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The Valrex Model for Valuing Employee Stock Options

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Using traded option models to value employee stock options (ESO) often results in overvaluation because the traded option models do not consider the selling restrictions typically placed on ESOs. In addition, traded option models result in low-quality valuations because they are highly sensitive to the user's estimate of the future volatility of the underlying stock.

Traded options have selling privileges: They can be sold and converted to cash quickly to hedge against future losses in the value of the options. ESOs have selling restrictions: They cannot be sold and converted to cash quickly. The selling restrictions placed on ESOs make them more risky and less valuable than otherwise identical traded stock options.

The Valrex model quantifies, then eliminates, the value of the selling privileges embedded within a traded option value. This value can be computed by calculating the value of an at-the-money put option on the ESO (i.e., the right to sell the ESO at its theoretical "freely traded" price).

The following are situations in which the Valrex model can be used to find a fair market value for ESOs:

- Preparing financial and proxy statement disclosures [to comply with SFAS 123 and 17 CFR section 229.402 (instructions to IRC section 402 (c), Item 9)].
- Assisting compensation committees in their option-grant decision-making.
- Assessing a basis for transfer taxes in estate and gift tax planning.

Valrex is a two-part model consisting of a traded call option pricing model and a put option on the call option (the put-on-call) with an exercise price set at the theoretical “freely traded” call ESO value. The difference between these two parts of the model reflects the Valrex fair market value of the option. There are two basic types of options:

- ***Call option.*** The right to buy an asset (e.g., a share of stock) at a set price for a period of time. ESOs are call options.
- ***Put option.*** The right to sell an asset (e.g., a share of stock, or a call option in the context of the Valrex put-on-call) at a set price for a period of time.

The Valrex fair market value of an ESO is computed as follows:

- A traded call option pricing model is used to find the theoretical freely traded value.
- A put-on-call option pricing model is used to quantify the value of the selling privileges embedded in the freely traded option price. The put-on-call value is equal to the discount for lack of transferability.
- Subtracting the put-on-call value from the freely traded value yields the Valrex fair market value of the ESO.

Valrex considers the same six input variables as Black-Scholes and other models for pricing traded options:

- Price of the underlying stock at the date of valuation.
- Exercise price of the option.
- Risk-free interest rate during the term of the option.
- Expected dividend yield of the underlying stock.
- Expected volatility of the underlying stock.
- Term of the option.

Example

Consider an ESO with the following characteristics:

Stock price	\$100.00
Exercise price (ESO)	\$100.00
Volatility	60%
Risk-free rate	5%
Dividend yield	0%
Term to expiration (ESO)	10 years

The stock is publicly traded. Because the stock does not pay dividends, the expected dividend yield is zero. The option's exercise price is set by the option contract. A user of the option pricing model must remember that expected volatility may be materially different from historical volatility and adjust the volatility input accordingly. The risk-free interest rate can be obtained from yield quotes on zero-coupon government bonds. The ESO is fully vested, can be exercised at any time before expiration, and cannot be sold.

Step One. A 10-period trinomial call option pricing model is used to find the freely traded price of the ESO. The result is a value that is close to the Black-Scholes and binomial values for a stock that does not pay dividends: \$73.15.

Step Two. A put-on-call option is used to find the value of selling privileges embedded in the freely traded call value.

A put-on-call option valuation model has eight input assumptions, six of which are identical to the assumptions used to determine the freely traded value of the ESO in step one. The other two assumptions address the term and exercise price of the put-on-call. In Valrex, the two additional put-on-call inputs are calculated from the other six inputs.

The term for the put-on-call must be slightly less than the term of the ESO. In the example, the term of the put-on-call is assumed to be 0.01 years less than the term of the ESO, that is, 9.99 years.

The final input is the exercise price of the put-on-call option. Because an at-the-money option (i.e., exercisable at the current freely traded price) is being valued, this amount is \$73.15.

The calculation results in a put-on-call value of \$31.90.

Step Three. The Valrex fair market value of the ESO is calculated by subtracting the put-on-call value of $31.90 from the freely traded value of the employee stock option of $73.15: $41.25.

Because the Valrex fair market value never exceeds the freely traded value, a discount rate can be computed. The Valrex discount to the freely traded price is equal to $31.90 divided by $73.15: 43.61%. The discount rates vary with the option's term and the volatility of the underlying stock. *Exhibit 1* shows a range of Valrex discounts for options with differing expiration and volatility factors.

Reliability Test

The management of many publicly traded companies acknowledge that Black-Scholes is an unreliable measure of an ESO's value. The following is an excerpt from the financial statement disclosures in Callaway Golf Company's 2000 10-K:

> The Black-Scholes option valuation model was developed for use in estimating the fair value of traded options which have no vesting restrictions and are fully transferable. In addition, option valuation models require the input of highly subjective assumptions including the expected stock price volatility. Because the Company's employee stock options have characteristics significantly different from those of traded options, and because changes in subjective input assumptions can materially affect the fair value estimates, in management's opinion, the existing models do not necessarily provide a reliable single measure of the fair value of grants under the Company's employee stock-based compensation plans.

The extent to which the subjective volatility input assumption influences the Black-Scholes value is evident from *Exhibit 2*. The Black-Scholes model for a 10-year at-the-money option with a $100 exercise price (assuming a risk free rate of 5% and dividend yield of 0%) varies from $45 to $99 as the volatility input assumption moves from 20% to 150%--a 120% increase.

By contrast, the Valrex model for a 10-year at-the-money option with a $100 exercise price (assuming a risk free rate of 5% and a dividend yield of 0%) varies from $37 to $41 as the volatility input assumption varies from 20% to 150%. In this model, the lowest and highest values differ by only 11%. The range of values is particularly insensitive to the volatility input when the ESO is at-the-money or slightly in-the-money.

The most important feature of the Valrex model is that it results in a more reliable measure of ESO value than the Black-Scholes or any other traded option pricing model. The Valrex fair value does not fluctuate significantly when an ESO is at- or slightly in-the-money because changes in volatility have approximately the same effect on the freely traded call as the put-on-call.

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Discount to Freely Traded Value Implied by Valrex

Exhibit 1

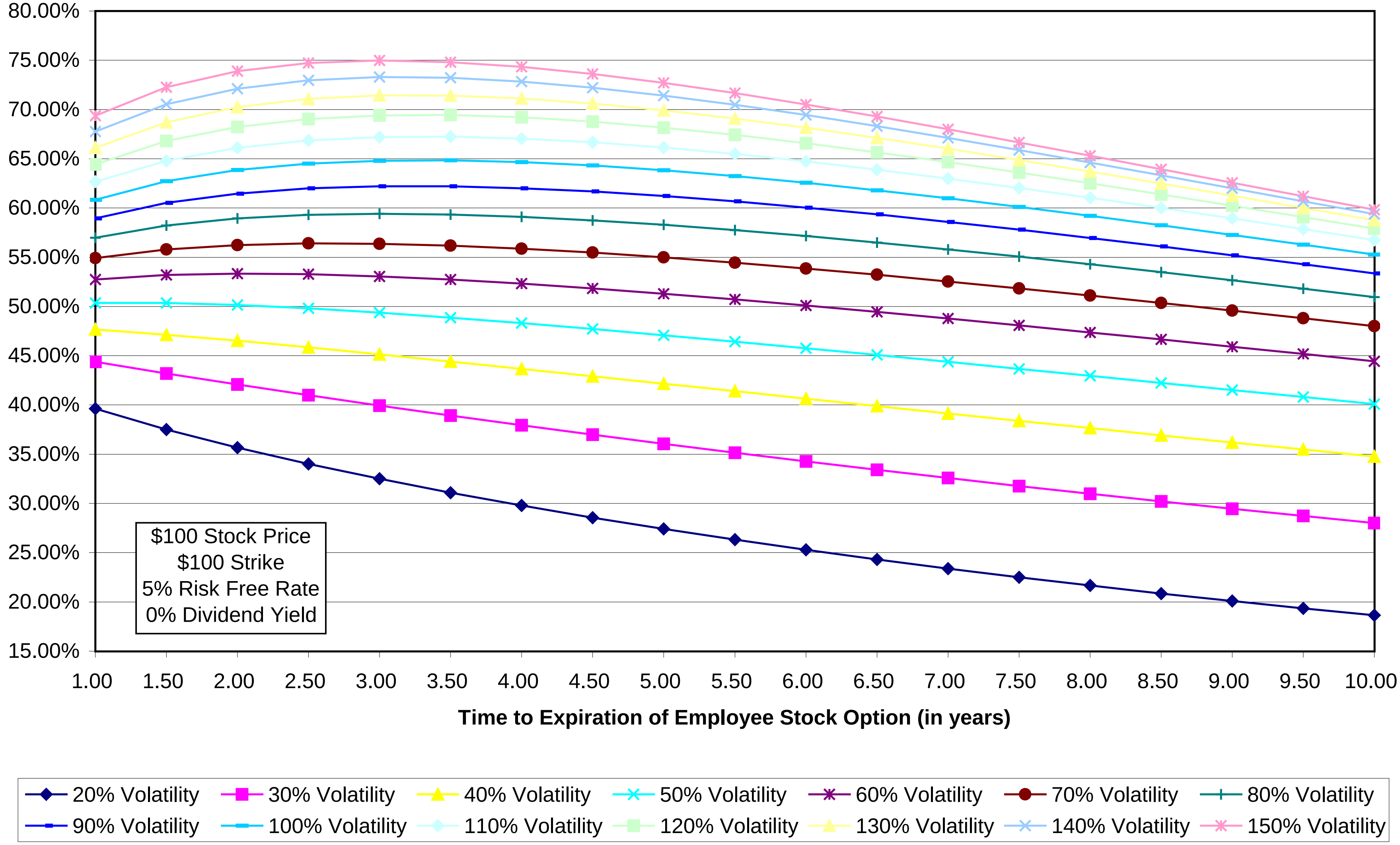
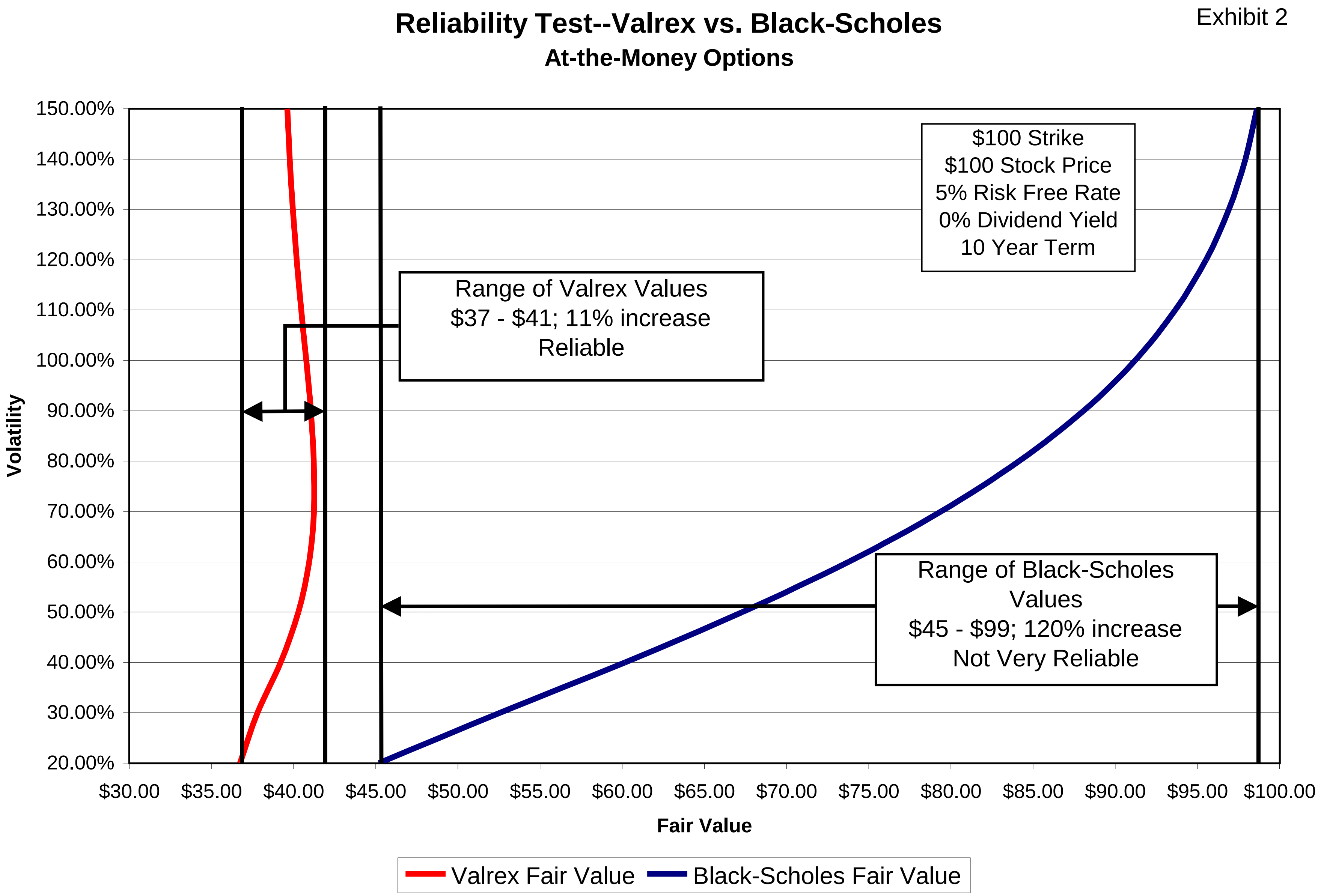


Exhibit 2



Reliability Test--Valrex vs. Black-Scholes
At-the-Money Options
$100 Strike
$100 Stock Price
5% Risk Free Rate
0% Dividend Yield
10 Year Term
Range of Valrex Values
$37 - $41; 11% increase
Reliable
Range of Black-Scholes Values
$45 - $99; 120% increase
Not Very Reliable
Volatility
150.00%
140.00%
130.00%
120.00%
110.00%
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
$30.00
$35.00
$40.00
$45.00
$50.00
$55.00
$60.00
$65.00
$70.00
$75.00
$80.00
$85.00
$90.00
$95.00
$100.00
Fair Value
Valrex Fair Value
Black-Scholes Fair Value