Is it Optimal to Accelerate the Payment of Income Tax on Share-Based Compensation?*

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Abstract

The value of stock-based compensation is typically taxed as ordinary income to the employee at vesting, but subsequent gains on the stock are capital gains. I examine whether it is ever optimal for an employee to accelerate the payment of ordinary income tax in order for subsequent gains to be taxed at the lower capital gains rate. The employee may accomplish this, for example, by exercising a compensation option or making a Section 83(b) election (applicable to grants of restricted stock). I show that in general, accelerating the ordinary income tax payment is not optimal. However, when the employee faces portfolio constraints and can borrow to pay the tax, acceleration may be optimal.

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1 Introduction

The value of stock-based compensation is typically taxed as ordinary income to an employee when the employee attains full ownership of the physical stock or its cash equivalent. For example, the value of a non-qualified compensation option is taxed as ordinary income to the employee when the option is exercised, at which point the option value is the difference between the stock price and the option's exercise price. If the employee continues to hold the stock after exercise, any future gains or losses are taxed as capital gains. This tax treatment raises the question of whether it can be optimal *for tax purposes* to exercise a non-qualified option prior to expiration. The logic of tax-induced early exercise is outlined in the following excerpt from a news story:

> The WorldCom claimants and their lawyers all recount identical experiences. The brokers who picked up the phone in the Atlanta office always recommended that customers exercise as many options as they could so as to have a low cost basis on their shares, minimizing taxes. Because WorldCom stock would undoubtedly be higher the next year, the brokers argued, it would be most beneficial for clients to buy the shares at their relatively low exercise prices and to hold on for long-term capital gains tax treatment. Borrowing money from Salomon to pay the taxes owed at the time of the exercise and to pay for the exercise itself was a good idea, the brokers said, because margin interest is tax-deductible.[1]

The argument is that if there is an appreciating asset for which the appreciation is taxed first as ordinary income and then as capital gains, it is tax-efficient to incur the ordinary income portion of the tax as soon as possible, so that subsequent gains are taxed at a lower rate. For this strategy to make sense the employee must expect the stock price to increase. The same argument also appears in the academic literature.[2]

[1] "Outrage Is Rising as Options Turn to Dust", by Gretchen Morgenson, *New York Times*, March 31, 2002

[2] This argument is often made informally in discussions of compensation option exercise and seems to be widely accepted. For example, in Malmendier and Tate (2002, p. 23): "The CEO has to pay ordinary income tax of up to 39.6% on the profits from exercise (stock price minus exercise price) and only capital gains tax of 20% on the profits from sale (stock price at sale minus stock price at income taxation). Therefore, whenever a CEO believes that the stock price will rise, he has an incentive to exercise his

An employee who receives an outright stock grant as compensation may also face a decision about when to pay tax on the grant.[3] By default, the market value of such stock is taxed as ordinary income when the grant vests or becomes unrestricted. However, an employee can make a so-called Section 83(b) election and pay the ordinary income tax at the time of the grant, based on the market value of the stock at that time. Gains or losses on the stock following an 83(b) election are taxed as capital gains. The same tax arguments used to justify option exercise are also used to justify 83(b) elections.[4]

The point of this paper is that the intuitively appealing argument in favor of accelerating the payment of ordinary income tax is generally incorrect.

To see why it is not optimal to accelerate the tax payment, consider the following simple example that highlights the tax issues. Suppose an employee owns a share of non-dividend paying stock in a compensation account. In order to remove the share from the account, the investor must pay a 50% tax on the value of the stock. After removing the stock from the account, the employee must continue to hold the stock and subsequent gains on the share are taxed at 20%. Assume that the employee can also trade shares of the stock outside of the compensation account. The key insight is that, because one-half of the share is taxed away when the share is removed from the ac-

options early." Huddart (1998a), also discussed in Section 4 below, argues that there are conditions under which early exercise is optimal. Taranto (2002) uses this tax argument for early exercise to account for the willingness of insiders to endure IPO underpricing. Scholes, Wolfson, Erickson, Maydew, and Shevlin (2002, p. 197) also argue that taxes are a motive for early exercise of non-qualified options (NQOs): "Early exercise of an NQO ... can be tax-favored ... because more of the total gain is taxed at lower capital gains rates than ordinary rates." In private communication, Terry Shevlin reports that Scholes, Wolfson, Erickson, Maydew, and Shevlin (forthcoming) will argue that taxes do not motivate early exercise, in agreement with the findings of this paper.

[3]There has been a recent increase in such grants of restricted stock. See "With Options Tainted, Companies Award Restricted Stock", by Joann S. Lublin, *Wall Street Journal*, March 3, 2003, p. B1.

[4]For an example, see the press coverage following Microsoft's announcement that it will grant restricted stock instead of options. "Employees ... will owe ordinary federal income tax, of up to 35 percent, at the value of the stock when it becomes vested ... An employee may, however, choose to pay taxes based on the value of the shares when they are granted. Then, any gain above that value would be taxed at the much lower capital gains rate of 15 percent. ... If a Microsoft employee is confident that the share price will rise, then paying the taxes up front could be a good move." ("Microsoft Workers Could Face a Tough Tax Situation", by Floyd Norris, *New York Times*, p. C1, July 10, 2003). See also "The Guide to Restricted Stock", by Ruth Simon, *Wall Street Journal*, p. D1, July 10, 2003. After these articles were published, the *Wall Street Journal* published a correction in which Microsoft stated that it would not permit employees to make 83(b) elections on stock grants.

count, *the employee owns only one-half of a share*. Once that one-half share is removed from the account, subsequent gains are taxed at a positive rate and the employee bears an additional layer of tax. Perhaps surprisingly, the one-half share the employee does own is tax-exempt as long as it remains in the account, therefore it is optimal to leave the share in the account as long as possible. If the capital gains tax rate were zero, the employee would be indifferent about when to remove the share from the account. This example of deciding when to remove a share from a compensation account is formally identical to the question of whether to make a Section 83(b) election when the employee is granted stock at no cost.

The mistaken belief that it is optimal to accelerate the payment of tax, and that expectations about the future stock return affect the decision, arise because the typical analysis assumes that the employee borrows (or equivalently, liquidates assets other than the stock) to pay the tax, as in the Worldcom example. In effect, borrowing to pay the tax is like borrowing to buy additional stock. In the example of the compensation account, if the employee could borrow to buy one-half share to pay the tax, the employee would subsequently own one share and earn the after-tax return on the share. The usual analysis confounds the two issues of whether to withdraw shares from the account and whether to borrow to buy stock, a transaction that is only optimal if the stock price is expected to rise. An employee who can trade stock apart from the compensation account can acquire a leveraged position without withdrawing the share from the account, so expectations about the stock return are irrelevant.[5]

The expositional device of the compensation account suggests that the question of when to pay the tax is similar to the question of when to withdraw an asset from a tax-deferred investment account.[6] For both the compensation account and tax-deferred investment account, gains on the asset are taxed only upon withdrawal from the account. However, there are two non-trivial differences between the compensation account and a tax-deferred investment account. First, dividends are tax-deferred in a tax-deferred investment account, but may be paid to the employee and taxed as compensa-

[5]In general, employees and insiders can trade company stock if it is public. Bettis, Coles, and Lemmon (2000) examine firm-imposed insider trading restrictions and show that even for statutory insiders there are well-defined periods when trading in the firm's shares is permitted.

[6]I thank Terry Shevlin for this observation; see Scholes, Wolfson, Erickson, Maydew, and Shevlin (2002, Chapter 3). The problem is also related to work on dividend capitalization by Auerbach (1979) and Bradford (1981). These papers developed the "trapped equity" theory of dividend capitalization. A share in the compensation account is analogous to cash inside the firm in their models.

tion when paid on shares in a compensation account.[7] Second, the analysis of tax-deferred accounts generally presumes that assets in the account can also be held outside the account. This is not necessarily the case when employees receive stock grants in non-public companies.

In Section 2 I study Section 83(b) elections in detail. Specifically I consider the base case of a non-dividend paying stock that can be traded outside the compensation account, and I also examine the effects of dividends, non-tradability, and borrowing constraints. As discussed above, when the employee is granted the share at no cost and can trade the share outside the account, an 83(b) election is not optimal. However, I show that non-tradability of the shares can make an 83(b) election optimal. Specifically, if the employee would like to hold additional shares and can borrow to pay the tax, then early withdrawal of the share from the account can be optimal. Borrowing to pay the tax effectively permits the employee to borrow to hold additional shares, which is impossible otherwise. It also turns out that a *pessimistic* employee who cannot sell the stock obtained from the account, and who cannot otherwise trade the stock, may remove the share prematurely from the account if it is possible to surrender shares to pay the tax. The reason is that if the share price drops, incurring an extra layer of tax reduces the loss on the remaining half-share. If the capital gains tax is zero, a pessimistic employee who can sell shares to pay the tax (but cannot otherwise sell shares) is indifferent about when to remove the share from the account. Oddly, a pessimistic employee who can sell shares to pay the tax provides the one circumstance in which the trading is truly tax-induced.

Section 3 studies the exercise of nonqualified compensation options. I show that the exercise of a compensation option is equivalent to making a Section 83(b) election on a grant of stock and also paying a positive price for the share. As long as the interest rate is positive, it is optimal to defer making the fixed payment as long as possible. In addition, as discussed above, with tradability of the stock and no dividends, it is not optimal to make a Section 83(b) election. Thus, for a tradable, non-dividend paying stock like Worldcom, it is not optimal to exercise a compensation option prior to expiration.

Section 4 presents a simple numerical example illustrating various calculations that have been performed in analyzing the early exercise decision. The examples illustrate why early exercise might appear desirable, but also

[7] Companies could also pay the dividends in the form of additional shares, which would then be treated as additional share grants subject to the same vesting restrictions as the stock.

demonstrate that there is a strategy without early exercise that performs uniformly better. I also examine an incorrect argument that is sometimes used to argue that early exercise is not optimal.

The conclusions about Section 83(b) elections and early exercise of nonqualified options assume that tax rates on a given form of income are constant. Section 5 shows that if tax rates are expected to rise, there is an increased incentive to exercise NQOs early and to undertake Section 83(b) elections. Section 6 concludes.

2 Section 83(b) Elections

A grant of stock to an employee is taxed in accord with Section 83 of the Internal Revenue Code, which governs the tax treatment of property transferred in exchange for services. The general rule is that the fair market value of the property, less any payment for the property, is taxable as ordinary income as soon as the property is either freely transferable or not subject to forfeiture. Under this rule, a grant of restricted stock is not taxable until it becomes unrestricted, and a grant of unrestricted stock which vests over time is taxed upon vesting. However, a Section 83(b) election permits the recipient to pay tax within 30 days of the grant, thereby accelerating the recognition of ordinary income on the grant. In this section I study the optimality of Section 83(b) elections.

The 1997 Tax Act created a tax planning problem similar to a Section 83(b) election. The Act lowered capital gains rates to 18% for 5-year holders of stock purchased after December 31, 2000. To benefit existing holders of stock, the Act allows shareholders of stock bought prior to 2001 to elect a deemed sale and repurchase on January 1, 2001, which would make the stock eligible for the 18% rate if held for 5 years after January 1, 2001. This deemed sale enables the shareholder to sell and repurchase for tax purposes, without having to bear the transaction costs of an actual sale and repurchase. The question of whether to sell and repurchase in 2001 is formally the same as whether to undertake a Section 83(b) election.

The following quotation discusses 83(b) elections:

> Why would someone choose to be taxed earlier instead of later? Because, as is often the case in early stage growth companies, the initial low purchase price for the shares may equal the actual market value of those shares at that time. When this is the case, making an 83(b) election creates no tax liability at the time of purchase and prevents tax liability arising when

> the restrictions lapse on the stock. This effectively defers the employees tax obligation until he sells the stock.
>
> Even an employee who purchases stock for less than its value, may choose to make the election. If the employee believes the stock will increase dramatically in value, he may prefer to be taxed now on a relatively small amount rather than risk being taxed on an amount which is much greater when the stock fully vests. Richardson (2000, p. 83)

The second paragraph of this quotation illustrates the logic we have already discussed in the Introduction. The first paragraph makes a different point, which is that a Section 83(b) election may be optimal if the employee pays a significant amount for the stock. In this section I analyze Section 83(b) elections for a general stock purchase price. I show that for an employee who does not face portfolio constraints, Section 83(b) elections are never optimal if the employee pays nothing for the stock, and may be optimal otherwise.

Suppose the grant and employee payment for shares occur at time 0 and the stock becomes unrestricted at time 1. Let S_0 denote the value of the stock at grant and B the employee's time 0 payment for the stock. In the calculations in this section we will ignore the cost, B, since it is paid at the time of grant and therefore is a sunk cost.[8] We assume initially that there are no dividends. The net value of the stock grant is ordinary income for tax purposes, with the taxable value determined at the time the tax is paid. By default, the stock grant is taxable at time 1. At this point, the employee owes tax of $\tau(S_1 - B)$. Thus, the time 1 value of the grant (ignoring the initial payment of B) is

$$S_1 - \tau(S_1 - B) \tag{1}$$

A Section 83(b) election permits the employee to pay tax on the net value of the grant at time 0, with subsequent gains on the stock taxed as capital gains. Thus, with a Section 83(b) election, the tax at time 0 is $\tau(S_0 - B)$. Suppose that the employee borrows the funds to pay the tax.[9] The time 1 payoff is then

$$S_1 - g(S_1 - S_0) - (1 + r)\tau(S_0 - B) \tag{2}$$

where r is the after-tax interest rate. Note that when $B = 0$, a Section 83(b)

[8] This illustrates the difference between a Section 83(b) election and exercising an option. With restricted stock, the employee pays B at the time of grant; the 83(b) election determines only the timing of the tax deduction for B. With an option, at exercise the employee both pays the strike price and receives a deduction for the strike price.

[9] Equivalently, the employee could pay the tax out of other cash holdings.

election has the same payoff as the exercise of a zero-strike compensation at time 0 and sale of the stock at time 1.

Under what circumstances is a Section 83(b) election optimal? I answer this question by considering a utility-maximizing employee who can invest in bonds and the market, as well as the stock of his own company. The employee makes investment decisions to maximize the utility of time 1 wealth. A key issue is whether the employee faces portfolio constraints; in particular, can the employee trade company shares outside the compensation account, and can the employee borrow? I analyze the Section 83(b) election decision under several different assumptions about constraints.

I assume that tax rates are constant; I relax this assumption in Section 5. Proofs of the propositions in this section are in Appendix A.

2.1 Unrestricted Stock Trading

In this section I assume that the stock pays no dividends and that the employee faces no portfolio constraints. In particular, the employee can freely trade the stock outside of the compensation account, which would typically be true for employees in publicly-held companies. The employee can also borrow. In Section 2.3 I study the effects of portfolio constraints, in particular the case where the employee cannot trade the stock outside the compensation account, as might occur if the company is private.

The basic result of this section is that a utility maximizing employee who can trade the stock apart from the compensation account and who can borrow will never perform a Section 83(b) election if B, the cost of the stock grant, is zero. If B is large, the employee may optimally elect to pay tax on the grant early. As noted in the introduction, advocates of tax acceleration argue that an 83(b) election may be optimal if the employee is sufficiently optimistic about the stock. However, the optimality of a Section 83(b) election is independent of expectations about the stock. To make this point completely clear, in Section 2.5 I demonstrate an investment strategy that earns a higher return than an 83(b) election for *any* subsequent return on the stock. When $B = 0$, as is typically the case, a Section 83(b) election is formally identical to the exercise of a zero-strike non-qualified option.

The explicit analysis of the employee's portfolio problem is in Appendix A. The basic idea is that the employee at time 0 can choose a portfolio from among three assets: a risk-free asset paying the after tax-return r, the market portfolio, paying the expected after-tax return ϕ, and the stock paying the expected pre-tax return α. In addition, the employee has a grant of one share of the stock. The ordinary income tax rate is τ, and the capital

gains tax rate is g. The employee at time 0 pays B to receive a grant of one share of stock, and this grant incurs ordinary income tax either at time 0 (a Section 83(b) election) or at time 1. I assume that, whatever the tax strategy, the share is sold and the capital gain realized in period 1. In effect, I assume that the marginal capital gains tax rate is positive, so that the employee cannot completely avoid the capital gains tax.

In the following proposition, I compute the certainty equivalent change in time 1 wealth induced by a time 0 Section 83(b) election. This is a measure of the gain or loss from the election.

Proposition 1 *Suppose that an employee receives a grant of one share of non-dividend-paying stock at a cost B, can also buy and sell stock outside the compensation account, and can borrow. An employee who pays ordinary income tax on the grant at time 0 instead of time 1 has a certainty-equivalent change in time 1 wealth, ΔW_1, of*

$$\Delta W_1 = \tau r B - S_0(1-\tau)g\frac{r}{1-g} \tag{3}$$

If $B = 0$, paying the tax at time 0 instead of time 1 entails an expected loss in time 1 wealth:

$$\Delta W_1 = -S_0(1-\tau)g\frac{r}{1-g} < 0$$

Therefore, when $B = 0$, a Section 83(b) election is not optimal.

Proposition 1 obtains for *any belief about the expected return on the stock*. In particular, optimism does not make early tax payment optimal. An optimistic employee will invest more heavily in the stock outside the compensation account. A pessimistic employee will invest less heavily or even short the stock outside the account. When outside investment is permitted, the tax payment decision is a purely technical decision about whether to incur an extra layer of capital gains tax.

Equation (3) has a straightforward interpretation. Suppose $B = 0$. Because the employee can hold stock outside the compensation account, in portfolio equilibrium the employee is indifferent between an after-tax return of r on the bond and a certainty-equivalent after-tax return of r on the stock. The stock is taxed at the rate g, so in order to have an after-tax certainty-equivalent return of r, the certainty-equivalent pre-tax return on the stock must be $r/(1-g)$.

The tax paid at time t is τS_t, which has a present value of τS_0.[10] Thus, the employee owns $1-\tau$ shares (the present value of the tax is not affected by the timing of the tax payment). However, once the employee makes a Section 83(b) election, the remaining $1-\tau$ shares are subject to capital gains taxes. *As long as the employee does not pay tax on the stock grant,* $1-\tau$ *shares are exempt from the capital gains tax.* This extra payment of the capital gains tax due to a Section 83(b) election gives rise to expression (3). After paying the tax, the employee has a share position worth $(1-\tau)S_0$, which on average earns the certainty-equivalent pre-tax return $r/(1-g)$, which is then taxed at the rate g. Thus the loss is the tax g, on the return $r/(1-g)$ on $1-\tau$ shares, or $-gS_0(1-\tau)r/(1-g)$.

When $B > 0$, the additional consideration in equation (3) is that the employee wants to accelerate the tax deduction of B. The gain from deducting B one period early is $r\tau B$. The employee prefers an 83(b) election when the gain exceeds the loss, or when $\tau rB > rgS_0(1-\tau)/(1-g)$. The interest rate affects both the gain and loss and hence does not affect the comparison.

Note that if $B = 0$ and the capital gains tax rate were zero, an employee would be indifferent between making and not making a Section 83(b) election. Either way, the employee would effectively own $1-\tau$ shares.

The analysis in this section also applies to the deemed sale and repurchase provision of the 1997 Tax Act. The payment of the 20% capital gain is analogous to the ordinary income tax, τ, the 18% capital gains rate is like the capital gains rate, g, and the basis for the stock is analogous to B. As with a Section 83(b) election, the voluntary payment of the 20% capital gains tax is optimal if B is large enough. If the January 1, 2001 stock price equalled the basis, the deemed sale and repurchase would have been optimal. If the stock had a sufficiently great price-to-basis ratio, however, the deemed sale and repurchase would not have been optimal, just as a Section 83(b) election would not be optimal for sufficiently small B.

2.2 Dividends

The effect of dividends on the desirability of an 83(b) election is potentially ambiguous. First, on a per share basis, the taxation of dividends is more favorable after the employee makes a Section 83(b) election. Under current tax law, a dividend paid on restricted or unvested stock is taxed as ordinary

[10] Put differently, as long as the stock does not pay dividends and there are no restrictions on share trading, the stock price today is the present value of the stock price in the future. Hence τS_0 is the present value of τS_t.

income if the dividend is paid to the employee.[11] Once the stock is fully vested, however, a dividend is taxed as on any other stock. Under current US tax law, this means the dividend is taxed at a 15% rate (subject to some restrictions) and the stock price drop when the stock goes ex-dividend reduces the taxable capital gain on the stock. There is a second, offsetting effect, however. Prior to an 83(b) election, the employee owns one share and receives dividends on one share. Following the 83(b) election, the employee owns and receives dividends on only $1-\tau$ shares.

To see the effect of a dividend on the desirability of an 83(b) election, equation (24) in Appendix A shows that the certainty equivalent change in wealth from an 83(b) election is[12]

$$\Delta W_1 = \tau r B - g S_0 (1-\tau)\frac{r}{1-g} - (\tau_D - g) D \frac{1-\tau}{1-g} \tag{4}$$

By comparing equation (4) with equation (3), as long as $\tau_D > g$, dividends make a Section 83(b) election less desirable. To understand this result, note that while stock is restricted, the employee receives the after tax dividend $(1-\tau)D$. Following a Section 83(b) election, the employee has $1-\tau$ shares and the dividend is taxed at the net rate $\tau_D - g$, since the ex-dividend stock price drop is taxed at the capital gains rate. Thus, after-tax dividends received on one restricted share are more valuable than after-tax dividends on $1-\tau$ unrestricted shares as long as

$$(1-\tau)D > (1-\tau)(1-\tau_D+g)D$$

The inequality holds as long as $\tau_D > g$, which is the condition in equation (4).

Equation (4) clarifies the effect on Section 83(b) elections of the 2003 Tax Act, which eliminated the differential between the capital gains and dividend tax rates (for a high bracket investor, the dividend tax was reduced to 15%.) For stock held in a compensation account, the dividend is taxed as ordinary income. Outside the account, held as an ordinary asset, the dividend is taxed at 15%. One might guess that if the stock paid significant dividends, an employee would make a Section 83(b) election to reduce the tax rate on dividends. However, this argument fails to account for the fact

[11] If dividends were not paid to the employee but rather reinvested within the restricted stock account, they would not be taxed until the shares vest. In this case dividends are effectively tax exempt until the shares are taxed; it is as if the stock did not pay dividends.

[12] In Appendix A, dividends on restricted stock are taxed at the rate τ_D^*. The analysis in the text assumes that $\tau_D^* = \tau$, as under current U.S. tax law.

that removing the share from the account leaves the employee with only $1 - \tau$ shares, and hence reduces the pre-tax dividend. Equation (4) shows that when $\tau_D = g < \tau$, as under 2003 tax law, dividends do not affect the 83(b) election decision.

2.3 Restricted Stock Trading

What if the employee cannot alter the quantity of stock by trading outside the compensation account? This can occur, for example, when the stock of a company is not publicly traded but employees receive share grants. (In this situation the company would typically repurchase the stock from employees wishing to sell.) For simplicity, I assume in analyzing this question that both D and B are zero.

When employees cannot trade outside the compensation account, a Section 83(b) election, coupled with borrowing or selling other assets to pay the tax, permits the employee to increase the share position, which is otherwise impossible since other trading of the stock is not allowed. For example, suppose $S_0 = \$100$, $B = 0$ and $\tau = 40\%$. The employee is obligated to pay the 40% tax and therefore effectively owns 0.60 shares. However, suppose the employee performs an 83(b) election and sells other assets to pay the tax. The employee effectively buys an additional 0.40 shares. Thus, the employee who would voluntarily have bought more shares outside the compensation account may find it optimal to acquire extra shares in this fashion, even though there is a tax cost to doing so.

Proposition 2 *Suppose the employee can borrow or sell other assets but cannot trade the stock outside the compensation account. A necessary condition for the employee to undertake a Section 83(b) election is that the employee would hold additional shares if unconstrained.*

As discussed above, the 83(b) election coupled with borrowing to pay the tax permits the employee to increase the share position in the stock. This is only optimal if the employee would hold additional shares if permitted. One might guess that a typical employee is overinvested rather than underinvested in a company's stock. When this is the case, and when the employee borrows to pay the tax, Section 83(b) elections are not optimal.

Interestingly, there are also circumstances in which *pessimism* can lead an employee to undertake an 83(b) election. Suppose that $B = 0$ and an employee is permitted to sell shares to pay the tax on the grant. (In practice this would typically not be permitted.) The pessimistic employee would like

to sell shares, but the sale of shares to pay the tax in and of itself does not accomplish anything since the present value of the tax is the same whether it is incurred today or in the future. In either case, the employee has $1-\tau$ shares. However, the 83(b) election *does* subject the $1-\tau$ shares to capital gains tax. If the stock falls, the capital gains tax absorbs some of the loss. Thus, if the employee can sell shares to pay the tax, a pessimistic employee can make a Section 83(b) election and, in effect, use the capital gains tax to reduce the expected after-tax loss on the stock.

Proposition 3 *Suppose the employee cannot trade the stock outside the compensation account but uses shares to pay the tax incurred in a Section 83(b) election. If $g > 0$, a necessary condition for an employee to undertake a Section 83(b) election is that the employee would sell additional shares if permitted. If $g = 0$, this same employee is indifferent about the timing of the Section 83(b) election.*

In interpreting Proposition 3, keep in mind that the employee cannot sell shares except to pay the tax. Thus the employee in effect owns $1-\tau$ shares. If $g = 0$, there is no benefit (or cost) from early payment of the tax.

In practice, shares are typically not sold to pay the tax; the point of restricting shares is that they must be held. Thus, Proposition 3 is unlikely to be empirically important.

2.4 Borrowing Constraints

What is the effect on the Section 83(b) election decision if the employee is constrained from borrowing? Appendix section A.3 explores the borrowing constraint formally, but a simple example will show why a borrowing-constrained employee might undertake a Section 83(b) election. To illustrate the role of a borrowing constraint, suppose the employee would, if unconstrained, borrow extra to invest more in the market portfolio. By definition, the employee holds no other assets for which the holding is unconstrained and that could be sold to invest more in the market.

Suppose that it is possible to borrow to pay the tax from a Section 83(b) election and that the employee is unconstrained with respect to company stock and holds company stock outside the compensation account. By making the election and borrowing to pay the tax, the employee increases the effective holding of company shares. Since the employee already had an optimal holding of company shares, it is optimal to sell some company shares and buy more of the market, which relaxes the effect of the borrowing constraint. In general, when the employee can borrow to pay the tax, a binding

borrowing constraint provides an additional force motivating a Section 83(b) election.

If the employee cannot borrow for other purposes, they may not be able to borrow to perform the Section 83(b) election. In the more realistic case when the borrowing-constrained employee also cannot borrow to pay the Section 83(b) tax, a borrowing constraint creates an additional *disincentive* to make the election. The reason is that if the borrowing constraint is binding, the employee would like to borrow to hold additional units of the market. The payment of the Section 83(b) tax would require selling some of this position in the market, which exacerbates the constraint.

Finally, the analysis in Appendix A.3 also considers the effect of a constraint against short-selling the market. This constraint has no direct effect on the 83(b) election decision. If the constraint is binding the employee has no position in the market, and the decision can be made as if the market election had not been available in the first place.

2.5 Dominant Strategies

Suppose once again that employees can trade the stock outside the compensation account. I now present a portfolio strategy such that an employee who does not perform a Section 83(b) election can always outperform an employee who does, whatever the subsequent return on the stock.

Consider two employees, Employee 1 who performs an 83(b) election at time 0, borrowing the tax payment, and Employee 2 who pays tax when the share vests at time 1. Let $B = 0$.

At time 0, Employee 1 makes an 83(b) election and borrows the tax payment of τS_0. At time 1, Employee 1's net cash flow is

$$S_1 - g(S_1 - S_0) - \tau S_0(1 + r) \tag{5}$$

If Employee 2 makes no election at time 0, Employee 2 will have $(1-\tau)S_1$ at time 1. It is ambiguous whether this amount is greater or less than expression (5). However, this is not a fair comparison. Because of the tax on the stock grant, both Employees 1 and 2 really have $1 - \tau$ shares. When Employee 1 borrows to pay the tax, it is like a separate additional transaction that increases Employee 1's share position. We can make a fair comparison by having Employee 2 also borrow to buy stock.

Suppose that Employee 2 borrows to buy $(\tau - g)/(1 - g)$ shares and pays stock on the grant at time 1. Employee 2 will then have

$$(1 - \tau)S_1 + \frac{\tau - g}{1 - g}\left[S_1 - g(S_1 - S_0) - (1 + r)S_0\right] \tag{6}$$

Expression (6) exceeds expression (5) as long as $r > 0$. Thus the strategy of paying tax at time 1 and borrowing $(\tau - g)/(1 - g)$ shares strictly dominates the strategy of making a Section 83(b) election at time 0 and borrowing to pay the tax. Note that $(\tau - g)/(1 - g) < \tau$, so Employee 2 borrows less than Employee 1.

What is the interpretation of the expression $(\tau - g)/(1 - g)$? The stock pays a certainty-equivalent return of $r/(1 - g)$. Employee 1 borrows to buy τ shares, and therefore has a single share with a payoff given by equation (5), yielding an after-tax certainty equivalent return of r.

Employee 2 earns the pre-tax return $r/(1 - g)$ on $1 - \tau$ shares and the after-tax return r on x borrowed shares. In order to have a position that also earns r after tax, x must satisfy

$$\frac{r}{1-g}(1-\tau) + xr = r$$

Thus, $x = (\tau - g)/(1 - g)$.[13]

Finally, if Employee 1 sells shares to pay the tax, it is possible to show that Employee 2 can earn a dominant return by short-selling $g(1 - \tau)/(1 - g)$ shares at time 0. Whatever combination of borrowing and share sales Employee 1 uses to pay the tax, Employee 2 can earn a higher return with an appropriate amount of borrowing to buy shares or short-selling.

2.6 A Numerical Example

Assume that $\tau = 0.5$, $g = 0.2$, $r = 10\%$, $S_0 = \$100$, and suppose that S_1 can be either \$50 or \$1000. Employee 1 makes a Section 83(b) election at time 0 and borrows to pay the tax, earning a time 1 return given by equation (5). Employee 2 pays the tax at time 1 and at time 0 borrows $(\tau - g)/(1 - g) = 0.375$ shares, earning the after-tax return given by equation (6). Table 1 shows the difference in time 1 cash flows for the two employees.

Employee 2 outperform Employee 1 by \$1.25 for the reasons discussed above. Immediate payment of tax on the stock leaves Employee 1 with 50% of the shares remaining. The certainty equivalent pre-tax expected return on these shares is $10\%/(1 - 0.2) = 12.5\%$. The expected extra tax paid by early sale of the shares is thus $\$100 \times 0.5 \times 0.2 \times 12.5\% = \$1.25$.

[13] This expression also appears in Dammon, Spatt, and Zhang (forthcoming), where it represents the tax benefit of switching \$1/r from a non-dividend-paying stock to a bond in a tax-exempt account, with an offsetting transaction in the taxable account.

Table 1: Cash flows from paying the ordinary income tax on a share grant at time 0 and borrowing to pay the tax, and from paying the tax at time 1 and borrowing to buy $(\tau - g)/(1 - g)$ shares at time 0. The calculations assume that $S_0 = \$100$, $r = 10\%$, $\tau = 50\%$, and $g = 20\%$.

S_1	Pay Tax at Time 0 Borrow to Pay Tax Eq. (5)	Pay Tax at Time 1, Borrow 0.375 Shares Eq. (6)
\$50	\$5.00	\$6.25
\$1000	\$765.00	\$766.25

3 Early Exercise of Non-Qualified Options

In this section I examine the option exercise decision. The costs and benefits of exercising a compensation option before expiration are similar to those of ordinary options. However, there is also a tax effect similar to that discussed in Proposition 1.

It is well-known that dividends and diversification provide non-tax reasons to exercise a call option prior to expiration. First, if the stock pays dividends, the option holder may exercise the option to capture the dividends.[14] Second, employees holding compensation options may exercise and sell the stock in order to reduce exposure to the risk of the company's stock.[15] Here I am interested in whether it is optimal to exercise the option and *continue to hold the stock*, behavior that distinguishes tax-induced exercise from diversification-induced exercise.

Consider a utility-maximizing employee who can trade the company's stock independently of compensation. The effect of exercising the option at time 0 is given by the following proposition (the calculation is in Appendix B).

Proposition 4 *Suppose an employee receives options expiring at time 1 and that the employee can trade shares outside the compensation and is not borrowing-constrained. An employee who exercises a fractional option at time 0 instead of time 1 has a certainty-equivalent change in time 1 wealth*

[14] McDonald (2003, Chapter 11) discusses the effect of dividends on option exercise.

[15] See Huddart (1998a) for an example in which non-diversified holders exercise an option before expiration. Huddart and Lang (1996) provide evidence on when exercise occurs in practice.

of ΔW_1 *of*

$$\Delta W_1 = -(1-\tau)rK - (1-\tau)E^Q[\max(0, K - S_1)] \\ - g(1-\tau)\frac{r}{1-g}S_0 + (1-\tau)D\frac{1-\tau_D}{1-g} \quad (7)$$

where $E^Q[\max(0, K - S_1)]$ *denotes a utility-weighted expectation of the time 1 payoff to a put option with strike price* K*. If the stock pays no dividends* ($D = 0$)*,* ΔW_1 *is unambiguously negative and the employee will never exercise a non-qualified option prior to expiration.*

Equation (7) delineates the costs and benefits of exercising a non-qualified option. The first three terms provide three reasons to not exercise a compensation option prior to expiration. First, it is optimal to defer the payment of interest on the strike price. Second, exercise at time 0 eliminates the implicit put option that protects against a decline in the stock price below the strike price. Third, exercise of the option makes the shares subject to capital gains taxation (the Section 83(b) effect discussed in Proposition 1). Finally, as with ordinary options, large dividends can provide a reason to exercise before expiration. Thus, three out of the four effects in equation (7) are present when exercising ordinary options: loss of strike price deferral, loss of the implicit put, and gaining the dividend on the stock. The compensation context adds a fourth factor that works against exercise, and that also works against making an 83(b) election.

Notice that when $K = 0$ and $D = 0$, equation (7) reduces to $-gS_0(1-\tau)r/(1-g)$, which, from Proposition 1, is the loss associated with a Section 83(b) election on one share. Thus the decision to exercise a zero-strike NQO is formally identical to making a Section 83(b) election.

The analysis in Appendix B also considers the case when the employee cannot trade shares outside the compensation account. In that case, the basic thrust of Proposition 2 still obtains: in order for early exercise to be optimal, the constrained employee who borrows to finance the tax must be optimistic about the stock. It is also possible to show that a pessimistic employee who can sell shares to pay the tax and who owns a deep-in-the-money option might exercise early, for the same reasons discussed in Proposition 3.

Notice that apart from the $-g(1-\tau)S_0r/(1-g)$ term, the conditions governing option exercise are different than the conditions affecting an 83(b) election. Option exercise also involves paying the strike and eliminating the implicit put, both of which work against exercise. Because the dividend is paid on restricted stock but not to an option holder, the dividend effect is larger in equation (7) than in equation (4).

Finally, when the employee can trade the stock freely, the no-early-exercise result can also be proven with a dominance argument, as in Section 2.5. One can compare the strategy of exercising with the strategy of not exercising and borrowing to buy $(\tau - g)/(1 - g)$ shares, as in Section.[16] It is straightforward to show that, as with a Section 83(b) election, adding $(\tau - g)/(1 - g)$ shares to an unexercised option gives a position with the same after-tax share price exposure as an exercised option. The gain from waiting to exercise and borrowing to buy $(\tau - g)/(1 - g)$ shares, as opposed to exercising at time 0, is

$$(1 - \tau)\left[-rK - \max(0, K - S_1) - g\frac{r}{1 - g}S_0 + D\frac{1 - \tau_D}{1 - g}\right] \tag{8}$$

This is the same as the right-hand side of equation (7), with the expectation of the put payoff replaced by the realized put payoff, $\max(0, K - S_1)$.

4 Erroneous Arguments For and Against Early Exercise

In this section I illustrate Proposition 4 with a numerical example, and also present and discuss different calculations that have been used, incorrectly, to argue for and against tax-induced early exercise of compensation options.

4.1 An Erroneous Argument in Favor of Early Exercise

The arguments for tax-induced early exercise discussed in the introduction suggest that a shareholder believing that the price will increase significantly over the next year might optimally exercise the option today. The argument for exercise is that it is desirable to have the gain from \$250 to \$1000, for example, taxed at the capital gains rate rather than the ordinary income rate. A calculation seeming to support this argument is to compare two payoffs: (1) the payoff from waiting to exercise with (2) the payoff from exercising at time 0 and borrowing to pay the strike price and tax due at exercise. The payoff from strategy (2) exceeds that from strategy (1) when

[16] McDonald (2003, Chapter 16) provides a terse version of this dominance proof and concludes that taxes do not provide a rationale for early exercise of a compensation option. However, in that discussion there is no real explanation of the result, no discussion of the implicit assumption that the employee can trade the stock outside the compensation account or what happens when such trading is not possible, and no discussion of Section 83(b) elections.

the stock price rises sufficiently. However, the comparison is not appropriate because it entails comparing positions containing different numbers of shares. In fact, the dominance strategy discussed in Section 3—waiting to exercise and borrowing to buy $(\tau - g)/(1 - g)$ shares—strictly outperforms strategy (2).

Let S_t denote the time t stock price, K the strike price, r the after-tax risk-free rate, τ the ordinary income tax rate, and g the capital gains tax rate. We assume that whatever the option exercise strategy, the stock is ultimately sold—and capital gains realized—at time 1. If the employee does not exercise until time 1, the payoff to the option is

$$(1 - \tau) \times \max[0, S_1 - K] \tag{9}$$

Suppose instead that the employee follows strategy (2): exercise at time 0 and borrow the strike price and tax at exercise. The employee thus borrows the amount $K + \tau(S_0 - K)$, and repays this amount plus interest at time 1. The capital gains tax at time 1 is $g(S_1 - S_0)$. The time 1 cash flow is therefore

$$S_1 - g(S_1 - S_0) - (1 + r)[K + \tau(S_0 - K)] \tag{10}$$

Table 2 illustrates the consequence of early and delayed exercise assuming that the employee who exercises at time 0 borrows the exercise price and also borrows the amount necessary to pay the tax at exercise. The example assumes that an employee owns an in-the-money compensation option that may be exercised immediately or one year from now. The strike price of the option is \$100 and the current stock price is \$250. The ordinary income tax rate is 50% and the capital gains tax rate is 20%. At exercise, the employee pays the 50% tax on the difference between the stock price and strike price. After exercise, subsequent gains or losses on the stock are taxed at 20%.

From comparing columns 1 (equation (9)) and 2 (equation (10)), the employee who exercises at time 0 has a greater payoff when the stock rises sufficiently.[17] Specifically, when the stock price at time 1 is greater than \$281.25, the employee who exercises at time 0 (column 3) has a greater time 1 cash flow than the employee who waits to exercise (column 2). This analysis thus *appears* to support early exercise for an optimistic shareholder. However, the comparison is misleading, since it implicitly compares different holdings of stock. The employee who exercises at time 0 and borrows to pay the exercise price and tax is effectively holding more shares than the

[17] This is the comparison made by Huddart (1998a), arguing that early exercise is sometimes optimal.

Table 2: Cash flows from early and delayed exercise of a compensation option, assuming that the employee borrows the strike price and time 0 tax. The calculations assume that $S_0 = \$250$, $K = \$100$, $r = 10\%$, $\tau = 50\%$, and $g = 20\%$. Column 1 assumes exercise of the option at time 1, column 2 assumes exercise at time 0, with borrowing to pay the tax at exercise, and column 3 assumes the exercise decision is at time 1, with borrowing to buy 0.375 shares at time 0.

	(1)	(2)	(3)
	Exercise at time 1	Exercise at time 0	Exercise at time 1
S_1	Eq. (9)	Eq. (10)	Eq. (11)
\$50	\$0	−\$102.50	-\$69.375
\$200	\$50	\$17.50	\$25.625
\$500	\$200	\$257.50	\$265.625
\$1000	\$450	\$657.50	\$665.625

employee who waits to exercise. To make the comparison fair, the non-exercising employee must be permitted to borrow as well.

Consider the strategy in which a non-exercising employee at time 0 following the dominance strategy of Section 2.5, borrowing to buy $(\tau - g)/(1 - g) = 0.375$ shares. The time 1 cash flow is then

$$(1-\tau) \times \max[0, S_1 - K] + \frac{\tau - g}{1 - g} \times [S_1 - g(S_1 - S_0) - (1 + r)S_0] \quad (11)$$

By comparing columns 2 and 3 (or equations (10) and (11)), when the option is in the money at time 1, borrowing to buy 0.375 shares and waiting to exercise outperforms exercising at time 1 by \$8.125. It is not surprising that the strategies in columns 2 and 3 underperform that in column 1 when the stock price is \$50, because both of the underperforming strategies have a leveraged position in the stock. The interesting comparison is that of column 2 to column 3, which demonstrates that early exercise is not the best strategy for an optimistic shareholder.

Equation (8) can be obtained by subtracting equation (11) from equation (10). Equation (8) therefore provides an explanation for the \$8.125 difference between columns (2) and (3) when the option is in the money at time 1. When $S_1 > K$ and $D = 0$, only the first and third terms on the left-hand side of equation (8) appear. The third term is the loss from performing a

Section 83(b) election:

$$-g(1-\tau)S_0\frac{r}{1-g} = -0.2 \times (1-0.5) \times \$250 \times \frac{0.1}{1-0.2} = -\$3.125$$

The loss from paying $(1-\tau)\$100$ one period early, the first term, is

$$-r(1-\tau)\$100 = -\$5$$

The total loss when the option is exercised at time 0 is $-\$3.125 - \$5 = -\$8.125$.

4.2 An Erroneous Argument Against Early Exercise

Practitioners sometimes consider another strategy to compare to early exercise. In any fair comparison of alternative strategies, the net cash investment at time 0 must be the same. From equation (10), the investor exercising at time 0 pays $K+\tau(S_0-K)$ to cover the strike price and taxes. An alternative requiring the same investment as exercising is to wait until time 1 to make an exercise decision and invest $K+\tau(S_0-K)$ in shares. The payoff to this strategy is

$$(1-\tau)\max(0, S_1-K) + \frac{K+\tau(S_0-K)}{S_0}\left[S_1 - g(S_1-S_0)\right] \qquad (12)$$

If we treat the strike price and taxes at time 0 as a cash outflow paid at that time, the time 1 payoff to an option exercised at time 0 is simply the payoff to one share:

$$S_1 - g(S_1-S_0) \qquad (13)$$

It is straightforward to show that equation (12) is greater than equation (13) when $S_1 > S_0$. This fact is sometimes used to conclude that early exercise is not optimal. However, equation (12) is less than equation (13) when $S_1 < S_0$. Thus, the strategy in equation (12), i.e., waiting to exercise and investing the strike and taxes in shares, does *not* dominate the strategy of exercising the option at time 0. Thus, this comparison does not prove that waiting to exercise is optimal.

By contrast, it is straightforward to show that the strategy of waiting to exercise at time 0, investing $(\tau-g)/(1-g)$ in shares and investing

$$K+\tau(S_0-K) - \frac{\tau-g}{1-g}S_0$$

in bonds *does* dominate exercising at time 0. This last strategy is the same as that in equation (11) except that it assumes a non-zero cash flow at time

0. As Table 2 illustrates (assuming a zero cash flow at time 0) this strategy does dominate exercising at time 0.

The strategy that entails waiting to exercise and buying $(\tau - g)/(1 - g)$ shares is the *only* strategy that strictly dominates exercising at time 0 because it is the only strategy that equates the after-tax return on shares to that from exercising at time 0. Thus, it is the only strategy demonstrating that tax-induced exercise is not optimal.

5 Changing Tax Rates

Employee tax rates can change either because the employee faces a change in income leading to a different marginal tax rate, or because of tax law changes. In this section I show that an expected increase in the ordinary income tax rate makes a Section 83(b) election more desirable and can induce early exercise of a compensation option. I assume that the ordinary income tax rate at time 0 is τ_0 and at time 1 is τ_1. To keep the comparison simple, I assume that the dividend tax rate, τ_D and the capital gains tax rate, g, do not change. I also assume that the tax rate change occurs before the dividend is paid.

Intuitively, a future increase in the ordinary income tax rate will encourage the employee to pay the ordinary income tax at the low rate. The following proposition demonstrates that this intuition is correct.

Proposition 5 *Suppose employees can trade shares outside the compensation account. The employee who makes a Section 83(b) election has a certainty-equivalent change in time 1 wealth of*

$$\Delta W_1 = B[\tau_0(1+r) - \tau_1] + (\tau_1 - \tau_0)S_0(1+r) \\ - S_0(1-\tau_1)g\frac{r}{1-g} - (\tau_D - g)D\frac{1-\tau_1}{1-g} \quad (14)$$

The effect of an increase in the future tax rate, τ_1, is

$$-B + S_0(1+r) + gS_0\frac{r}{1-g} + (\tau_D - g)\frac{D}{1-g} \quad (15)$$

There are four effects evident in equation (14). The first term is the gain from accelerating the deduction of B. If the tax rate increases faster than the interest rate, it is optimal to defer the receipt of this deduction. The second term represents the change in the present value of the tax on the share value. Because the present value of tax at rate τ is τS_0, this term

is simply the stock price times the change in the tax rate. The third term is the cost of a Section 83(b) election from Proposition 1. The final term reflects the benefit of receiving the dividend on one share as opposed to $1 - \tau_1$ shares.

In practice, given current tax law, an increase in the ordinary income tax rate will make an 83(b) election more likely. It should always be that $B \leq S_0$. Under recent and current tax law, $\tau_D \geq g$. Thus, equation (15) is positive. For stocks paying large dividends and with $\tau_D < g$, an increase in the tax rate could theoretically make an 83(b) election less likely.

A future increase in the tax rate also has the potential to make it optimal to exercise an option prior to expiration, even on a non-dividend-paying stock. As Huddart (1998b) shows, from the perspective of the employee, the decision rule is simple. If the employee holds the option past the date of the tax rate change, the employee will receive $(1 - \tau_1)(S_1 - K)$ at exercise, hence the value of the option unexercised is $(1 - \tau_1)W$, where W is the value to the employee of the pre-tax option payoff. Thus, if the tax rate is about to change from τ_0 to τ_1, the employee should exercise the option if $(1 - \tau_1)W > (1 - \tau_0)(S_0 - K)$, or

$$\frac{1 - \tau_1}{1 - \tau_0} > \frac{S_0 - K}{W}$$

By performing the same comparison as in Section 3, we can decompose the effects that lead to early exercise.

Proposition 6 *Suppose the employee can trade shares outside the compensation account. The strategy of waiting until time 1 to make an exercise decision and borrowing to buy $(\tau - g)/(1 - g)$ shares has a greater time 1 value than the strategy of exercising at time 0 if the following expression is positive*

$$\begin{aligned} &Kr(1 - \tau_1) + (1 + r)(S_0 - K)(\tau_0 - \tau_1) \\ &\quad + (1 - \tau_1)\max[0, K - S_1] + gS_0(1 - \tau_1)\frac{r}{1 - g} - (1 - \tau_D)D\frac{1 - \tau_1}{1 - g} \end{aligned} \quad (16)$$

An increase in τ_1 has the following effect on the value of deferring exercise:

$$-rK - (1 + r)(S_0 - K) - \max[0, K - S_1] - gS_0\frac{r}{1 - g} + \frac{1 - \tau_D}{1 - g}D$$

By Proposition 6, an increase in the tax rate lowers the value to deferring exercise, except for the effect on dividends. There are two dividend effects:

the after-tax value of a dividend on one share is lower, and the employee will have fewer shares after exercise.

Equation (16) also shows that, for a given increase in the tax rate, the more in-the-money the option, the greater the value to early exercise.

6 Conclusion

It is commonly believed that if an asset is taxed first at a high rate and then at a lower rate, that it can make sense to accelerate the payment of the high tax so that more of the subsequent gain can be taxed at the lower rate. This is generally incorrect. This paper examines this idea in the context of two compensation-related applications—Section 83(b) elections and early exercise of non-qualified options—and shows in both cases that if the employee can trade the stock outside of the compensation account, early payment of the high rate tax is *disadvantageous*, and actually creates double taxation of returns that would be otherwise be single-taxed.

When the employee cannot trade the stock outside of the compensation account or is otherwise restricted, Section 83(b) elections and early exercise of options can be optimal as a means of relaxing constraints.

Appendices

Appendix A Section 83(b) Elections

Consider an employee who can potentially invest in three assets: company stock worth S_0 at time 0 and S_1 at time 1; an alternative risky asset (the market) with after-tax return ϕ; and a risk-free asset with after-tax return r. Let τ be the ordinary income tax rate, τ_D the dividend tax rate, and g the capital gains tax rate. We consider a single trading period, with the capital gains tax levied on appreciation at the end of this period.

Suppose an employee has one share of restricted stock with basis B (the employee pays this amount for the stock) and makes a Section 83(b) election, choosing to be taxed on the fraction λ at time 0, with the rest taxed at time 1. The employee can also trade β shares of the stock, where $\underline{\beta} \leq \beta \leq \overline{\beta}$ can be held outside the compensation account. Purchase of β shares at time 0 and taxation of the fraction λ of restricted stock at time 0 results in the employee holding $\lambda + \beta$ shares outside the account and a reduction in initial wealth of $\beta S_0 + \lambda\tau(S_0 - B)$; the second term is the tax payment resulting

from a Section 83(b) election on λ shares. Remaining wealth is allocated between the risk-free asset and the market, with ω the fraction invested in the market. There are no constraints on borrowing or shorting-selling the market. The stock pays a dividend, D, which is taxed at the dividend tax rate, τ_D when the stock is held outside the compensation account and at the rate τ_D^* when the stock is held inside the compensation account. (Under current law, dividends paid on restricted or unvested stock that are paid to the employee are taxed as compensation, so $\tau_D^* = \tau$.)

Period 1 wealth for employee 1 is

$$\begin{aligned} W_1 = [W_0 - \beta S_0 - \lambda\tau(S_0 - B) - B][1 + (1-\omega)r + \omega\phi] \\ + (\lambda + \beta)[S_1 + D(1-\tau_D) - g(S_1 - S_0)] \\ + (1-\lambda)[S_1 + D(1-\tau_D^*) - \tau(S_1 - B)] \end{aligned} \tag{17}$$

The employee selects β, λ, and ω to solve

$$\max_{\beta,\lambda,\omega} E[U(W_1)] \tag{18}$$

subject to equation (37) and also subject to

$$0 \leq \lambda \leq 1 \tag{19}$$

The last constraint says that the employee cannot withdraw more or less than is in the compensation account. This restricts the number of shares that receive compensation tax treatment; it does not restrict trading in shares outside the compensation account.

A.1 Unrestricted Shareholding

I first consider the case where borrowing is unrestricted and the employee can freely trade shares outside the compensation account, so that $\underline{\beta} = -\infty$ and $\overline{\beta} = +\infty$. Let $\underline{\lambda}$ and $\overline{\lambda}$ denote the Lagrange mulitpliers associated with the constraint on λ, equation (19). The first-order conditions for ω, β, and λ are

$$\omega : E\{U'(\phi - r)\} = 0 \tag{20}$$

$$\beta : E\{U'[S_1 + D(1-\tau_D) - g(S_1 - S_0) - S_0(1 + r + \omega(\phi - r))]\} = 0 \tag{21}$$

$$\begin{aligned} \lambda : E\{U'[-\tau(S_0 - B)[1 + r + \omega(\phi - r)] + D(\tau_D^* - \tau_D) \\ + \tau(S_1 - B) - g(S_1 - S_0)]\} + \underline{\lambda} - \overline{\lambda} = 0 \end{aligned} \tag{22}$$

By complementary slackness, at most one of $\underline{\lambda}$ or $\overline{\lambda}$ will be zero. If a Section 83(b) election is not optimal, then $\underline{\lambda} > 0$, i.e., the constraint that $\lambda \geq 0$ is binding.

Using equation (20), equation (21) can be rewritten

$$E\left\{U'\left[S_1 + D\frac{1-\tau_D}{1-g} - S_0\left(1+\frac{r}{1-g}\right)\right]\right\} = 0 \tag{23}$$

Using equations (20) and (21), equation (22) can be written

$$E\left\{U'\left[\tau r B - gS_0(1-\tau)\frac{r}{1-g} + D\left(\tau_D^* - \tau - (\tau_D - g)\frac{1-\tau}{1-g}\right)\right]\right\} + \underline{\lambda} - \overline{\lambda} = 0 \tag{24}$$

If $B = 0$, and if the employee is unconstrained with respect to shareholdings (equation (23) holds), early payment of tax on the grant of shares unambiguously lowers employee utility. Since equity and bond holdings are optimally chosen, the issue of financing the tax payment does not arise.

Proof of Proposition 1 Set $D = 0$ in equation (24). If $B = 0$, then $\underline{\lambda} > 0$ and the employee will set $\lambda = 0$, not undertaking a Section 83(b) election. If $\tau B = gS_0(1-\tau)/(1-g)$, then equation (24) is zero, and the employee is indifferent between paying taxes early or late. ■

A.2 Restricted Shareholding

Now I consider the cases where trading shares outside the compensation account is prohibited but the employee can borrow. Specifically, β is constrained so that

$$\underline{\beta} \leq \beta \leq \overline{\beta} \tag{25}$$

The constraints associated with the upper and lower bounds for β are $\overline{\psi}$ ($\beta \leq \overline{\beta}$) and $\underline{\psi}$ ($\beta \geq \underline{\beta}$).

When the employee would buy additional shares if possible, the first-order condition for β, equation (21), becomes

$$E\{U'[S_1 + D(1-\tau_D) - g(S_1 - S_0) - S_0(1 + r + \omega(\phi - r))]\} - \overline{\psi} = 0 \tag{26}$$

for some $\overline{\psi} > 0$. When the employee would sell shares if possible, equation (21) becomes

$$E\{U'[S_1 + D(1-\tau_D) - g(S_1 - S_0) - S_0(1 + r + \omega(\phi - r))]\} + \underline{\psi} = 0 \tag{27}$$

for some $\underline{\psi} > 0$. With restricted shareholdings, we can write the certainty-equivalent return as

$$E[U'S_1] = E\left\{U'\left[S_0\left(1+\frac{r+\omega(\phi-r)}{1-g}\right)-D\frac{1-\tau_D}{1-g}\right]\right\}+\frac{\overline{\psi}-\underline{\psi}}{1-g}$$
$$= E\left\{U'\left[S_0\left(1+\frac{r}{1-g}\right)-D\frac{1-\tau_D}{1-g}\right]\right\}+\frac{\overline{\psi}-\underline{\psi}}{1-g} \quad (28)$$

The second line is obtained using equation (20). Again, by complementary slackness, at most one of $\overline{\psi}$ and $\underline{\psi}$ can be positive, with the other zero. With constraints on shareholding and no dividends, the certainty equivalent return exceeds $r/(1-g)$ if the employee is constrained from holding additional shares ($\overline{\psi} > 0$) and is less if the employee is constrained from holding fewer shares ($\underline{\psi} > 0$).

In theory the employee undertaking a Section 83(b) election could finance the tax payment either by borrowing or by selling shares. In practice, the employee will generally borrow to pay the tax since the restricted shares cannot be sold. However, for logical completeness we also consider the possibility that restricted shares can be surrendered to pay the tax. I now assume for simplicity that $D = 0$ and $B = 0$.

If the employee finances the tax payment by borrowing, time 1 wealth is

$$W_1 = [W_0 - \beta S_0 - B][1 + (1-\omega)r + \omega\phi] + (\lambda+\beta)[S_1 - g(S_1 - S_0)]$$
$$- \lambda(1+r)(\tau S_0 - B)] + (1-\lambda)[S_1 - \tau S_1] \quad (29)$$

As before, the problem is to maximize expected utility of period 1 wealth. The first-order condition for λ is

$$E\{U'[(\tau-g)(S_1-S_0) - r\tau S_0]\} + \underline{\lambda} - \overline{\lambda} = 0$$

Substituting equation (28) for $E[U'S_1]$, and using equation (20), we obtain

$$E(U')\left[-g(1-\tau)\frac{r}{1-g}S_0\right] + \frac{\tau-g}{1-g}(\overline{\psi}-\underline{\psi}) + \underline{\lambda} - \overline{\lambda} = 0 \quad (30)$$

Proof of Proposition 2 In equation (30), a necessary condition for $\overline{\lambda} > 0$ (the employee applies a Section 83(b) election to all shares) is that $\overline{\psi}$ (the constraint against buying additional shares) is sufficiently positive, i.e., the employee would buy additional shares if unconstrained. ■

Thus, strictly speaking, it is not that the employee must expect the share price to rise, but that the employee is holding fewer than the optimal number of shares given expectations.

If the employee sells shares to finance the tax, W_1 is

$$\begin{aligned} W_1 = &[W_0 - \beta S_0][1 + (1-\omega)r + \omega\phi] \\ &+ (\lambda + \beta)[(1-\tau)(S_1 - g(S_1 - S_0))] + (1-\lambda)[S_1 - \tau S_1] \end{aligned} \quad (31)$$

The first-order condition for λ is

$$E\left\{U'\left[(1-\tau)(S_1 - g(S_1 - S_0)) - (1-\tau)S_1\right]\right\} + \underline{\lambda} - \overline{\lambda} = 0$$

Using equation (20) and equation (28) to substitute for $E(U'S_1)$, we obtain

$$E(U')\left[-g(1-\tau)\frac{r}{1-g}S_0\right] - \frac{g(1-\tau)}{1-g}(\overline{\psi} - \underline{\psi}) + \underline{\lambda} - \overline{\lambda} = 0 \quad (32)$$

Equations (30) and (32) differ in the coefficient on $\overline{\psi} - \underline{\psi}$.

Proof of Proposition 3 When the employee sells share to finance the tax, $\overline{\lambda}$ can be positive only if $\underline{\psi} > 0$. That is, only an employee *overinvested* in the stock, given shareholdings and beliefs about returns on the stock, will undertake a Section 83(b) election with the tax financed by selling shares. If $g = 0$, equation (32) becomes $\underline{\lambda} = \overline{\lambda}$, which because of complementary slackness is only satisfied if both multipliers are zero, thus the shareholder is indifferent about a Section 83(b) election. ■

A.3 Borrowing Constraints

Finally, I analyze the case where borrowing is also constrained. Specifically,

$$0 \leq \omega \leq 1 \quad (33)$$

The constraints for ω are $\underline{\gamma}$ ($\omega \geq 0$, i.e., no short-selling the market portfolio)and $\overline{\gamma}$ ($\omega \leq 1$, i.e., no borrowing).

With this constraint, the first order condition for ω becomes

$$E[U'(\phi - r)] + \underline{\gamma} - \overline{\gamma} = 0 \quad (34)$$

As before, at most one of $\underline{\gamma}$ or $\overline{\gamma}$ can be positive.

For simplicity, assume again that $D = B = 0$. Substituting equations (28) and (34) into equation (22), we obtain the following first order condition for λ:

$$E(U')\left[-g(1-\tau)\frac{r}{1-g}S_0\right] + \frac{\tau-g}{1-g}(\overline{\psi}-\underline{\psi}) + \underline{\lambda} - \overline{\lambda} + g\frac{1-\tau}{1-g}S_0\omega(\underline{\gamma}-\overline{\gamma}) = 0 \quad (35)$$

Equation (35) assumes that the employee personally finances the payment of tax at time 0. Comparing equation (35) with equation (30), we can assess the effect of restrictions on borrowing and short-selling the market.

First, a restriction against short-selling the market does not explicitly affect the Section 83(b) election decision. If $\underline{\gamma} > 0$, then $\omega = 0$, and the last term in equation (35) drops out. If the employee is borrowing constrained, then $\overline{\gamma} > 0$ and $\omega = 1$. As one would expect, the borrowing constraint works against a Section 83(b) election when the employee must finance the tax payment.

Now we consider the case where the employee can borrow the funds to pay the tax. In this case, the first order condition for λ is

$$E(U')\left[-g(1-\tau)\frac{r}{1-g}S_0\right] + \frac{\tau-g}{1-g}(\overline{\psi}-\underline{\psi}) + \underline{\lambda} - \overline{\lambda} + \frac{\tau-g}{1-g}S_0\omega(\overline{\gamma}-\underline{\gamma}) = 0 \quad (36)$$

Because the coefficient on $\overline{\gamma}$ is positive, a sufficiently borrowing-constrained employee may choose to make the election as a way to relax the borrowing constraint.

Note that in all cases, the borrowing and short-selling constraints are multiplied by ω. If the employee is constrained from short selling the market, then $\omega = 0$ and the $\overline{\gamma}$ and $\underline{\gamma}$ constraints drop out of the first order conditions. Of course the binding constraint affects the marginal utility of consumption and other decisions and therefore, like any other constraint, has an indirect effect.

Appendix B Option Exercise

Consider an employee who receives a grant of one option and exercises the fraction ϵ at time 0, deferring until time 1 the decision to exercise the remaining $1-\epsilon$ options. Let $\overline{\mu}$ and $\underline{\mu}$ are the multipliers for the constraints

that $\epsilon \leq 1$ and $\epsilon \geq 0$. The employee pays $\epsilon[K + \tau(S_0 - K)]$ at time 0. I assume there are no restricted shares but that the employee can possibly trade shares outside the compensation account.

The time 1 payoff to a call is

$$\max[0, S_1 - K] = S_1 - K + \max[0, K - S_1]$$

Using this equation, we can write the employee's time 1 wealth as

$$\begin{aligned} W_1 = \{W_0 - \beta S_0 - \epsilon[K + \tau(S_0 - K)]\}[1 + (1-\omega)r + \omega\phi] \\ + [\epsilon + \beta][S_1 + D(1-\tau_D) - g(S_1 - S_0)] \\ + (1-\epsilon)(1-\tau)(S_1 - K + \max[0, K - S_1]) \end{aligned} \quad (37)$$

As before, substituting equation (28) for $E[U'S_1]$, and using equation (20), the first-order condition for is ϵ is

$$\begin{aligned} E\Big\{U'\Big[-(1-\tau)rK - (1-\tau)\max(0, K - S_1) \\ - g(1-\tau)\frac{r}{1-g}S_0 + (1-\tau)D\frac{1-\tau_D}{1-g}\Big]\Big\} \\ + \frac{\tau - g}{1-g}(\overline{\psi} - \underline{\psi}) + \underline{\mu} - \overline{\mu} = 0 \end{aligned} \quad (38)$$

Proof of Proposition 4 From equation (38), the certainty equivalent change in time 1 wealth from exercising marginally more options today is

$$\begin{aligned} -(1-\tau)rK - (1-\tau)E^Q[\max(0, K - S_1)] \\ - g(1-\tau)\frac{r}{1-g}S_0 + (1-\tau)D\frac{1-\tau_D}{1-g} \end{aligned} \quad (39)$$

where $E^Q(x) = E[U'(x)]/E[U']$. ■

Appendix C Changing Tax Rates

Suppose that the ordinary income tax rate is τ_0 at time 0 and τ_1 at time 1. Consider the case where the employee's shareholdings are unrestricted. Wealth at time 1, W_1, is

$$\begin{aligned} W_1 = [W_0 - \beta S_0 - \lambda\tau_0(S_0 - B) - B][1 + (1-\omega)r + \omega\phi] \\ + (\lambda + \beta)[S_1 + D(1-\tau_D) - g(S_1 - S_0)] \\ + (1-\lambda)[S_1 + D(1-\tau_D^*) - \tau_1(S_1 - B)] \end{aligned} \quad (40)$$

By substituting into equation (40) the first-order conditions for ω and β, which are unchanged from the case when tax rates do not change, the first-order condition for λ is

$$E\Bigg\{U'\Bigg[B(\tau_0(1+r)-\tau_1)+(\tau_1-\tau_0)S_0(1+r) \\ -S_0(1-\tau_1)g\frac{r}{1-g}+D(\tau_1-\tau_D^*)\Bigg]\Bigg\}+\underline{\lambda}-\overline{\lambda}=0 \quad (41)$$

To consider the exercise of an NQO, compare the cash flows from exercising the option at time 0 with those from holding the option until time 1 and buying $(\tau_1 - g)/(1 - g)$ shares. The payoff to the former strategy is

$$(1-g)S_1+gS_0+(1-\tau_D)D-(1+r)K-(1+r)\tau_0(S_0-K) \quad (42)$$

The payoff to the latter strategy is

$$(1-\tau_1)\max[0,S_1-K]+\frac{\tau_1-g}{1-g}\left[(1-g)S_1+gS_0+(1-\tau_D)D-(1+r)S_0\right] \quad (43)$$

Equation (16) gives the condition under which (43) is greater than equation (42).

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