Journal of Corporate Finance 15 (2009) 469–487

Contents lists available at ScienceDirect

Journal of Corporate Finance

journal homepage: www.elsevier.com/locate/jcorpfin

Liquidity and employee options: An empirical examination of the Microsoft experience☆

Don M. Chance*

William H. Wright, Jr. Endowed Chair for Financial Services; Department of Finance, Louisiana State University, Baton Rouge, LA 70803, United States

ARTICLE INFO

Article history:
Received 30 October 2008
Received in revised form 22 January 2009
Accepted 24 January 2009
Available online 5 February 2009

JEL classification codes:
G39
M52
G13

Keywords:
Employee stock options
Liquidity
Compensation
Turnover

ABSTRACT

In recent years several companies have offered employees the opportunity to transfer certain out-of-the-money options to a dealer. This paper examines one such high-profile program offered by Microsoft in 2003. The program was not very transparent in that employees were forced to decide whether to tender their options before knowing how much they would be offered, and it had only a modest rate of participation. Nonetheless, the market easily absorbed intense selling pressure as the options were transferred and hedged. The dealer, JPMorgan Chase, though profiting from the transfer, apparently failed to hedge the volatility risk it accepted from the employees and lost nearly the entire value it paid for the options. The overall experience has important implications for the design of programs that are intended to solve problems of low morale and increased turnover caused by underwater options.

1. Introduction

Human capital is a critical asset for every corporation. Cash is invested in employees in the form of compensation, training, and supporting costs on an ongoing basis in return for the long-term expectation of a return of cash from productivity. Options are part of many compensation schemes for numerous layers of employees, and they serve to motivate employees to remain with the firm and be productive. The characteristics of employee stock options trade off the cost of the options against the benefits they bring. Thus, how companies design, and in some cases alter, employee option contracts has important implications for corporate finance decisions.

One of the most consistent features of all employee options is that they have virtually no liquidity. They are designed to be held for a vesting period, after which value can be realized only by exercising them. When the options are out-of-the-money and prior to expiration, employees can realize no value in comparison to ordinary investors who can at least sell them to capture the remaining time value, however small. Employees below management level can easily feel that at the margin, their individual efforts cannot contribute significantly to bringing their options back in-the-money. At that point, the options cease to serve much purpose and can even have a negative effect given that employees accepted them in lieu of higher salaries.

To address this problem some companies have examined the possibility of providing a small degree of liquidity for their options. This study clinically examines one such effort, the employee option transfer program executed by Microsoft and J. P. Morgan Chase (JPMC) in the fall of 2003. The program provided that employees could receive cash and transfer certain out-of-the-money options to JPMC, which would convert the options into conventional over-the-counter options with reduced maturities. Although two smaller firms had

☆ This paper was presented at faculty seminars at Louisiana State University, Auburn University, the University of Massachusetts, George Washington University, Virginia Tech, and the University of Laval and at the Northern Finance Association and Southern Finance Association meetings. The author thanks Mary Ellen Carter, Steve Ferris, Patrick Dennis, Raman Kumar, Navroz Patel, Vijay Jog, Shiva Rajgopal, Lou Ederington, Jim Hilliard, Steve Ferris, Cliff Stephens, Chip Ryan, Pam Peterson, and the editors, Jeff Netter and Dave Denis, for helpful discussions and Tung-Hsiao Yang for research assistance.

* Tel.: +1 225 578 0372; fax: +1 225 578 6367.
E-mail address: dchance@lsu.edu.

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doi:10.1016/j.jcorpfin.2009.01.005

previously implemented similar programs, Microsoft was the first major corporation to provide employees with this means of essentially selling their options. As such, the program was a landmark event that could lead to significant changes in the design of employee compensation plans.

The Microsoft program provides insights into three issues. The first is in understanding the objective of a program designed to improve the employee compensation package at the expense of changing the illiquid nature of the instrument. The second is in how such a program should be designed to achieve success, whether defined as broad participation and a large number of options tendered or by granting an offer that employees will value but can choose to reject. The third is in observing the critical role played by financial markets and investment bankers in implementing such a program. Options are risky instruments and a transfer of options from employees to an investment bank shifts a firm's option holders from unhedged entities to hedged entities.

By providing an extensive and detailed examination of the program and an assessment of option value compared to offer price, we gain a deeper understanding of how employees perceive and are motivated by options and how firms consider the tradeoffs between liquidity, incentives, and retention. In addition to the implications for corporate management, this study also has important considerations for the role of investment banking firms in accepting risk transferred from employees. Because Microsoft is such a high-profile company and the program was so large and well-publicized, it provides an excellent laboratory setting in which to study these issues.

In understanding the first issue, it is important to realize that options are granted to non-executive employees for multiple objectives. Incentive justifications are common, as in Core and Guay (2001) and Kedia and Mozumdar (2002), while Holland and Elder (2006) show that options can be a low-cost source of capital. Oyer and Schaefer (2005) and Kole (1997) argue that options primarily encourage retention, in particular of more optimistic employees, a point we discuss later as an important function of transfer programs. Regardless of the reason, however, anecdotal evidence suggests that many relatively low-ranking employees became quite wealthy, at least for a time, from sharply rising stock prices. Falling stock prices, however, significantly lower the values of these options and leave employees with low incentives and reduced morale, which encourages turnover. Though estimates of the cost of turnover vary widely, most experts agree that it is extremely costly. Moreover, given differences in employee mobility, potential turnover is typically greater for the most talented employees. To address this problem, firms are faced with the difficult choice of raising salaries, repricing existing options, or ignoring the problem. Paying higher salaries can be a significant drain on cash flow, especially given that many firms use options to conserve cash. Empirical evidence shows that repricing options can reduce employee turnover (Carter and Lynch, 2004), but the practice is highly controversial and appears to have declined somewhat from its heyday in the late 1990s. Ignoring the problem is what most companies to date have done. The performance of the stock market in 2008, however, suggests that deep out-of-the-money employee stock options will again become a concern.

Standard practice in stock option design is to use vesting periods to encourage continued employment and productivity. Once the vesting period passes, the employee can freely exercise the option, and as Huddart and Lang (1996) show, a significant number do exercise their options at that point. Of course after exercise, employees are less motivated to remain with the company. In general, there is no provision for the employee to sell the option, as could an outside investor. Illiquidity is estimated to result in about a 30% discount off of the value of an option (Brenner et al., 2003). Even though a vested but deep out-of-the-money American option has value, that value is typically less, perhaps far less, than the value of a deep out-of-the-money option purchased on an options exchange. In some cases, firms could perceive that the costs of controlling turnover in this manner exceed the benefits. By injecting some liquidity into these options, firms could obtain a more beneficial tradeoff between costs and benefits and improve employee morale and incentives, while reducing the threat of turnover.

Another possible objective of an option transfer program is in reducing come of the dilutive effects of options exercised. As Weisbenner (2004) notes, much of the growth in share repurchases has been done to offset the issuance of shares upon option exercise. Option transfer programs can potentially solve the dilution problem at a similar or lower cost that repurchasing shares. But regardless of the reason, providing liquidity to an otherwise completely illiquid instrument greatly changes the nature of the instrument and has many implications for corporate policy in constructing future compensation plans.

The design of such a program is the second critical issue. Employee option valuation is a difficult process, having to account for illiquidity, vesting, and early exercise. There is an extensive body of literature (cited later) on this subject, but employees in general would have less of an understanding of option valuation than would executives, who would at a minimum have better access to specialized advice. Employees faced with the decision of whether to tender their options must estimate the values of their options and compare those values to the amounts offered. Hence, an offer should be simple and easy for employees to evaluate. But options in general are complex instruments, particularly when illiquid. A successful program must find a way of balancing the complexity of option valuation against the need to enable employees to make informed decisions. Otherwise, employees are likely to be confused and confusion can lead to a failure to find value in the program. Thus, transparency is extremely important.

The third important issue is in the role of financial markets and investment bankers. In deciding whether to tender their options, employees will take into account the position of these options in their tradeoff between risk and return. Although employees typically have less concentrated portfolios than executives, their wealth is, nonetheless, highly exposed to the performance of a single company, particularly when considering their human and reputational capital. There is an extensive body of literature and models on how employee option valuation is affected by this exposure (e.g., Huddart, 1994). A decision to tender might improve the employee's expected utility, but the risk does not disappear as it is merely transferred to another entity, the investment bank, which will engage in hedging transactions. The implications of this point cannot be underemphasized. Employees holding the options do not hedge the market risk of their positions for if they did, it would undermine the purpose of granting them the options. If the options are transferred to an investment bank, however, that bank will hedge its position. Thus, we can expect some selling of the stock or another derivative that could drive down the price of the stock, thereby imposing a critical cost on the program that might have been overlooked.

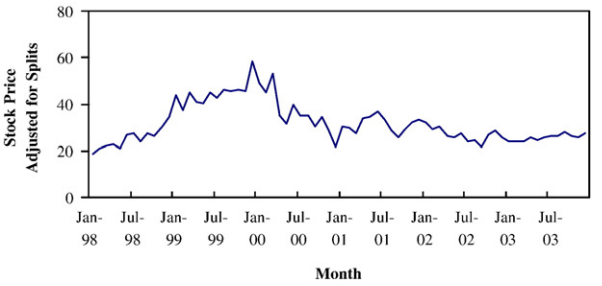

Fig. 1. Microsoft's stock price performance over the period 1998–2003. The stock price is adjusted for 2-for-1 splits on February 23, 1998, March 29, 1999, and February 18, 2003.

The paper is organized in the following manner. Section 2 provides details of the offer. Section 3 provides an empirical analysis of Microsoft's stock price behavior at critical times during the program. Section 4 examines the valuation of the option. Section 5 contains a discussion of the results. Section 6 provides conclusions.

2. Elements of the option transfer program

As noted, Microsoft is not the only company to offer its employees an opportunity to tender their options and receive cash prior to expiration. First we briefly review other programs.[1]

2.1. Programs of other companies

In August 2002, Siebel Systems, a Silicon Valley software firm, offered a cash payment of $1.85 or stock for each option tendered. The stock was at about $8, and the options had exercise prices of $40 to $109, with an average of around $50 and an average time to expiration of a little over eight years. Employees owed more than $5000 would receive cash, and others would receive stock, half of which was unrestricted. The program was highly successful in that about 90% of eligible options were tendered by about 68% of employees. Siebels stated that the amount offered exceeded the Black–Scholes values with expiration reduced to the expected exercise date for all eligible option tranches.[2] Employees would typically value an option at less than this adjusted Black–Scholes value, so the amounts offered appeared to exceed the values to the employee.

About a month later, Nvidia, a Silicon Valley provider of graphic chips, offered its employees the opportunity to exchange their options for stock. The offer applied to options with exercise prices ranging from $27 to $65, with an average of about $36 and an average maturity of more than seven years. Nvidia stock, which had traded as high as $71 only eight months prior, was selling for less than $9 at the time of the offer. The offer was stated as the right to tender an option and receive stock worth 3.2 times the number of shares underlying the option divided by $10.46, the closing price on October 24, 2002. Nvidia had approximately 20.6 million eligible options. The program was highly successful with 18.8 million options turned in. As with Siebels, Nvidia claimed that the offer exceeded the Black–Scholes values with appropriately reduced maturity, which would mean that the offer exceeded the values to the employees.[3]

2.2. The Microsoft agreement with JPMorgan Chase

Microsoft was founded in 1975 and went public in 1981. It had annual sales of about $32 billion, cash and cash-equivalents of about $49 billion, and net income of about $10 billion for fiscal year ending June 30, 2003. As seen in Fig. 1, however, Microsoft's stock had been generally falling from the beginning of 2000, at which time it was about $60. In mid-summer 2003, its market cap was almost $300 billion with about 133,000 shareholders and 10.8 billion shares outstanding. On July 8, 2003 with the stock at $27.70, Microsoft announced that it was exploring the possibility of a program to enable employees to receive cash for certain out-of-the-money options.[4] On October 9, 2003 Microsoft formally entered into a contract with JPMC (Microsoft, 2003a) for the latter

[1] Transfer programs should not be confused with programs designed to identify the values of options by creating a marketable analog to the employee option. In 2005 Cisco proposed an auction of a marketable option that would have similar characteristics to employee options and could be purchased by non-employee investors. The SEC, however, opposed the plan, though a similar plan of an online auction by Zions Bancorporation was approved and executed with some modest success in 2007 and 2008 (Mazumdar et al., 2007). These plans do not provide employees with liquid options. They only create an instrument that could be used for valuing employee options for expensing purposes, and that is a completely separate issue from the objective of this paper.

[2] Because all option tranches met this criterion, Siebels was able to avoid special accounting charges. See Schwanhausser (2002) and Siebels Systems (2002) for details of the program.

[3] See Nvidia (2002a), Nvidia (2002b) and Nvidia (2003). As with Siebels, this assertion was made to support it not taking a special accounting charge.

[4] On that same day, Microsoft announced that it would no longer award stock options and that it would take a large write-off to expense existing options, which was prior to when accounting standards required expensing. An event-study analysis centered on that day shows slightly rising abnormal returns prior to the announcement and slightly falling abnormal returns afterwards but the announcement day reaction is not significant. Given that three announcements were made on that day, it is difficult to attribute whatever information there was to any one of the three announcements.

to provide assistance for the employee option transfer program. The offer applied to vested and unvested options and share appreciation rights with exercise prices of at least $33 that expire on or after February 29, 2004. Approximately 624 million options, about 40% of outstanding options and 6% of outstanding shares, held by about 37,000 of the approximately 55,000 employees of Microsoft were eligible for the program.

JPMC would be exclusive counterparty to the options but would not provide any legal, accounting, or tax advice. The options would be converted into over-the-counter American-style options, with terms and conditions governed by the standard ISDA (International Swaps and Derivatives Association) agreement. The transformed options were partially dividend-protected, allowing for an adjustment in exercise price if dividends paid were not the amounts anticipated and specified in the agreement. This feature became particularly valuable to JPMC when Microsoft paid a special dividend of $3 a share in December 2004. It is not clear whether JPMC reserved the right to sell the options to another party, but there is no such indication in the documents. JPMC's stated intention of delta-hedging the options would suggest that it planned to hold them until expiration.

Microsoft agreed to pay JPMC an up-front non-refundable fee of $6 million, and if more than 50% of the options were tendered, an additional fee of $4 million. If more than 75% of the options were tendered, another fee of $5 million would be earned. Microsoft would also pay JPMC $0.02 per share for each share that the bank sold to establish a hedge, which could total another $12.7 million. JPMC would pay Microsoft for the options within three business days after the end of the averaging period. JPMC would not be liable to shareholders or creditors for any matter related to the program and retained the right of first refusal to participate if any other arrangements of this sort were undertaken by Microsoft during the next two years, although Microsoft stated that it did not expect to do this program again.[5] Microsoft determined that there was no legal requirement that it get shareholder approval, and it did not directly inform its shareholders, although the program was well-publicized.

Each employee had until midnight November 12, 2003 to decide whether to tender her options. A decision to tender applied to all options held by the employee, an important point because some options might be worth tendering while others might not. A decision to tender before the deadline, could be revoked up until the deadline. Microsoft reserved the right to cancel the program any time up until March 24, 2004. The program was offered to employees in over 70 countries, with the exception of Belgium, Italy, and Pakistan, where legal and tax matters made the program impossible or inadvisable. The program was not available to Board members, thus excluding Chairman Gates and CEO Ballmer. The program was, however, open to non-board-member executive officers, who held about 41 million options, about 6.5% of the eligible options.

The expiration dates of many of the tendered options would be reduced. Expirations of more than 36 months would be reduced to 36 months. Certain options called multi-year awards, which were mostly held by high-ranking executives, would have their expirations reduced to 24 months. Most options with maturities less than 36 months would retain their original expirations, though the multi-year awards with expirations more than 24 but less than 36 months would be reduced to 24 months. Although Microsoft would receive the funds from JPMC, it guaranteed to the employees that it could make the payments from its cash on hand. Thus, Microsoft provided a credit guarantee for JPMC.

2.3. Overview of the outcome

To better analyze the program, it is instructive to know what eventually happened. The stock price was sampled over the period November 17 through December 8, resulting in an average price of $25.572. A total of 18,503 employees (about 50%) tendered about 344.6 million options, which was about 55% of the number that could have been tendered, and received payments of about $382 million, an average of $1.11 per option. Of this total, about $218 million was paid up front with the remainder to be paid with interest over several years, subject to continued employment with the company. The tendered options represented about 22% of the outstanding options and about 3.3% of the outstanding shares.

2.4. Determining the amount offered for an option

Microsoft stated that the option value offered to the employees would be determined "in part by reference to Black–Scholes and other option pricing models." (Microsoft, 2003a). As noted, these options were American-style, so the reference to "other option pricing models" is most likely a reference to a binomial or finite-difference model that captures early exercise, which would be induced only by dividends. But the impact of dividends here is small. As we examine in more detail later, Microsoft had been paying a very low dividend and tendered options are protected against changes, further minimizing the effect of early exercise on the option value.

The amount offered would be based on the average closing price from the first business day following the second calendar day after the deadline and ending 15 trading days later. Given the Thanksgiving holiday, this would define the averaging period as November 17 through December 8, though extendable as late as December 15 if trading disruptions had occurred. The averaging procedure would be based on rounding up the price to the nearest 1/10,000 of a dollar.

If the amount owed an employee were less than $20,000, then the employee would receive the money more or less as soon as possible and no later than December 31, 2003. If the amount owed exceeded $20,000, the employee would receive one-third of

[5] It is easy to see that such a designed program would probably contain a statement indicating that the company did not plan to do the program again. Otherwise, the potential for further liquidity windows in the life of the option might encourage employees to not participate until a later date.

the amount by December 31. The remaining amounts would be paid with interest at the Treasury bill rate in either one or two installments, depending on the employee's rank, by December 31, 2005 and December 31, 2006. All amounts paid would be net of withholding taxes and some other unspecified fees.

A potentially important feature is that continued employment with Microsoft would be required to receive these deferred payments. The more the employee is owed, the longer she would have to continue working for Microsoft to receive full payment. Thus, for some employees the program had a vesting requirement.

2.5. Microsoft's advice to employees

Microsoft provided a web site from which employees could determine how much they would receive, given the terms of the option and the average stock price over the averaging period. Of course, an employee would not know the average stock price before having to make the decision. Microsoft did not make any statements to suggest that the averaging process would help the employee, but averaging reduces the risk from unusual price behavior near the end of the averaging period and would make it easier for the employee to forecast the value of the option.

In an email to employees at the time of the announcement, CEO Steve Ballmer (Ballmer, 2003) stated that options with exercise prices of $33 could likely be sold for about $2, with options with exercise prices of $42 worth about $0.60, and options with exercise prices of $45 valued at about $0.25. Of course, these figures were just rough estimates designed to give the employees a general idea of how much money they might receive.

The agreement specified that JPMC would engage in sales of stock during the averaging period. Microsoft alerted employees that JPMC would sell an approximately equal number of shares each day during the averaging period and would then buy back some of these shares. It also noted that JPMC might use derivatives, which could have an impact on the stock price. These sales would be executed for the purpose of complying with certain regulatory requirements and ultimately establishing a hedge against the bank's acceptance of the short option positions. Microsoft heavily advised its employees that this selling pressure could result in significant declines in the price of the stock, and therefore lead to a lower average price and lower option value.

Microsoft made clear that it was making no recommendation on whether an employee should take the offer. This point suggests that perhaps Microsoft was not encouraging employees to tender, which suggests that its objective in offering the program was only to provide employees a morale-boosting device. But the absence of explicit encouragement to tender does not mean that Microsoft was indifferent. Indeed, the all-or-nothing requirement strongly suggests that Microsoft probably wanted to get as many options as possible off the books. In addition, the incentive payments to JPMC also suggest that it was not indifferent about the success.

Microsoft did give employees some advice. It recommended that a decision be a function of a number of factors including the outlook for the stock, the likelihood of continuing employment, the employee's risk tolerance, the current option vesting period, the employee's need for cash, and tax considerations. Microsoft also identified the standard variables that affect the value of a traded option. It mentioned the Black–Scholes model but noted that the model was not entirely appropriate for non-traded options. Microsoft also provided a brief explanation of the difference between implied and historical volatility.

Microsoft obtained a private letter ruling from the IRS that tendering would not be a taxable event nor would the Doctrine of Constructive Receipt apply. Thus income offered but declined would not be taxable.

2.6. The costs to Microsoft and JPMC

Microsoft estimated that employees would receive from $313 million, based on an average stock price of $22 and option value of $0.50, to almost $2 billion, based on an average stock price of $32 and option value of $3.18. It estimated overall costs at $4.5 million, not counting fees of $6 to 15 million, and $0.02 per share sold. Microsoft also paid an SEC registration fee of about $1.4 million for filing form S-3, to be discussed later. These figures suggest that total costs would range from $11–$33 million. Given the effectiveness of the program with about 55% of options tendered, total costs should have been around $22 million.

As noted, at the time of the announcement Microsoft stated that it would begin expensing its employee options. As a result of the transfer program, it had to accelerate the expensing of unvested tendered options, which resulted in a charge to earnings, a tax deduction, and adjustments to its deferred tax account.

2.7. Regulatory approval

As Hall (2004) notes, one of the beneficial effects of Microsoft's program is that it cleared many apparent regulatory hurdles and could open the door for further programs. Microsoft asked the SEC for relief from certain regulatory provisions of Rules 13-e and 14-e, which relate to tender offers. Microsoft argued that a precedent had been established in matters previously addressed by the SEC in regard to option repricing and employee stock purchase programs used by other firms that might be construed as applicable to the transfer program. The SEC provided a no-action letter (United States Securities and Exchange Commission, 2003a) on October 15, which meant that it did not object to nor would it apply these rules to the program. Microsoft did, however, file SEC form S-3 on September 16, which stated that JPMC would sell up to 635 million shares, some of which could be borrowed. (United States Securities and Exchange Commission, 2003b). It also filed Schedule TO on October 15, treating the program as a tender offer (United States Securities and Exchange Commission, 2003c).

2.8. The risk to JPMorgan Chase

In typical over-the-counter option deals, JPMC would buy options from a seller that might be another dealer, a corporation, or a hedge fund. Dealers and hedge funds would be fairly sophisticated investors and should be able to easily assess the value of an option. Corporations would vary in their ability to value these options accurately, but all companies could arrive at a Black–Scholes value. Employees of Microsoft could, with the help of Microsoft, surely estimate the offer prices as Black–Scholes values, conditional on an assumed average stock price, but would have some difficulty assessing their own perceived values of the options, given such factors as illiquidity and vesting requirements. As in most over-the-counter trades, the dealer has an advantage in that it can trade the option at a price that buyers will pay or sellers will accept and hedge with a dynamically adjusted combination of stock, bonds, or other derivatives. The greater the information advantage, the more value that can be extracted by the dealer. From the perspective of JPMC, the program is an opportunity to use a hedge strategy to synthetically sell over-the-counter options for more than it pays. Nonetheless, JPMC bears some risk as well. Although a delta hedge is intended to be risk-free, no delta hedge is ever perfect. In addition, there are some risks faced by JPMC in setting up the delta hedge, which we shall examine.

Because of the large size of the transaction, JPMC could not sell short all of the shares at the instant at which it took title to the options. It, thus, began selling short during the averaging period and priced the offer based on the average stock price during that period. Prior to the beginning of the averaging period and before the time at which it determined the number of options that would be tendered, it filed a registration statement with the SEC to sell 635 million shares, which was slightly above the maximum number that could be tendered. A delta hedge would require no more than this number of shares. In all likelihood it would sell less, perhaps far less, given that the options were deep out-of-the-money. But because of regulatory requirements, it committed to sell one share for every option tendered. Hence, it would have to oversell the stock and buy back any excess shares. Thus, JPMC would need to sell as many shares as options tendered, but any excess shares would be repurchased on the same day. Ultimately it would be left with a delta-hedged position.[6] Let us analyze JPMC's position in setting up the hedge. First, we assume a zero interest rate, which is reasonable given the low rate of interest at that time and the very short length of the averaging period.

Let S_0 be the price at the beginning of the averaging period, S_τ be the price at the end, and $\overline{S}$ be the average stock price during the period. We standardize this analysis with an assumption of one share. At the end of the period, JPMC will need h_τ shares where h_τ is the delta-hedge ratio at the end of the period given the stock price S_τ. Of course, it does not know this stock price, so it does not know this hedge ratio at the beginning of the period. We assume that it estimates that the end-of-period stock price is the beginning-of-period stock price, which is probably reasonable given the short length of the period. Therefore, the estimated hedge ratio is h_0, given S_0.

During the averaging period, it sells short h_0 shares with an equal number each day. At the end of the period, cash proceeds will be $h_0\overline{S}$. It then determines that the actual number of shares required is h_τ, which could mean that it must short more shares or that it must buy back some shares. We can express this effect by stating that it must short $h_\tau - h_0$ additional shares at the price S_τ. It would then be short $h_0 + h_\tau - h_0 = h_\tau$, the proper number of shares. It will then acquire an option paying $c(\overline{S})$ and receive an option worth $c(S_\tau)$.

We can now determine an expression for JPMC's position when the hedge is in place. It will have a liability of $h_\tau S_\tau$ short shares, plus $h_0\overline{S}$ in cash proceeds received from the short sales, $(h_t - h_0)S_t$ in cash proceeds (outlay if negative) from the final adjusting transaction, plus $c(S_\tau)$ in option value, minus $c(\overline{S})$ paid for the options, for a net position of $h_0(\overline{S} - S_\tau) - (c(\overline{S}) - c(S_\tau))$. Define this expression as the gain to JPMC:

$$G = h_0\left(\overline{S} - S_\tau\right)\ \left(\mathbf{c}(\overline{\mathbf{S}})\ \ \mathbf{c}(\mathbf{S}_\tau)\right)$$

In a world of perfect foresight, the initial hedge ratio h_0 would equal the final hedge ratio h_τ. In that case, the gain would be $h_\tau(\overline{S} - S_\tau) - (c(\overline{S}) - c(S_\tau))$, which would be a perfect delta-hedge position for an infinitesimal difference between $\overline{S}$ and S_τ. So for a perfect hedge,

$$h_\tau\left(\overline{S} - S_\tau\right) = c\left(\overline{S}\right) - c(S_\tau)$$

for $\overline{S} - S_\tau \to 0$. The gain to JPMC can now be restated as

$$G = h_0\left(\overline{S} - S_\tau\right) - h_\tau\left(\overline{S} - S_\tau\right) = \left(\overline{S} - S_\tau\right)(h_0 - h_\tau).$$

By definition, these hedge ratios are

$$h_0 = \frac{\partial c(S_0)}{\partial S_0}, \quad h_\tau = \frac{\partial c(S_\tau)}{\partial S_\tau}.$$

[6] Recall that Microsoft would be paying JPMC a fee of $0.02 per share sold to establish the delta hedge. JPMC might be tempted to sell short an excessive number of shares, pocketing this fee, and hedging with a long position. This strategy would probably not cover transaction costs, however, and even if so, it would require that JPMC intentionally take advantage of one of its prime clients, which seems unlikely.

Table 1
Monte Carlo simulation of hedge establishment strategy.

Initial stock price (S_0)	$25.98				
Initial delta (h_0)	0.3011				
Initial gamma (G_0)	0.0254				
	Average	Standard Deviation	95% low	95% high	%>0
Final stock price (S_τ)	$26.01	$1.87	$22.26	$29.75	
Average stock price (S_τ)	$25.99	$1.12	$23.75	$28.23	
Final delta (h_τ)	0.3066	0.0474	0.2119	0.4013	
$\overline{S}_0 - S_\tau$	−$0.03	$1.87	−$3.77	$3.72	50.74%
$\overline{S} - S_\tau$	−$0.01	$1.04	−$2.09	$2.06	50.77%
Profit/loss from hedging strategy	$14.65	$23.05	−$31.45	$60.76	82.55%

The simulation is based on the assumption that 344.6 million options are tendered, the options all have an exercise price of $40 and an expiration, which has been contractually shortened, of three years. The volatility is 30%. The averaging period is 15 trading days and 21 calendar days. The stock price at the beginning of the averaging period is $25.98, and the dividend yield is 1%. The risk-free rate for the three-year options is 2.31%, the continuously compounded equivalent of the three-year U. S. dollar swap rate. Interest is ignored during the averaging period. The number of simulation runs is 100,000.

The change in the hedge ratio h_0 is

$$dh_0 = \frac{\partial h_0}{\partial S_0} dS_0 = \frac{\partial \left(\frac{\partial c(S_0)}{\partial S_0}\right)}{\partial S_0} dS_0 = \frac{\partial^2 c(S_0)}{(\partial S_0)^2} dS_0 = \Gamma_0 dS_0.$$

This expression is the option's gamma times dS_0 and must equal $dh_0 = h_\tau - h_0$. Thus,

$$-dh_0 = h_0 - h_\tau = \Gamma_0 (S_0 - S_\tau)$$

Hence,

$$G = (S_0 - S_\tau)\left(\overline{S} - S_\tau\right)\Gamma_0.$$

This expression provides a simple approximation of the gain or loss from the strategy to establish the hedge. Gamma is always positive for long option positions so JPMC benefits if the final price is lower than the initial price and the average price is higher than the final price, or if the final price is higher than the initial price and the average price is lower than the final price.

We estimate the performance of the hedge with a Monte Carlo simulation. One immediate problem encountered, however, is that each trial results in an average stock price that must be inserted into an American option pricing model. The most likely candidate for an American option pricing model is a binomial tree that reflects the potential for early exercise. Unfortunately, attaching a binomial tree to the end of a Monte Carlo simulation leads to an extremely intense and slow computational process. Fortunately, the very low dividend and the dividend protection feature of the agreement mean that the Black–Scholes model could be a reasonable proxy for an American option price. We compare Black–Scholes values with American option values obtained using a binomial tree for a range of exercise prices and expirations appropriate for these options and find a maximum difference of less than one cent in price, less than 0.06 in delta, and less than 0.0002 in gamma.[7] These values are sufficiently small that we can henceforth price the options quite accurately using the Black–Scholes model.

We assume that the options have an exercise price of $40 and are converted to three-year options.[8] We use 100,000 trials and assume that 344.6 million options are tendered. The results are summarized in Table 1. At the beginning of the averaging period, the stock is at $25.98, the delta is 0.3011, and the gamma is 0.0254. The average final price and the average of the average price are both within pennies of the original price, but the average final price has a volatility of $1.87, while the average of the average price has a much lower volatility of $1.12. The average final delta is 0.0055 higher than the original delta, and the volatility of the delta is about 0.05. As noted above, the performance of JPMC's hedging strategy is the product of the gamma and the differences between the initial price and final price and the average price and final price. The average difference between the initial price and final price is −$0.03 and the average difference between the average price and final price is −$0.01. Hence, the average profit is positive. We see that this average profit is about $14.65 million with a standard deviation of $23.05 million.

Note that the two price differences are positive about half the time, but the overall profit is positive over 82% of the time. Hence, the two price differences tend to be both positive or both negative. These two conditions that lead to positive profits are $S_0 > S_\tau$ combined with $\overline{S} > S_\tau$ and $S_0 < S_\tau$ combined with $\overline{S} < S_\tau$. The first condition is simply that the price falls over the averaging period and the average price is higher than the final price. The second is that the price rises over the averaging period and the average price is lower than the final price. These conditions are frequently met because a random variable with a positive drift will often have its average lie between the initial and final values.

[7] Details about the choice of volatility, time-to-expiration, dividend yield, and exercise price are provided in Section 4.
[8] These values are rounded off versions of the average strike of $38.56 and maturity of 2.9 of eligible options as reported by Microsoft.

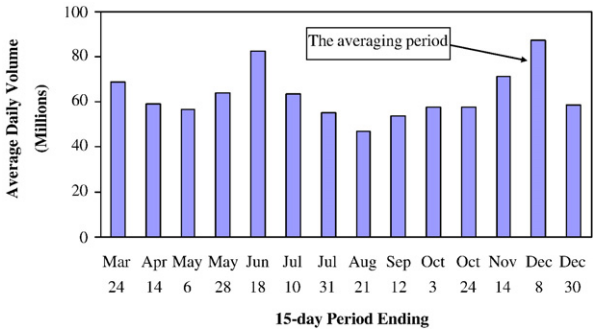

Fig. 2. Average daily volume over contiguous 15-day periods during 2003. The earliest period starts shortly after February 18 on which there was a stock split.

In addition to profits from the trading strategy, JPMC would collect interest on the proceeds from the short sales, which was not factored into the above analysis. Thus, we see that, while JPMC does bear some risk, the strategy to establish the hedge would appear to have great potential. As noted above, JPMC does bear some second-order (gamma) risk, which we shall discuss later. In addition, it assumes some volatility (vega) risk that we also discuss later.

3. Market activity during the averaging period

As noted earlier, one of the key issues in whether transfer programs can be successful is in the role played by financial markets. Employee options are held by investors who maintain exposed positions. Indeed, firms want their employees exposed to the performance of the stock. When options are transferred to investment bankers, however, those bankers become dealers. Indeed, most large investment banking firms are already option dealers, and they typically and perhaps by law are required to hedge their positions. Hedging entails the selling or short selling of stock or an analogous derivatives transaction that can drive down the price of the stock.[9] Since the transfer program is implemented over a short period of time, there may indeed by intense pressure on the price of the stock.

Microsoft is certainly one of the most liquid of all stocks, and it is tempting to dismiss this issue, admittedly with the benefit of hindsight. But Microsoft provided extensive warnings to employees about the possible effect of JPMC's trading on the offer price of the options. Consider the following language directed at the employees, which appeared in the tender offer (United States Securities and Exchange Commission, 2003c):

> JPMorgan has informed us that it intends to enter into market transactions to hedge its exposure to the ownership of the Eligible options, as amended. … If these sales decrease the market price of our common stock during the Averaging Period, this would cause you to receive a lower price for your Eligible Options under the Stock Option Transfer program. … Any of JPMorgan's market activities with respect to our common stock may affect the market price and volatility of our common stock. (pp. 10–11)

> JPMorgan expects to sell approximately equal numbers of shares each day during the Averaging Period. These sales could have the effect of decreasing the market price of our common stock. It is possible that the Average Closing Price will be substantially below prevailing prices during the Election Period. It is also possible that prices during the Averaging Period could rise so that some Eligible Options would be in-the-money or close-to-being-in-the-money. (p. 15)

It would seem virtually impossible for employees to ignore this concern. In this section we examine how well financial markets worked in absorbing this selling pressure.

3.1. Trading activity during the averaging period

Prior to knowing the number of options tendered, Microsoft registered with the SEC for JPMC to sell up to 635 million shares. This committed for JPMC to sell as many shares as were tendered, which exceeds the number needed to establish the delta hedge. As noted, it stated that JPMC would buy back the excess shares the same day it sold them. At the beginning of the averaging period, JPMC knew how many shares were tendered. It committed to sell an equal number of shares each day during the averaging period to establish an approximately delta-hedged position. At the end of the averaging period, the average price would be known, which would determine the amount to be offered for the options and the delta of the options. At the end of the averaging period, JPMC would then make some final trades to fine-tune its position. As previously shown, a rough approximation of the delta of a typical out-of-the-money three-year Microsoft option would be about 0.3. Thus, JPMC would need to short about 103 million shares over the averaging period or about 7 million a day. Of course at the end of the averaging period it would determine the correct amount it needed and would make some residual trades to get the delta-hedged position finalized. Having committed to sell 345 million shares over the averaging period, it would therefore sell an

[9] If the dealer sells calls or forwards or buys puts, it transfers the risk to another entity, which in all likelihood would itself engage in hedging.

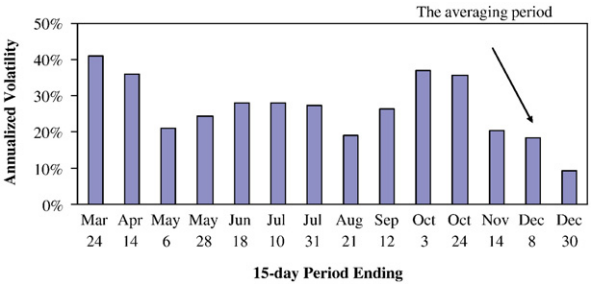

Fig. 3. Volatility over contiguous 15-day periods in 2003. The earliest period starts shortly the February 18 stock split. Volatility is the annualized standard deviation of the log return without dividends.

additional 242 million shares at a rate of about 16 million a day, but it would repurchase these shares on the same day. Hence, these seemingly excess shares, sold to comply with regulations and bought back, would affect volume but would not likely affect price.

We might expect most of the buying activity to finalize the hedge to occur in the first few days of the period following the averaging period.[10] Starting with the averaging period, we divide all other prior days in 2003 into non-overlapping 15-day periods, going back to the beginning of March, which is well past the February 18 date of a 2-for-1 stock split.

The average daily volume during the averaging period was about 87 million shares. Fig. 2 shows the average daily volume for these 15-day periods. Note that the averaging period had the largest average daily volume, but there is an upward trend in volume from the period ending August 21. Note also that volume for the 15-day period following the averaging period is down substantially from the averaging period. Recall that JPMC would be selling about 242 million shares during the averaging period to comply with regulations but would also buy these back. Purchases and sales would amount to about 32 million a day. It would also sell about 7 million shares daily to establish its delta hedge. Thus, an approximation of incremental daily volume is about 39 million shares. If these shares are removed, the daily average during the averaging period is about 48 million. Average daily volume for the other periods is about 61 million shares.

The days during the averaging period are well-represented in a ranking of the highest volume trading days of the year, with the year defined as the period following February 18, the split day. The averaging period represented 6.79% (15 of 221 days) of the post-split trading days of 2003. Thus, we would expect that $10*0.0679 = 0.679$ days would be in the top 10, $20*0.0679 = 1.358$ in the top 20, and $40*0.0679 = 2.716$ in the top 40. Days during the averaging period were three of the top 10 trading days of 2003, 7 of the top 20, and 11 of the top 40. Thus, it does appear that volume is notably higher during the averaging period.[11]

As noted, volume is down in the post-averaging period, but this period includes the holiday season and the final days of the year, when trading is typically light. Volume immediately following the averaging period was about 103 million (the 10th largest volume day of the year), 83 million, 79 million, and 69 million before dropping off sharply and averaging 61 million for the full 15-day period following the averaging period. Thus, there was large volume following the averaging period, which is likely to due to JPMC setting up its delta hedge.

3.2. Stock price performance during the averaging period

Using the same set of 15-day periods, we estimate the volatility of daily returns. During the averaging period, the annualized volatility was 18.37%. Fig. 3 shows the volatility of contiguous 15-day periods. The averaging period had one of the lowest volatilities of all of the 15-day periods, and the volatility for the two surrounding periods is also quite low. Volatility for the period following the averaging period, which could include the effect of the aforementioned buying pressure, was only 9.21%. For the period in 2002 comparable to the averaging period, the volatility was 29.52%. While seasonality could explain some of this effect, there is no indication that volatility during the averaging period was unusually high. The additional liquidity provided by JPMC could have even contributed to lower volatility. In addition, buying in the period following the averaging period could also have contributed to lower volatility.

Now let us examine the performance of the stock. On November 14, the day before the averaging period began, the stock closed at 25.50. On December 8, the end of the averaging period, the stock closed at 26.24, a return over 2.9% over the averaging period. By comparison, the S&P 500 increased about 1% over that period. Fig. 4a shows the abnormal returns (ARs) for each day of the averaging period estimated with the Fama–French three-factor model. There is no indication that the ARs are uniformly positive or negative and none are statistically significant. Eight are positive and seven are negative, with the average being 0.08%. Fig. 4b shows the abnormal returns for the period following the averaging period. Note that there are large positive abnormal returns for the first two days following the averaging period. These are likely to derive from JPMC's buying pressure. On the third day, however, the return is negative. For the full period, there are seven positive and eight negative abnormal returns with none significant.

[10] Of course, in maintaining a delta hedge, JPMC will trade on a regular basis throughout the remaining life of the option, buying and selling shares as needed. But the number of shares bought and sold would probably not be large relative to other trading in the stock. Microsoft exchange-traded and other over-the-counter options are delta-hedged on a regular basis by options dealers. It is the large number of trades required in a short period of time to put the hedge in place that could have a significant impact on the price.

[11] The day with the highest volume was October 24, the day following Microsoft's first quarter earnings announcement. The stock fell sharply from $28.91 the day before to $26.61 on 210 million shares of volume.

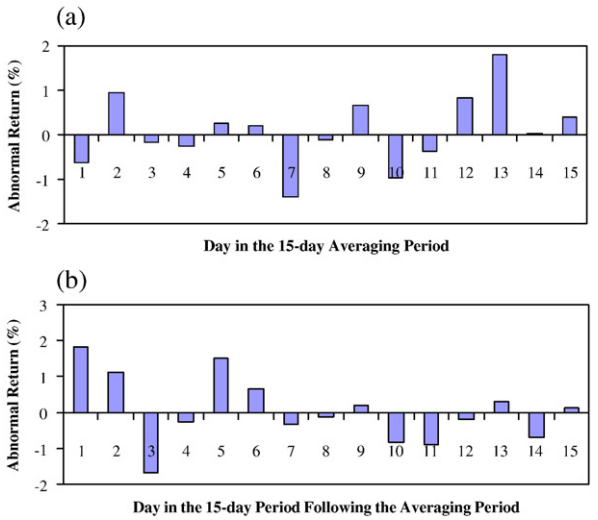

Fig. 4. a) Abnormal returns for the 15-day averaging period, November 17 through December 8. Abnormal performance is estimated using a Fama–French three factor model with sensitivities estimated over the period June 21, 2002 through June 20, 2003. b) Abnormal returns for the 15-day period following the averaging period, December 9 through December 30. Abnormal performance is estimated using a Fama–French three factor model with sensitivities estimated over the period June 21, 2002 through June 20, 2003.

In summary, stock price performance during the averaging period was not unusual. Volume was somewhat higher, and the stock had a return of almost 3% and a relatively low volatility (compared to earlier months) of about 18%. For the period following the averaging period, the stock had a return of 4.9% and a volatility of 9.21%. It appears that the market easily absorbed the intense volume of short selling and may have even benefited from it.

4. Valuation of the option

A critical aspect of the program is how employees value the option in comparison to the amount offered. To value the options we need to know their characteristics. Eligible options had to have an exercise price of at least $33. Microsoft's 10-K for the fiscal year ending June 30, 2003 (Microsoft Corporation (2003b) states that there were 387 million options with strikes of $33.01 to $41 and an average expiration of 3.2 years and 264 million options with strikes of $41.01 to $59.56 and an average expiration of 2.4 years.[12] Examining the split-adjusted stock price and the 10-K's for 1994–2004 reveals that the options had to have been issued in a fairly narrow window, between early December 1999 and mid-January 2002. Microsoft issued most of its options with seven-year maturities and 4.5-year vesting periods. There were probably only a few options struck above $50, because the stock price was above $50 only for a brief period, December 1999 through March 2000. If seven-year options were granted during that period, they would have maturities of at least 3.5, which seems unlikely for a sample reported as having an average maturity of 2.4 and with no offsetting short-term options in that same strike range having been previously issued. By the time of the transfer in December, any such options would have maturities of about three years and would vest in about one-half year. But since there were at least some options with these high strikes, we will examine options struck at 50 and 60 with three-year maturities, vested in 0.5 years. Most options are likely to be in the strike range of 33 to 45. Given when the stock was in this range, these options could have maturities of from two to five years. For options in this range, we will examine strikes of 33, 40, and 45. Considering the dates on which the stock was at these prices, representative maturities would be two and five years for the 33s, and 2.5 and 3.5 years for the 40 s and 45 s. The two-year options are vested, the three-year options vest in 0.5 years, and the five-year options vest in 2.5 years. For options with maturities of more than three years, offer prices are based on a reduced maturity of three years as prescribed in the agreement.

In its 2003 10-K Microsoft stated it priced its 2001, 2002, and 2003 options using risk-free rates of 5.3%, 5.4%, and 3.9%. These rates seem to corresponded to the seven-year Treasury constant maturity rate. But the appropriate rate for evaluating the offer is explicitly stated in a document called “Call Option Transaction Confirmation with JPMorgan Chase Bank” that Microsoft filed with the SEC (Microsoft, 2003c). It specifies that the risk-free rate would be the U. S. Dollar LIBOR swap curve, converted to a continuously compounded equivalent. We obtain these figures from the Federal Reserve's data base for maturities of 2, 3, 4, and 5. For options with maturities of 2.5 and 3.5 years, we round down to the two- and three-year rates, respectively. Option valuation results are not particularly sensitive to the risk-free rate.

Microsoft's 10-K for 2003 indicated that it used a volatility of 39% in pricing its 2001 and 2002 options and 42% for its 2003 options. Its historical volatilities for 2001 and 2002 were just slightly higher at 43.1% and 42.6%, respectively. While these figures

[12] These figures add up to 651 million options, which is slightly more than the 635 million eligible options. The difference probably represents options held by board members, who were ineligible for the program.

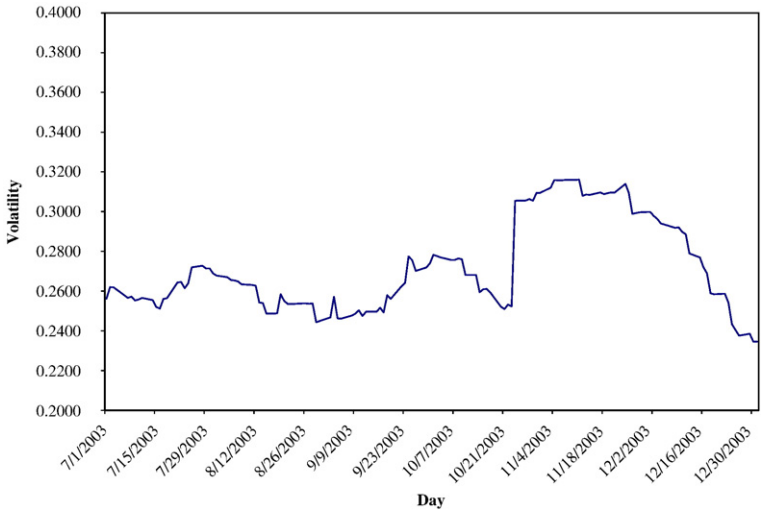

Fig. 5. Rolling annualized 60-day volatility of Microsoft stock for the second half of 2003. Volatility is the annualized standard deviation of the log return estimated using a 60-day rolling window.

represent the volatilities at which it priced those options, they are not particularly current as of 2003 and would not be reasonable for valuing the options when analyzing the offer. The 42% figure that it quoted in its 2003 10-K at which it priced the options seems to greatly overstate the true current volatility. At no time during 2003 did the rolling 30-, 60-, or 90-day volatility get as high as 40% and was around 32% at the time of the offer. Fig. 5 shows the rolling 60-trading day volatility of the continuously compounded return on the stock for the last six months of 2003. Volatility averaged from 23 to 32%, with a sharp spike in late October, which probably corresponded to the first quarter earnings announcement that generated record trading volume. Sixty-day volatility was 30.8% on the decision day, November 12. We shall use a volatility of 30% but will also check the sensitivity of the results by examining volatilities of 25% and 35%.[13]

Awash with almost $50 billion in cash, Microsoft began paying dividends in February 2003. We assume that the annual dividend of $0.24 paid in 2003 will be continued. Based on the stock price of $25.98 on November 12, this is equivalent to a yield of 0.92%, which we round to 1%.

4.1. The effect of uncertainty in the decision process

On November 12 the employee must estimate two values: the current value of the option and the current value of the offer. Clearly the decision to tender is a risky one, as these values are not known when the decision must be made. For now, we shall disregard this risk and will estimate the values of the offer and the employee option value. We will address the risk later. Replicating the manner in which the employee would decide whether to tender, on November 12 we determine the offer price for December 8, conditional on information available on November 12. We then determine the value of the option to the employee.

4.2. The effect of the averaging period

Options that pay off based on the average stock price over a defined period of time are called Asian options, and are well known for being difficult to value. While the offer may appear to be an Asian option, it is not. In an Asian option, the average price is inserted into a standard payoff formula, and stepping back, a valuation formula or procedure is then derived. In the Microsoft option, the valuation formula is that of a standard option, but the average price is inserted instead of the current price. Nonetheless, valuation of this option is not straightforward.

Thus, we employ a Monte Carlo simulation with 100,000 trials each of which generates a path of stock prices. The average of these prices is then inserted into the Black–Scholes model.[14] The overall average value across runs is the value of the option. We do not discount this value back to the beginning of the averaging period, because the employee receives the money around the end of the averaging period or later with interest. For comparison purposes, we then find the Black–Scholes value, positioned on December 8 with various expirations for the option mentioned but using the current stock price, $25.98 on November 12. In effect, this alternative valuation using the Black–Scholes model makes the assumption that the current stock price is an unbiased estimate of the average stock price over the short averaging period.

[13] Alternative volatility estimation periods of 30- and 90-days reveals similar figures for historical volatility on November 12. Given the relative inaccessibility of historical option data bases, implied volatilities would not be easy to obtain, but it is unlikely that they would go beyond the range we use here.

[14] Recall that we previously established that because of the low dividend, these American options could be valued reasonably well by the Black–Scholes model.

Table 2
Black-Scholes and Monte Carlo values of the Microsoft employee option offers.

Strike/maturity	Volatility = 25%		Volatility = 30%		Volatility = 35%	
	Black–Scholes	Monte Carlo	Black–Scholes	Monte Carlo	Black–Scholes	Monte Carlo
33/2	1.67	1.68	2.34	2.36	3.04	3.06
33/5*	2.63	2.64	3.49	3.51	4.36	4.38
40/2.5	0.99	1.00	1.61	1.63	2.31	2.33
40/3.5*	1.38	1.39	2.13	2.14	2.94	2.96
45/2.5	0.57	0.58	1.07	1.08	1.67	1.69
45/3.5*	0.87	0.88	1.50	1.52	2.23	2.25
50/3	0.55	0.56	1.07	1.08	1.71	1.72
60/3	0.22	0.23	0.55	0.56	1.02	1.03

Prices are computed for options using the Black–Scholes model and a Monte Carlo simulation that takes into account the averaging period that precedes the date on which the option value will be determined. The average price over the 15 trading-day period of November 17, 2003 through December 8, 2003 is determined and inserted into the Black–Scholes model. A total of 100,000 simulations are performed. The Black–Scholes price shown is computed in the standard manner, positioned on December 8 with a stock price of $25.98. The stock price on November 17 is $25.98, the exercise prices, volatilities, and times to expiration are as shown above, the risk-free rates are maturity-matched continuously compounded yields from the U. S. dollar swaps market, interpolated where necessary, and the dividend yield is 1%. The average simulated price over all 2.5 million trials is $25.99 (the actual price average price was $25.572). *Indicates that the maturity is longer than three years and according to the terms of the buyout offer, the maturity is reduced to three years.

Table 2 provides these Black–Scholes and Monte Carlo values of options with the various exercise prices and expirations previously discussed and volatilities of 25%, 30%, and 35%. The averaging process has little effect on the value of the option. The Monte Carlo prices are slightly higher but never by more than $0.02, which is because the averaging period is extremely short relative to the life of these deep out-of-the-money options. Thus, they have relatively low deltas and are, therefore, less sensitive to the stock price.

The simulated average price for the entire set of 2.5 million trials is $25.99, essentially the same as the price at the beginning of the averaging period of $25.98. Separate tests using much longer averaging periods show that the effect of the averaging period can be greater, but these cases do not apply in the Microsoft transfer program. Given that the simulated values are so close to the Black–Scholes values, we can safely proceed using only the Black–Scholes values.

4.3. The value of an option to an employee

While JPMC would effectively offer the Black–Scholes value of the option with reduced maturity, we must determine how much value the employee would assign to the option. There is an extensive body of literature on the valuation of employee options. Typical models take into account such factors as the option's illiquidity, vesting, and even psychological factors. These utility-based models are, for example, Lambert et al. (1991), Carpenter (1998), Detemple and Sundaresan (1999), Heath et al. (1999), and Hall and Murphy (2002). There is a family of alternative models, often called reduced-form models, that utilizes data on early exercise and vesting patterns to value options. These models require no employee-specific characteristics but treat all employees alike. If we took that approach, it would be impossible to identify why some options were tendered and some were not. Since the program obtained a modest degree of success, it is important to try to identify why the offers were accepted by some employees and rejected by others. Only the utility-based models can provide that information.

We use the model of Hall and Murphy, which fits a binomial tree to the stock price so that it evolves with an expected return and volatility equal to the expected return from the Capital Asset Pricing Model and the volatility that would be used in the Black–Scholes model. The model obtains the employee value of the option at expiration and then steps backwards through the tree, exercising when the expected utility from exercise exceeds the expected utility from not exercising. The employee's utility function is of the power utility form, $U(W) = -(W^{1-\lambda}/\lambda)$, where W is wealth and λ is the employee's coefficient of relative risk aversion.[15] Working backwards through the tree, the option value is the certainty equivalent that, if received at time 0 and invested in risk-free bonds, would produce the same expected utility as holding the option and following the optimal exercise strategy. Exercise can occur at any time after vesting. Employees with excessive (deficient) market exposure will find the option less (more) desirable and exercise (hold on to) it if vested or possibly tender (hold on to) it in the presence of a transfer program.

The Hall–Murphy model requires the number of options, the employee's non-option wealth, and the allocation of the non-option wealth to stock and risk-free bonds. It also requires an estimate of the stock's expected return. Thus, to value the option we need option-specific information (exercise price, expiration, vesting period, and number of options), stock-specific information (stock price, beta, dividend yield, and volatility), and employee-specific information (risk aversion, non-option wealth, and asset allocation of non-option wealth among stock and risk-free bonds). Of course, we must also decide on the number of binomial time steps.

For the option-specific information, we have already discussed the likely exercise prices, times to expiration, and vesting periods. There are 624 million eligible options held by about 37,000 employees, an average of 16,864 per employee. We round to 15,000 but also examine holdings of 10,000 and 20,000. The stock-specific assumptions are already stated, except for the beta.

[15] While power utility models are not the only approaches to stock option valuation, they are used far more often than models based on alternatives such as exponential utility.

Table 3
Offer values and expected utility values of the Microsoft employee options.

Strike/maturity/ years to vest	Volatility = 25%			Volatility = 30%			Volatility = 35%		
	Offer	Value	Diff	Offer	Value	Diff	Offer	Value	Diff
33/2/0	1.67	2.50	−0.83	2.34	2.81	−0.47	3.04	3.10	−0.06
33/5*/2.5	2.63	7.13	−4.50	3.49	6.62	−3.13	4.36	6.51	−2.15
40/2.5/0	0.99	1.75	−0.76	1.61	2.11	−0.50	2.31	2.43	−0.12
40/3.5*/1	1.38	2.94	−1.56	2.13	3.19	−1.06	2.94	3.47	−0.53
45/2.5/0	0.57	1.13	−0.56	1.07	1.44	−0.37	1.67	1.75	−0.08
45/3.5*/1	0.87	2.18	−1.31	1.50	2.53	−1.03	2.23	2.83	−0.60
50/3/0.5	0.55	1.16	−0.61	1.07	1.53	−0.46	1.71	1.84	−0.13
60/3/0.5	0.22	0.53	−0.31	0.55	0.88	−0.33	1.02	1.14	−0.12

Prices are computed for options using the Black–Scholes model as the amount offered and an expected utility model that takes into account the option holder's risk aversion, holdings, and wealth along with various other relevant factors in determining employee value. The stock price is $25.98, the exercise price, maturity, and time to vest are shown above, the risk-free rates are maturity-matched continuously compounded yields from the U. S. dollar swaps market interpolated where necessary, the volatility is shown above, and the dividend yield is 1%. The number of options is 15,000, the Microsoft beta is 1.66, the option holder has non-option wealth of $300,000 allocated completely to risk-free bonds at the start, and the option holder's risk aversion is 2.5. The market risk premium is 6.5%, and exercise proceeds are placed into risk-free bonds. The expected utility model is a binomial model that uses one time step per month and will exercise the option early if the expected utility from exercise exceeds the expected utility from holding the option. *Indicates that the maturity is longer than three years and according to the terms of the buyout offer, the maturity is reduced to three years for purposes of estimating the buyout offer.

Microsoft's beta is estimated over the 60-trading day period from August 20 through November 12 against the S&P 500 as 1.66. A market risk premium of 6.5% is used, as this is the estimate used by Hall and Murphy. For the employee-specific information, we assume risk aversion of 2.5 but also examine coefficients of 2.0 and 3.0.[16]

An estimate of non-option wealth is more difficult to obtain. Some information on net worth in the U. S. is contained in the Federal Reserve's survey of consumer finance (Bucks et al., 2006). In the western geographic region, median family net worth in 2001 and 2004 was $93.3 and $94.8 thousand with a mean of $468.8 and $523.7 thousand, respectively. About 75% of Microsoft's employees live in the Seattle area where average household income in 2003 was about $65,000 and median house value was about $330,000. This information suggests that a range of $100,000 to $500,000 should give a good perspective on non-option wealth of the typical Microsoft employee. We will use $300,000 as the base value and examine $100,000 and $500,000 as the higher and lower values. We will also discuss the impact of numbers outside of this range. The most important point is not the exact wealth but the effect of changing the wealth. For the standard case, we assume that this non-option wealth is invested in risk-free bonds at the start but also examine the cases in which 20% and 50% is invested in Microsoft stock. Proceeds from early exercise are invested in risk-free bonds.

If the employee resigns or is fired, he could lose the opportunity to exercise the option, but this risk would also apply if he tenders the option. Recall that if the amount owed to an employee for a tendered option exceeds $20,000, a portion is deferred as much as three years. Although these adjustments are not likely to offset perfectly, they create a comparable risk, the effect of which should be of secondary importance. Even if we did apply a probability of termination, such a probability does not represent a risk to which the employee is neutral; hence, an arbitrary application of a probability of termination to an option pricing model is quite problematic. Accordingly, we disregard the probability of termination.[17]

4.4. Comparison of offer values to employee valuations

Table 3 shows the offers compared to the values assessed by the employee for the base case with three volatilities, 25%, the benchmark of 30%, and 35%. Like a standard option, higher volatility increases the value of an employee option. But an employee option is valued using risk preferences and not arbitrage, so higher volatility also reduces the value of the option. For the options examined here, value increases with volatility, but the effect is mitigated somewhat by the negative effect of volatility. Overall, these factors combine to make the offer more attractive the higher the volatility. The net effect, however, is that for each combination, the offer value is lower than the value of the option as perceived by the employee. With but one small exception, the absolute difference between the offer and the value is smaller the higher the volatility.

Although all of the options are unattractive for tendering, certain ones emerge as the least and most attractive. Options with maturities more than three years have their maturities reduced to three years and are the three least desirable options for tendering for all volatilities. For both the 25% and 30% volatilities, the highest strike option, the 60, is the most attractive to tender. For the 35% volatility, the 33-strike, two-year maturity is the most attractive.

These conclusions are based on the benchmark case. In Tables 4 and 5 we vary certain inputs associated with the employee. To conserve space, we show only the difference between the offer and the value assessed by the employee. Panel A of Table 4 varies

[16] In the literature we find that Hall and Murphy use 2 and 3, Lambert, Larcker, and Verrecchia use a range between 0.5 and 4, Rubinstein uses a range of 0.5 to 4, and Carpenter uses 2. As Hall and Murphy discuss, there seems to be a reasonable consensus among economists that risk aversion should be in the range of 2 to 3. Later we will discuss the possibilities if higher or lower values are used.

[17] Technically, there is one point in which termination risk might not be offsetting. If the option's original life exceeds three years, the employee might factor a risk of termination beyond three years into his valuation of the option, while the amount owed if the options are tendered might be so small that none of it would be deferred. We ignore this minor effect. Other than the potential for termination to eliminate any amounts owed, the simple deferral of the payments does not affect the value of the option because Microsoft will pay the employees the remaining amounts plus interest at the Treasury bill rate.

Table 4
Difference between offer values and expected utility values of the Microsoft employee options by options held and non-option wealth.

Strike/maturity/ years to vest	A. Number of options held			B. Non-option wealth		
	10,000	15,000	20,000	$100,000	$300,000	$500,000
33/2/0	−0.84	−0.47	−0.20	0.54	−0.47	−0.94
33/5*/2.5	−4.33	−3.13	−2.35	−0.41	−3.13	−4.68
40/2.5/0	−0.84	−0.50	−0.26	0.35	−0.50	−0.92
40/3.5*/1	−1.61	−1.06	−0.68	0.27	−1.06	−1.76
45/2.5/0	−0.62	−0.37	−0.20	0.23	−0.37	−0.68
45/3.5*/1	−1.49	−1.03	−0.72	0.06	−1.03	−1.61
50/3/0.5	−0.74	−0.46	−0.27	0.22	−0.46	−0.81
60/3/0.5	−0.49	−0.33	−0.21	0.07	−0.33	−0.54

Prices are computed for options using the Black–Scholes model as the amount offered and an expected utility model that takes into account the option holder's risk aversion, holdings, and wealth along with various other relevant factors in determining the employee value. The number in each cell is the difference between the Black–Scholes value and the employee option value and, thus, represents the gain or loss to the employee from tendering. The stock price is $25.98, the exercise price, maturity, and time to vest are shown above, the risk-free rates are maturity-matched continuously compounded yields from the U. S. dollar swaps market interpolated where necessary, the volatility is 30%, and the dividend yield is 1%. The Microsoft beta is 1.66, wealth is allocated completely to risk-free bonds at the start, and the option holder's risk aversion is 2.5. The market risk premium is 6.5%, and exercise proceeds are placed into risk-free bonds. In Section A, the non-option wealth is $300,000, and the number of options varies as shown. In Section B, the number of options is 15,000, and the non-option wealth varies as shown. The expected utility model is a binomial model that uses one time step per month and will exercise the option early if the expected utility from exercise exceeds the expected utility from holding the option. *Indicates that the maturity is longer than three years and according to the terms of the buyout offer, the maturity is reduced to three years.

the number of options held from 10,000 to 15,000 (the benchmark case) to 20,000. Again, none of the offers are sufficiently attractive to accept. Because of greater exposure to the stock, the offers are more attractive the more options owned. For the case of 10,000 and 15,000 options, the most attractive offer is the 60-strike, three-year maturity. With 20,000 options, the most attractive is a tie between the 33-strike, two-year maturity, and the 45-strike, 2.5-year maturity, with the former being slightly less negative when the results are carried out to more decimal places. For all cases, the three options that have their maturities reduced are the least desirable to tender.

In Table 4, Panel B, the employee's non-option wealth is varied. Now we see that some offers are attractive, and the attractiveness varies inversely with wealth. For employee with wealth of $100,000, almost all of the offers are attractive, though barely. Thus, options tendered were likely to be tendered by employees with the lowest external wealth. The reason for this result is that for a given number of options, exposure is greater the lower the wealth, so eliminating this exposure can be justified. For wealth of $100,000, the most attractive is the 33-strike, two-year maturity. For wealth of $300,000 and $500,000, the most attractive is the 60-strike, three-year maturity. In each case, the least attractive option is the 33-strike, five-year maturity.

In Table 5 we vary the asset allocation and risk aversion. The former is the percentage of non-option wealth invested in the stock and is set at 0% for the benchmark case, but we now change it to 20% and 50% in Panel A. Note again that the more exposure the employee has to the stock, the more attractive the offer and with a sufficiently high asset allocation, all options are worth tendering. The longer maturity options take a heavy hit, but the 40-strike, 3.5-maturity option ranks low with 0% and 20% asset allocations but ranks second with a 50% asset allocation. In Panel B, we see that the results are not particularly sensitive to the degree of risk aversion. For the benchmark case, no offers are attractive for risk aversion from 2.0 to 3.0 and the rankings are similar. Given some concern that the true risk aversion coefficient extends beyond the range of 2.0 to 3.0, we also examined values of 0.5

Table 5
Difference between offer values and expected utility values of the Microsoft employee options by asset allocation and risk aversion.

Strike/maturity/ years to vest	A. Asset allocation (percentage in stock)			B. Risk aversion		
	0%	20%	50%	2.0	2.5	3.0
33/2/0	−0.47	0.15	0.80	−0.73	−0.47	−0.26
33/5*/2.5	−3.13	−0.33	0.39	−4.07	−3.13	−2.43
40/2.5/0	−0.50	0.11	0.67	−0.73	−0.50	−0.32
40/3.5*/1	−1.06	−0.11	0.75	−1.45	−1.06	−0.75
45/2.5/0	−0.37	0.10	0.50	−0.53	−0.37	−0.24
45/3.5*/1	−1.03	−0.19	0.52	−1.35	−1.03	−0.78
50/3/0.5	−0.46	0.09	0.53	−0.65	−0.46	−0.31
60/3/0.5	−0.33	−0.04	0.25	−0.44	−0.33	−0.24

Prices are computed for options using the Black–Scholes model as the amount offered and an expected utility model that takes into account the option holder's risk aversion, holdings, and wealth along with various other relevant factors in determining the employee value. The number in each cell is the difference between the Black–Scholes value and the employee option value and, thus, represents the gain or loss to the employee from tendering. The stock price is $25.98, the exercise price, maturity, and time to vest are shown above, the risk-free rates are maturity-matched continuously compounded yields from the U. S. dollar swaps market interpolated where necessary, the volatility is 30%, and the dividend yield is 1%. The Microsoft beta is 1.66, the number of options held is 15,000, and the non-option wealth is $300,000. The market risk premium is 6.5%, and exercise proceeds are placed into risk-free bonds. In Section A, the risk aversion is 2.5 and the asset allocation varies as shown. In Section B, the asset allocation is 0% in stock, and the risk aversion varies as shown. The expected utility model is a binomial model that uses one time step per month and will exercise the option early if the expected utility from exercise exceeds the expected utility from holding the option. *Indicates that the maturity is longer than three years and according to the terms of the buyout offer, the maturity is reduced to three years.

and 4.0. At 0.5, the offer is even less attractive. If employees have risk aversion 4.0, the 33-strike, 2-year maturity option is worth accepting but the difference is only slightly positive. The differences for the other options are all still negative.

Thus, the offer is more attractive if the employee has a small amount of non-option wealth, a large fraction of wealth in Microsoft stock, and a large number of options. The penalty for maturity reduction is heavy, so it is unlikely that one would tender a longer-term option. Another factor, however, is the fact that the estimated differences between the offer and the value assessed by the employee are forecasts. Risk-averse employees, forced to decide about two weeks before the offer is finalized, might well have viewed any small positive expected gains as not worth the risk.

4.5. Who tendered what?

In spite of the apparent unattractiveness of the offer, about half of the options were tendered. It would be interesting to obtain detailed characteristics of the options tendered and the employees who tendered, but that information is not public. We can, however, attempt to identify the most likely options to be tendered and the most likely employees to tender. Microsoft reported that the average premium paid was $1.11 and the average strike was $38.70. The average strike suggests that there were very few high-strike options tendered, and as we noted earlier, there were likely only a few of these high-strike options outstanding.

We use the average strike and premium paid to try to identify the likely maturity and strike of a typical option tendered. A strike of $38.70 and maturity of two years would correspond to a premium of $1.34. It would require a maturity of 1.75 years to generate a premium as low as $1.11. We noted that the likely minimum maturity was two years. Thus, JPMC apparently priced these options with volatility lower than 30%, probably 28%, to obtain these values.

Given that most options tendered appeared to be somewhat old options (around two years maturity remaining) with strikes in the $33 to $40 range, it is likely that the employees who tendered were more experienced employees. Employees with two years or less experience are unlikely to have held many eligible options. Recall that that we found that the options were most likely tendered by employees with the highest percentage of their non-option wealth invested in Microsoft stock, employees with a large number of options, and employees with the highest risk aversion. Combining all of these factors suggests that employees who tendered were more likely to be low-wealth employees with more than two years experience at Microsoft and high exposure to the stock. These are also likely to have poorly diversified portfolios. If the program induced these employees to reduce their exposure, it likely benefited them.

It is also possible that employees who tendered had private information or were pessimistic about the company's outlook. As Oyer and Schaefer (2005) note, options can serve to separate optimistic from pessimistic employees. Option transfer programs are consistent with the Oyer–Schaefer hypothesis and can serve a useful purpose in improving the separation of these two types of employees. Consider two employees with identical at-the-money option holdings, wealth, and exposure to the stock. One employee is optimistic and one is pessimistic. The optimistic employee will value the options more highly and is more likely to stay with the company. But if the options are deep out-of-the-money, the greater likelihood of retaining the optimistic employee has been reduced. By granting a liquidity window, both sets of employees are given the opportunity to cash out and leave. At the margin, however, the less optimistic employee will be more inclined to leave than the most optimistic employee. More optimistic employees would, therefore, be more likely to not tender. As it turned out, tendering employees were either prescient or lucky because Microsoft's stock price, at around $27 at the time of the deal, never reached $30 over the next two years.

5. Discussion

We now provide an analysis and discussion of the program's success and certain qualitative aspects, in particular the all-or-none requirement and the implications for future programs. We also review what happened afterwards.

5.1. Was the program successful?

Recall that Microsoft offered JPMC payments of $6 million regardless of the program's success, an additional $4 million if more than 50% of the options were tendered, and an additional $5 million if more than 75% of the options were tendered. These figures suggest that Microsoft would consider a tender rate of 50% moderately successful and a tender rate of 75% highly successful. With a 55% tender rate, the program would be deemed moderately successful. But this rate is very low in comparison to the programs of Siebel Systems and Nvidia, where over 90% of the options were tendered. Recall that those programs were much simpler, offering employees known amounts that appeared to be larger than the values employees would place on the options.

It would be interesting to learn if the program reduced turnover, but turnover data are impossible to obtain. For example, the Carter-Lynch (2004) study of the effect of repricing on turnover used forfeited options as a proxy for turnover. Forfeited options in turn are usually included within cancelled and expired option data reported by firms. Clearly that kind of data would be a poor proxy when employees are being offered a transfer program.

5.2. The requirement to tender all options or none

Oftentimes an all-or-none requirement is used because of adverse selection. It might appear that an employee could tender the options that were advantageous to tender and retain those that were advantageous to retain, leaving a counterparty at a disadvantage. Let us consider the possible ways the program could have been designed with the adverse selection problem in

mind. Assume that there are only two tranches of options, tranche A and tranche B and only one employee who holds one of each tranche. The company considers two programs, Plan 1 permitting the employee to tender either or both options, or Plan 2 requiring the employee to tender both or none. Assume that the values of the options to the employee are V_A and V_B and that the offer price is O_A and O_B, respectively. We ignore any uncertainty in the offer price or value for now.

Now consider why the company created the program. The company and the employees felt that the options did not provide much incentive. Thus, we assume that the incentive provided by an option is small but non-zero. If the employee holds on to an option, the incentive is retained. If the employee tenders the option, the incentive is destroyed. Thus, tendering is costly to the company but this cost is clearly small inasmuch as the options have already been deemed to provide very little incentive.

Table 6 summarizes the possible outcomes, optimal employee actions and the implications for the employee and Microsoft under the two alternative structures. Under Plan 1 the employee tenders only the options that are worth tendering, while under Plan 2 the employee could find it worthwhile to tender options not worth tendering if the options worth tendering provide gains that more than offset the losses from the options not worth tendering.

There are six conditions represented by the rows. In the first and fourth, the effect on Microsoft is the same under both plans. In the second condition, the marginal impact of the restriction of Plan 2 is the loss of incentive on option B. In the third outcome, Microsoft retains the incentive on option A. In the fifth outcome, the marginal impact of Plan 2 is that Microsoft loses the incentive on option A. In the sixth outcome, the marginal impact is retention of the incentive on option B. Thus, under two of the outcomes, Microsoft would prefer Plan 1, under two it would prefer Plan 2, and under two it would be indifferent. If the outcomes are equally likely, there is no clear preference for either plan. But taking into account the fact that Microsoft is offering the program because it believes the options do not provide much incentive, the cost from the loss of incentives must be very low. The only justification for Plan 2 would be retention of incentives, which it admits are worth very little. Considering the fact that Microsoft would seem to want a high degree of participation, Plan 2 does not appear to be the better alternative.

Moreover, Plan 2 has a greater degree of uncertainty of the number of options tendered. Under both plans, the expected number of options tendered is the same at 1. But the standard deviation of the number of options tendered is 0.58 under Plan 1 and 1.00 under Plan 2. So, while Microsoft would expect the same number of options to be tendered under both plans, there is about 70% more uncertainty of the number of tendered options with the all-or-nothing plan.

This analysis assumes that employees can assess the values of the options and the amounts offered. Given that they cannot, an all-or-nothing plan implies that Microsoft believed that an employee would be more inclined to tender than not. If a risk-averse employee does not tender, his wealth position will be unaffected. If he tenders, his wealth will either increase or decrease. Without strong priors pointing to a greater likelihood of a wealth increase from tendering, any risk-averse employee would probably be inclined to not tender.

One reason Microsoft might have offered the all-or-nothing plan is administrative ease. It is quite possible that it was much easier and less costly to implement the plan on an employee basis rather than on an option tranche basis. Consider that records of employee options have two dimensions: the option characteristics and the employees. Because not all option tranches would be tendered under any plan, Microsoft would still have multiple option tranches outstanding regardless of how it structures the plan. But under the all-or-none rule, Microsoft would be able to eliminate the administrative costs of having any options owned by a given employee. There could be some savings in this case. While we cannot thoroughly analyze this factor, we should not discount the potential role it could have played in Microsoft's decision.

Finally, we should consider that when Microsoft simultaneously announced the program and the fact that it would no longer use options and that it would go ahead with expensing its existing options even before it was required to do so, it may have been attempting to eliminate all traces of its use of options. A decision to require that all options be tendered or none may have been simply a part of its plan to wipe its slate clean of options. Clearly this did not work.

Table 6
Comparison of the Microsoft employee options under tendering any or all options versus tendering all or no options.

Condition	Plan 1 (tender either or both)			Plan 2 (tender both or none)		
	Employee action	Effect on employee wealth	Effect on Microsoft	Employee action	Effect on employee wealth	Effect on Microsoft
$O_A > V_A$ and $O_B > V_B$	Tender A and B	$O_A - V_A + O_B - V_B > 0$	Loss of incentives on A and B	Tender A and B	$O_A - V_A + O_B - V_B > 0$	Loss of incentives on A and B
$O_A > V_A$ and $O_B \le V_B$ and $O_A + O_B > V_A + V_B$	Tender A	$O_A - V_A > 0$	Loss of incentives on A	Tender A and B	$O_A - V_A + O_B - V_B > 0$	Loss of incentives on A and B
$O_A > V_A$ and $O_B \le V_B$ and $O_A + O_B \le V_A + V_B$	Tender A	$O_A - V_A > 0$	Loss of incentives on A	Do not tender	No effect	No effect
$O_A < V_A$ and $O_B < V_B$	Do not tender	No effect	No effect	Do not tender	No effect	No effect
$O_B > V_B$ and $O_A \le V_A$ and $O_B + O_A > V_B + V_A$	Tender B	$O_B - V_B > 0$	Loss of incentives on B	Tender A and B	$O_A - V_A + O_B - V_B > 0$	Loss of incentives on A and B
$O_B > V_B$ and $O_A \le V_A$ and $O_B + O_A \le V_B + V_A$	Tender B	$O_B - V_B > 0$	Loss of incentives on B	Do not tender	No effect	No effect

The table below assumes that there is a single employee and two tranches of options, tranche A and tranche B, with the employee holding one of each tranche. The values of the two options to the employee are V_A and V_B, and the amounts offered are O_A and O_B. We assume no uncertainty with respect to these amounts. Plan 1 allows the employee to tender either or both options, and Plan 2 requires that the employee tender both or none. It is assumed that if an employee tenders an option, Microsoft loses the incentives, although these incentives are small because the options are deep out-of-the-money.

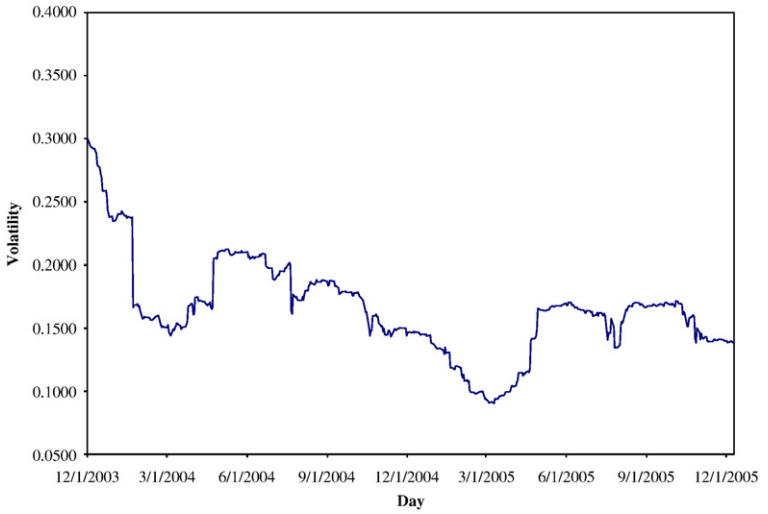

Fig. 6. Rolling annualized volatility of Microsoft stock for two years after the transfer. Volatility is the annualized standard deviation of the log return estimated using a 60-day rolling window.

5.3. Implications for future programs

Hall (2004) praises the Microsoft program as opening the door to a new concept in employee compensation and incentives in the form of transferable options. He notes that these options are quite advantageous in terms of simplifying valuation, maintaining incentives, providing transparency, and introducing competitive pricing in the form of third-party valuation. Let us consider the implications of a company offering a transferable stock option program.

The Microsoft options were not transferable when first offered.[18] Thus, employees, shareholders, and perhaps even Microsoft itself would not have viewed these options as transferable until the program was announced. It is not clear how the potential for random transferability would affect an option's value. Suppose that the company stated up front that the options would become transferable as of a certain date. Valuation would still be complex, because the employee and issuer would need to account for the potential that an employee would tender the options. While it would appear that employees would always prefer transferable options, if there is maturity reduction penalty the choice is not as obvious. There are a myriad of complex issues and ways in which transferable options could be designed. If the employee is unable to make an informed decision, it is not clear that transferable options are better for employees.

In fall 2004 JPMC conducted a similar program for 63,000 non-Comcast employees who held about 42 million Comcast options awarded when Comcast acquired AT&T Broadband in 2002. The options had Black–Scholes value of about $125 million. Since these were not Comcast employees, their holdings of Comcast options did not provide incentives and resulted in administrative costs, while still being illiquid. Only about 11 million options were tendered for about $37 million. (Comcast, 2004a,b). In December 2006 Google announced a program in which employees could offer their options to the highest bidder from among interested financial institutions (Jung, 2007). The maturities would be reduced to a maximum of two years.

In 2003 JPMC was reported to have applied for a patent on the program to protect what it felt was its intellectual property (Crystal (2003), but this action might have been premature. The bank soon found that the program transferred a risk it had not anticipated.

5.4. The aftermath

On September 1, 2005 Reuters (2005) reported that JPMC was selling the options it had acquired from Microsoft due to large losses that apparently began shortly after the deal was completed. Reuters reported anecdotal estimates of JPMC's losses at anywhere from $100 to $450 million. The upper range seems unlikely given that the options were acquired for only $382 million. But it is not difficult to determine why large losses were incurred. JPMC evidently failed to consider its assumption of volatility risk.[19]

Fig. 6 shows the rolling annualized 60-day volatility of Microsoft from early December 2003 through early December 2005. The reduction is remarkable, from around 30% at the time of the deal to about 15%, a level reached as early as the first quarter after the deal was completed. The offer prices estimated in Table 3 for 30% volatility for the different tranches were $2.34, $3.49, $1.61, $2.13, $1.07, $1.50, $1.07, and $0.55. The respective vegas are 13.78, 17.34, 13.32, 15.64, 11.12, 13.72, 11.69, and 8.03. Simple calculations reveal that a 15% reduction in volatility would destroy between 70 and 100% of value. With the hedge executed with short sales of

[18] Microsoft may have hinted at this program as early as 2001, because the proxy statement for its 2001 stock option plan contains the following: "An Award may not be sold, pledged, assigned, hypothecated, transferred, or disposed of in any manner other than by will or by the laws of descent or distribution and may be exercised, during the lifetime of the Awardee, only by the Awardee; *provided that the Board may permit further transferability, on a general or specific basis*, and may impose conditions and limitations on any permitted transferability. (italics added) See Microsoft (2001).

[19] See Patel (2005) for a practitioner discussion of the events following the completion of the deal.

stock, there is no offsetting vega from the hedge instrument. So unless JPMC hedged the volatility using a volatility derivative, it likely lost nearly all of the value of the options, at least for awhile.

As noted earlier, employee options have less volatility risk than traded options. By converting employee options into traded options, a considerable amount of volatility risk was created and assumed by JPMC. Employees who tendered, of course, shed this risk, and employees who did not tender did not bear much of this risk. Consider the employee option values in Table 3 at a volatility of 30%. It is possible to use the aforementioned employee option valuation model to estimate an average vega from the employee's perspective. These estimates produce vegas of between 2.5 and 7, with an average of 5.56, considerably lower than the average vega of the options assumed by JPMC of about 13.08. Thus, the employees who did not tender had volatility risk of less than half the volatility risk assumed by JPMC, and the employees who did tender eliminated this risk, turning it into much greater risk for JPMC.

6. Conclusions

The Microsoft employee option transfer program brought to light a number of issues in the design and use of employee options. Options use illiquidity to retain and incentivize employees. If the options are deep out of-the-money, however, employees, who feel unable to connect their individual efforts with stock price performance, have less incentive to remain with a company and exert their best efforts. In the past when companies detect that the costs of options exceed the benefits, they choose to pay higher salaries, reprice their options, or do nothing. By providing a liquidity window, employees are offered an opportunity to capture some more immediate benefits of their long-term equity-based compensation. Even if the program is rejected, the mere offering of the plan could improve morale. But liquidity windows are costly, and firms must design programs with a high probability of success. The complexity and confusion of this program reinforces the critical role of transparency in financial transactions.

An important element of transfer programs is the role of financial markets. The transfer of a large amount of risk in a short period of time can have a significant impact on the stock price. In the Microsoft case, financial markets functioned well. Trading volume was a very large percentage of average daily volume, but there was no discernible impact on price. Although programs of smaller and less liquid companies might not fare as well in this regard, such programs would likely be smaller and in proportion to trading volume.

The Microsoft story also addresses another issue in the risks associated with employee options. Employees are unlikely to truly recognize volatility risk. Employees who held on to their options did see further paper losses as a result of the sharp decline in volatility. In short, it became less likely that those options would get above the already-high hurdle. Those who transferred this risk probably did not consider it, but nonetheless benefited from it. And finally, when we learn that the investment bank failed to hedge this risk, it demonstrated that quality risk management from start to finish is necessary to make transfer programs successful.

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