance, measured by the growth of the firm market value. The participation rate (π) is the ratio between the number of persons participating to the scheme (N) and the total number of employees (L) and is thus given by the expression:

$$\pi = \frac{N}{L} \tag{1}$$

In the following, I am going to assume that the number of employees is fixed, so that the choice variable is the number of employees participating in the scheme (N).

Assume that the higher performance from a higher participation rate (π) translates into a higher growth rate of market value (r). The increase in share price during this period includes a random component ε and a component attributable to a higher performance due to the stock option scheme, depending on the participation rate π. The relationship between the growth rate of the market value and participation rate is represented by a concave function:

$$MV_1 - MV_0 = r(\pi, \varepsilon)MV_0, r_\pi > 0, r_{\pi\pi} < 0 \tag{2}$$

I augment expression (2) by noting that the growth of the market value is not going to depend only on the existence of the option plan, but the plan has to be sizable enough to give meaningful incentives to each employee. I assume that for each employee there is a minimum threshold of option incentives that has to be reached before they have any effect.[iii] To keep things simple, I assume that once this threshold is reached firm market value increases by a certain amount as stipulated in expression (2) and that further increases in option incentives do not increase market value. Equity incentives below the threshold do not produce any effect on market value. The optimal amount of stock options for a given individual is either equal to the threshold or zero.

The expected gain of an option holder is the expected growth rate in market value ($E(r)$) times the market value at time 0, multiplied by the size of his holdings relative to the total stock outstanding ($\frac{s_{i1}}{S_1}$). If $E(r)$ is zero or negative then no option scheme will be launched. Assume that the threshold level required for the incentive effects can be written as a fraction β_i of the wages, and β_i is assumed to be equal for all employees. Thus, we have the following expression:

$$\frac{s_{i1}}{S_1} E(r)MV_0 = \beta w_i, E(r) > 0, 0 < \beta < 1. \tag{3}$$

To abstract from subjective valuations of options, assume that both employees and outside investors are risk neutral and share the same expectations about the development of share price. Next, I will derive the relationship between the total dilution and the participation rate.

Recall that employees will join the option scheme in order of their hierarchical position in the firm organization. Assuming that there is a positive, monotonic relationship between wages and hierarchical position, the sum of wages must be a concave function: when starting to sum up wages from the top of the firm organization, $W(N)$ increases, but each addition is smaller than or equal to the previous one, since employees of lower hierarchical position are included. Although the number of employees is discrete, the sum of wages can be approximated as a continuous function and thus be written as an integral of individual wages:

$$W(N) = \int_1^N w(x)dx, W_N > 0, W_{NN} < 0 \tag{4}$$

Using (3) and (4), we can now move up from the individual to the aggregate level, and write the total dilution as a function of *N*:

$$\frac{S_1 - S_0}{S_1} = \frac{\beta W(N)}{E(r(\pi,\varepsilon))MV_0} \qquad \textit{where } E(r) > 0 \quad \textit{and} \quad \frac{\partial \frac{S_1 - S_0}{S_1}}{\partial N} > 0. \tag{5}$$

Note that if the denominator would increase faster than the numerator in the expression (5), then increasing the number of participants in the stock option program would actually decrease the total dilution. In such a case, increasing participation rate would always be optimal. However, I concentrate on the more interesting case and assume that dilution is always strictly increasing in the number of participants.

The shareholders' problem is then to choose the optimal participation rate (π) knowing that increasing the number of participants in the stock option program increases market value but it also increases the costs of the program in the form of dilution. This can be written as

$$\max_{\pi} \frac{S_0}{S_1} E(r(\pi,\varepsilon)MV_0 \tag{6}$$

Substituting from (5) we obtain

$$\max_{\pi} E(r(\pi,\varepsilon))MV_0 - \beta W(N) \tag{7}$$

Taking the first order conditions of (7) with respect to π and rearranging we obtain[iv]

$$\frac{\partial E(r)}{\partial \pi} \frac{MV_0}{L} = \beta \frac{\partial W}{\partial N} \tag{8}$$

The left-hand side of the expression (8) can be interpreted as the marginal benefit from increasing the participation rate, while the right-hand side may be interpreted as the marginal cost of increasing the number of participants to the stock option scheme (dilution effect). From this form it can easily be seen that increases in market value increase the marginal benefit from increasing the participation rate, but leaves the marginal cost constant. Therefore firms with higher market value per employee are more likely to use broad-based stock option plans.

The same argument can be shown graphically in the Figure 1, where the solid line represents the marginal benefits from the stock option scheme (left-hand side of the equation 8), and the dashed line represents the marginal costs from the stock option scheme (right-hand side of the equation 8). The optimal participation rate π_1* is where the two lines cross. When market value per employee increases, marginal benefits increase while marginal costs remain constant, and the new optimal participation rate moves right to the point π_2*.

3 Conclusion

The results in this paper suggest that the use of option compensation should be related to the firm market value per employee. This finding has interesting empirical implications. First, at the firm level those firms having a higher market value per employee are more likely to use stock options in their compensation package. They are also more likely to target options to a broader group of employees. Second, the model fits the common observation that broad-based stock options became common during the stock market upheaval of the late 1990s. It also predicts that during

stock market downturns, firms target their stock options to a more select group of employees and some firms cease to issue options altogether. There is evidence from the Finnish stock market supporting these hypotheses (Jones et al., 2004). The results suggest that future research would benefit by paying more attention to the role of equity values as potential determinants of the use of equity compensation.

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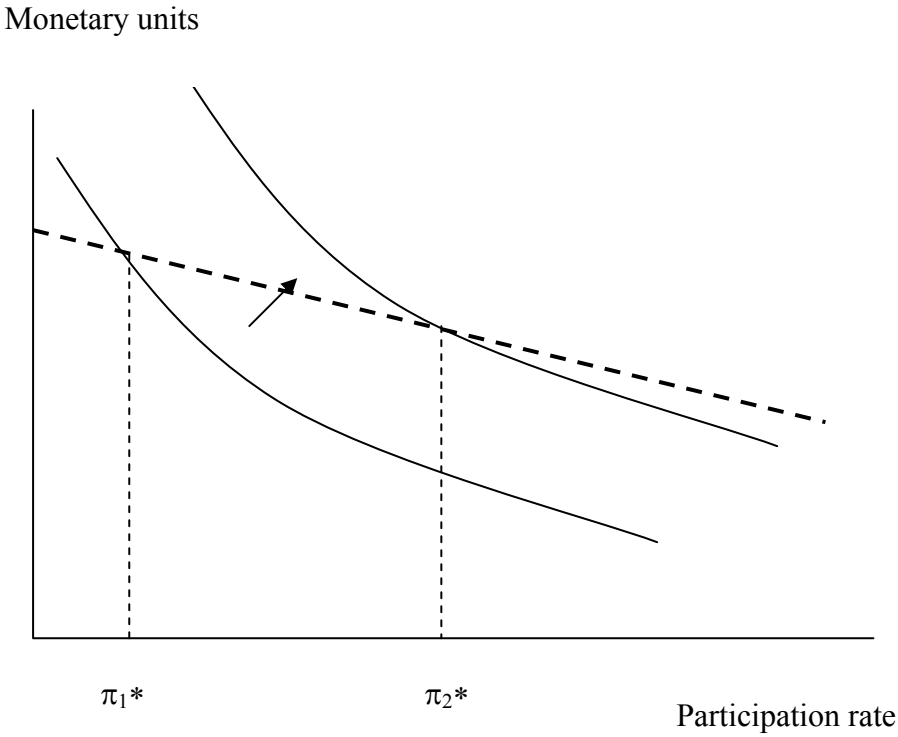
FIGURE 1: THE DETERMINANTS OF THE OPTIMAL PARTICIPATION RATE



Notes

[i] I am not aware of any systematic empirical evidence supporting the claim that options are used to substitute fixed wages. Standard notions of risk aversion suggest that the possibilities to shift risk to employees in this way may be limited, at least when considering the workforce at large.

[ii] Empirical support for this hypothesis can be found in Freeman et al. (2006), who in general find positive performance effects from employee stock ownership plans (ESOP), but note that these effects disappear when ESOPs substitute for fixed wages.

[iii] Again, this can be motivated by gift exchange arguments. Gifts that are of unexpectedly low value may not be interpreted as gifts and therefore are not reciprocated.

[iv] Notice that in differentiating the wage function I used the expression (1) and the chain rule $dW / d\pi = (dW / dN) * (dN / d\pi)$.