



De-Kalo Ben-Yehuda
Investment House

Employee Stock Option Plans

**Valuation & Consulting -
Under 123(R) and SEC's SAB 107**

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On December 16, 2004, the FASB issued Statement 123(R), *Share-Based Payment*. Public companies (excluding small business issuers) will be required to adopt Statement 123(R) on January 1st 2006. Under the modified-prospective-transition method, companies will be required to recognize compensation cost in financial statements issued subsequent to the date of adoption, for all awards granted, modified, or settled after the date of adoption, as well as for any unvested awards.

Statement 123(R) does not state an explicit preference for any particular option-pricing model. However, the FASB indicated that in many circumstances a lattice model or Monte-Carlo simulation model will provide a better estimate of the fair value of ESOs because of the flexibility of the lattice approach. In contrast to the Black-Scholes formula, the Monte-Carlo can be designed to accommodate dynamic assumptions of expected volatility over the option's contractual term, and estimates of expected option exercise patterns during the option's contractual term, including the effect of blackout periods. **Therefore, when specific real-life business conditions need to be modeled (that is, probability of forfeiture, time-vesting, sub-optimal exercise, and so forth) other models, such as the Monte -Carlo simulation should be used.**

Regardless of the valuation technique or model selected, companies must develop reasonable and supportable estimates for each assumption used in the model, including the ESOs' expected term, taking into account both the contractual term of the option and the effects of employees' expected exercise and post-vesting employment termination behavior.

Using Monte-Carlo simulation models, we provide a wide variety of consulting services, including:

- **Analysis of input measures used in the various valuation models (lattice, Black-Scholes etc.) based on the provisions of Statement 123(R) and IFRS 2 (e.g. future volatility assumptions, employee exercise behavior);**
- **Valuation of ESOs using adjusted Black-Scholes model and Monte-Carlo lattice-based simulations;**
- **Consulting, sensitivity analysis and optimization of ESO features for companies considering an ESOP;**
- **Valuation of ESOs with exotic features.**

Using Black-Scholes Model for Estimating Fair Value of ESOP

Using the Black-Scholes model for estimating fair value of ESOPs has become very common among companies, mainly for its simplicity, as reflected in its single formula. Another possible reason for implementing this model for so long is that the majority of companies have used it solely for pro-forma note disclosures (according to Statement 123) and not in their primary financial statements - a usage that makes its implications "less important".

After adoption of Statement 123(R), the figures and assumptions used by the company for valuating the ESO compensation cost recognized in the financial statements, will be subject to tight scrutiny by investors and regulatory authorities such as the SEC.

The Monte-Carlo Option-Pricing Model

A Monte-Carlo model can accept more assumptions and a wider range of assumptions to better factor in the unique characteristics of an employee stock option. The flexibility to use a wide range of assumptions in a Monte-Carlo model allows companies to better price their employee stock options. For example, in our model, we have included the following assumptions:

- **Employee post-vesting early exercise behavior:** Because employees cannot sell their options, they tend to exercise them early, making the options less valuable than if they were held to maturity. In our model, we assume that when the stock price is a certain multiple of the exercise price, the employees would exercise their vested options (this method has been proposed in a number of research papers and also by the FASB).
- **Vesting period:** Our model sets a vesting period in which the option cannot be exercised.
- **Forfeiture Rate:** Statement 123(R) eliminates the alternative available under Statement 123 that permitted accounting for forfeitures as they occurred. Statement 123(R) requires an entity to estimate expected forfeitures at the grant

date and recognize compensation costs only for those awards expected to vest. The estimate of expected forfeitures must be reevaluated at each balance sheet date.

- **Stochastic volatility:** Volatility is arguably the most subjective of all assumptions. **It is a key driver of an option's value.** Historical volatility can be objectively measured, but expected future volatility drives the value of an option. Generally, a company's historical volatility will serve as a starting point in determining the expected volatility. **In Statement 123(R) the FASB specifically precludes companies from defaulting to the use of historical volatility without considering other factors that may cause expected volatility to be different.**

The FASB highlights six factors that companies should consider in estimating their expected volatility, including:

1. **Implied volatility:** A company that has actively traded warrants from which it can derive implied volatility data may conclude that this implied volatility data represents market participants' expectations of its future stock volatility and, therefore, is more useful in estimating expected volatility than its historical stock-price volatility.
1. **Peer group assessment:** New public companies that have issued options with expected lives exceeding the period over which trading activity is available may want to look at the volatility level of comparable companies when assessing their own volatility levels.
2. **Return to average volatility:** Companies will want to use statistical tools to adjust their volatility assumptions for unusual events that may have caused an unusual spike in their historical volatility levels (e.g. a takeover bid). The idea is that a company's volatility will revert to average levels after stripping out these unusual periods.
3. **Corporate structure:** Companies should evaluate the impact of their financial and operational structure on their volatility levels, adjusting for the impact of different lines of business. For example, a company may need to reevaluate the impact of its corporate structure on its expected volatility after acquiring or

disposing of a line of business that is significantly more or less volatile relative to existing lines or after a significant change in its financial leverage.

All of the above features can be incorporated in our model to provide for flexible assumptions regarding volatility into the valuation of the option. Companies may incorporate the following volatility stochastic models used by our Monte- Carlo path simulation model:

- ***Constant Elasticity of Variance (CEV) Model:*** This model presumes that a constant correlation exists between the stock price and volatility. Meaning, volatility decreases as the stock price increases, and vice versa.
- ***Reverting to Average Volatility Model:*** Volatilities tend to be mean-reverting. If the current volatility is historically high, then there is an expectation that it will decrease and so the volatility used for an option should be a decreasing function of its maturity.

Monte-Carlo Simulation Results

In order to get a feeling of the impact that the different features of ESOs have on the value of the stock option, we provide the following data tables:

Employee post-vesting early exercise behavior

The following tables illustrate the effect of the early exercise multiple on the value of the option. As expected, the higher the multiple, the higher the value of the option. The higher the contractual life/volatility of the option, the stronger effect the exercise multiple has on the value of the option.

		Exercise Multiple									
		(S=40, X=40, VP=2, R=4%, F=0%, V=50%, P=400, N=30K)									
		<u>1.2</u>	<u>1.3</u>	<u>1.4</u>	<u>1.5</u>	<u>1.6</u>	<u>1.8</u>	<u>2</u>	<u>2.5</u>	<u>3</u>	<u>B&S</u>
Contractual Life	4	13.5 (0.14)	14.14 (0.15)	14.64 (0.14)	15.04 (0.15)	15.2 (0.14)	15.97 (0.16)	16.36 (0.16)	16.875 (0.18)	16.89 (0.19)	17.31
	7	14.83 (0.16)	15.58 (0.15)	16.42 (0.15)	17 (0.15)	17.7 (0.16)	18.55 (0.16)	19 (0.17)	20.64 (0.19)	20.88 (0.20)	22.48

Exercise Multiple

		(S=40, X=40, T=7, VP=3, R=4%, F=0%, P=400, N=30K)									
		1.2	1.3	1.4	1.5	1.6	1.8	2	2.5	3	B&S
Volatility	30%	12.13 (0.10)	12.73 (0.10)	13.25 (0.10)	13.74 (0.10)	14.02 (0.10)	14.65 (0.11)	15.06 (0.12)	15.74 (0.13)	15.88 (0.15)	16.35
	50%	16.92 (0.08)	17.75 (0.22)	17.84 (0.21)	18.68 (0.21)	18.74 (0.20)	19.71 (0.22)	20 (0.21)	20.61 (0.22)	21.29 (0.23)	22.48
	70%	21.51 (0.43)	21.61 (0.36)	22.29 (0.39)	22.75 (0.36)	23.58 (0.37)	24 (0.37)	24.04 (0.36)	25.44 (0.40)	25.4 (0.37)	27.74
	100%	26.95 (0.72)	27.63 (0.75)	27.48 (0.77)	30.36 (0.96)	27.68 (0.76)	27.83 (0.81)	27.53 (0.72)	29.34 (0.68)	30.18 (0.71)	33.56

The numbers in parenthesis represent standard deviation.

Effect of Forfeiture and Early Exercise Rate

The following tables illustrate the effect of forfeiture on the value of the option. As expected, the higher the forfeiture rate, the lower the value of the option. The higher the contractual life/volatility of the option, the stronger effect the forfeiture has on the value of the option.

The Results in tables 1 and 2 are based on the assumption that forfeiture exists during the vesting period and also when the option is vested. The pre-vesting and post-vesting forfeiture rate is equal. In tables 1.a and 2.a we calculated the Black-Scholes value of the option, taking into account forfeiture during the period the option is unvested.

Table 1

		Forfeiture Rate				
		(S=40, X=40, T=7, VP=3, R=4%, M=3000, P=400, N=30K)				
		1%	2%	3%	5%	7%
Volatility	30%	15.65 (0.18)	15.2 (0.18)	14.61 (0.17)	13.56 (0.15)	12.57 (0.14)
	50%	21.52 (0.44)	20.78 (0.43)	20 (0.40)	18.33 (0.34)	17.16 (0.33)
	70%	27 (1.11)	26.11 (1.01)	24.49 (0.86)	23.11 (0.85)	21 (0.77)
	100%	29.28 (2.44)	29.35 (3.07)	26.12 (1.71)	27.2 (1.96)	27.68 (2.47)

Table 1.a

B&S		<u>Forfeiture</u>			<u>Rate</u>		
		<u>0%</u>	<u>1%</u>	<u>2%</u>	<u>3%</u>	<u>5%</u>	<u>7%</u>
Volatility	30%	16.35	15.86	15.39	14.92	14.02	13.15
	50%	22.48	21.81	21.16	20.52	19.27	18.08
	70%	27.74	26.92	26.11	25.32	23.78	22.31
	100%	33.56	32.56	31.59	30.63	28.77	26.99

Table 2

		<u>Forfeiture Rate</u>				
		<u>(S=40, X=40, VP=2, R=4%, V=50%, M=3000, P=400, N=30K)</u>				
		<u>1%</u>	<u>2%</u>	<u>3%</u>	<u>5%</u>	<u>7%</u>
Contractual Life	4	16.94 (0.27)	16.4 (0.26)	16.07 (0.25)	15.36 (0.23)	14.56 (0.22)
	6	20 (0.36)	19.6 (0.37)	19.34 (0.40)	18.13 (0.32)	17.3 (0.31)
	8	22.78 (0.51)	22 (0.48)	21.73 (0.47)	19.7 (0.38)	18.7 (0.36)

Table 2.a

B&S		<u>Forfeiture rate</u>					
		<u>0%</u>	<u>1%</u>	<u>2%</u>	<u>3%</u>	<u>5%</u>	<u>7%</u>
Contractual Life	4	17.31	16.97	16.62	16.29	15.62	14.97
	6	20.97	20.55	20.14	19.73	18.93	18.14
	8	23.83	23.36	22.89	22.42	21.51	20.61

Effect of Vesting Period

The following table illustrates the effect that vesting period has on the value of the option. As expected, the longer the vesting period, the higher the value of the option, as the effect of forfeiture is diminished given that the period in which forfeiture is allowed is shorter. The higher the forfeiture rate, the lower the value of the option.

		<u>Vesting</u>			
		<u>(S=40, X=40, T=7, R=4%, V=50%, M=3000, P=400, N=30K)</u>			
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Forfeiture Rate	3%	20.6 (0.40)	20.45 (0.42)	20.15 (0.42)	19.58 (0.39)
	5%	19.7 (0.37)	19.22 (0.37)	18.6 (0.36)	17.64 (0.33)
	7%	18.83 (0.34)	18 (0.33)	17.18 (0.32)	16.33 (0.32)

		<u>Vesting</u>					<u>B&S</u>
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>		
Forfeiture	3%	23.18	23.89	24.63	25.39	22.48	
Rate	5%	23.66	24.91	26.22	27.60	22.48	
	7%	24.17	25.99	27.95	30.05	22.48	

Effect of Changing Volatility

The CEV Model

The following table illustrates the effect that the elasticity of variance (“Alpha”) has on the value of the option. As expected, a lower Alfa brings to a lower option value. The higher the start volatility, the stronger effect the Alfa has on the value of the option.

		<u>Alfa</u>					<u>B&S</u>
		<u>(S=40, X=40, T=5, VP=3, R=10%, F=0%, M=3000, P=400, N=20K)</u>					
		<u>1</u>	<u>0.95</u>	<u>0.9</u>	<u>0.85</u>	<u>0.8</u>	
Start	30%	18.5 (0.20)	17.5 (0.15)	16.82 (0.12)	16.3 (0.10)	16 (0.08)	18.41
Volatility	60%	24.22 (0.57)	22.76 (0.38)	20.72 (0.27)	19.5 (0.14)	18.31 (0.16)	24.78
	90%	30.64 (1.67)	27.65 (0.87)	25.2 (0.51)	23 (0.34)	21.27 (0.26)	30.37

The Mean-Reverting Volatility Model

The following table illustrates the effect of mean-reverting speed on the value of the option. The higher the mean-reverting speed, the lower the value of the option, as the initial volatility (“Vstart”) is higher than the average volatility (“Vaverage”).

		<u>Mean Reversion Speed</u>							
		<u>(S=40, X=40, VP=3, R=10%, F=0%, Vaverage=50%, Vstart=80%, M=3000, P=400, N=20K)</u>							
		<u>0%</u>	<u>5%</u>	<u>10%</u>	<u>15%</u>	<u>20%</u>	<u>30%</u>	<u>40%</u>	<u>50%</u>
Contractual	5	27.62 (1.02)	27.48 (0.98)	27.5 (0.96)	26.97 (0.9)	26.1 (0.79)	25.57 (0.7)	25.4 (0.66)	24.4 (0.59)
Life	8	30.75 (1.77)	31.1 (1.68)	30.58 (1.6)	31.23 (1.36)	29.41 (1.16)	30 (1.07)	29.59 (0.98)	29.47 (0.92)