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TITLE   **: Analysis of valuation methods for stock options on firms that experience a spin-off**

ANALYSIS OF VALUATION METHODS FOR STOCK

# OPTIONS ON FIRMS THAT EXPERIENCE A SPIN-OFF

BY

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Faculty Comments

This paper examines the divergence between Internal Revenue Service rules and Option Exchange rules governing the repricing of stock options. One event which necessitates that employee stock options be repriced is a spin-off of a firm's subsidiary. Nearly all firms follow IRS rules governing the repricing in order to maintain a tax-free transaction to the executive. However, the new options can be significantly more or less valuable than the prior option from the financial markets' perspective (i.e. a Black-Scholes valuation).

This paper examines the spin-off of Anadarko Petroleum Corporation from Panhandle Eastern Corporation in October 1986. The findings indicate that, after repricing, the executive stock options on Panhandle Eastern were less valuable ex-post. These findings are consistent with the hypothesis that there can be a significant difference between the two revaluation techniques. This work is a preliminary analysis using one data point and the generalizability of the results is currently a working project of the faculty supervisor.

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Faculty Supervisor
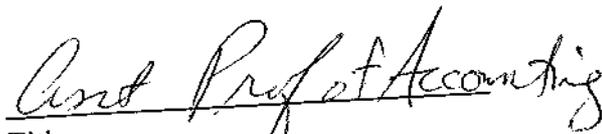
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Title

I. Introduction

Spin-offs are a restructuring mechanism available for corporations to drvest a segment of the business or a subsidiary. In general, a spin-off is accomplished tough a pro-rata distribution of new shares to current shareholders of the parent company. Thus, a spin-off does not generate any cash inflow for either the parent or the subsidiary being spun-off and, it is a tax-free transaction. Through a spin-off, the operating control of the subsidiary is transferred ,» its management team. In fact, for a spin-off to take p.ace, the parent company must not retain voting control over the subsidiary. Spin-off activity during the 1990s has seen record amounts. Just in 1993, a record $26 billion in spin-off transactions were completed[1].

Another important fact about spin-offs is that the stock price of the parent often appreciates following the announcement of the spin-off[2]. This reaction can be explained as the market's expectation that the spin-off wi.l create value overall. In other words, the post-spin-off combined market value of the parent and the subsidiary is expected to plateau above the current pre-spin-off value. A possible exp.anation of such expectations is the fact that both, the parent and the subsidiary, will be ab,e to focus on their respective core competences, thus increasing their operating performance.

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[1] Patrick Cusatis, James A. Miles and J. Randall Woolridge, "Some New Evidence that Spinoffs Create Value" BankAmerica, *Journal of Applied Corporate Finance* (Summer 1994).

[2] James Miles and James Rosenfeld, "An Empirical Analysis of the Effects of Spin-off Announcements on Shareholder Wealth", *Journal of Finance* 38 (1983); Gailen Hite and James Owers, "Security Price Reactions around Corporate Spin-off Announcements", *Journal of Financial Economics* 12 (1983); and Katherine Schipper and Abbie Smith, "Effects of Recontracting on Shareholder Wealth: The Case of Voluntary Spin-offs", *Journal of Financial Economics* 12 (1983).

In most American corporations, stock option grants make up a significant portion of senior executives' compensation packages. Within the framework of spin-off analysis, it is important to understand the rights owned by the holder of these options, as well the definition of the underlying assets on which the option holder can exercise his rights. The objective of this paper is to analyze the potential role stock options play in the decision making process of corporate restructuring. Specifically, it is important to determine whether there are differences in the way the Internal Revenue Service (IRS) and the options' exchanges revalue stock options in companies that have gone through a spin-off. Then, if such differences exist, it is important to determine their magnitude. If the differences between the two valuation methods are of considerable magnitude, they might influence management's decision to pursue a spin-off over some other form of corporate restructuring (e.g. divestiture, leveraged buyout).

II. IRS and OCC Revaluation Methods

After a spin-off, employee stock options are revalued according to Internal Revenue System (IRS) rules, while exhange traded options are revalued according to the Option Clearinghouse Corporation (OCC) rules. The IRS is concerned with maintaining the same realizable gains (wealth claim), whereas the exchange's goals are to maintain the claim on the firm's productive assets.

According to the IRS, a stock option on a firm that has spun-off a segment of the business should be revalued according to the procedure described below[3]; otherwise, (1) the tax benefits of afforded employee stock options would be lost, (2) the firm would have to report current taxable income to the executive, and (3) the company would record an expense in the income statement.

1. Determine the number of shares (N_0) on which the employee holds an option, prior to the spin-off

2. Determine the exercise price of this option (X_0)

3. Determine the closing stock price of the company on the last day of trading prior to the spin-off (S_0)

4. Determine the closing stock price of the company on the first day of trading after the spin-off (S_1)

5. Calculate the ratio of S_0 to S_1 (R)

6. Calculate the new number of shares under the option (N_1) as N_0 times R

7. Calculate the new exercise price (X_1) as X_0 divided by R

As an example, assume that an executive holds an option for 100 shares in company ABC, with an exercise price of $50. On the last day of trading before the spin-off is completed, ABC's stock price closes at $65. Therefore, the option is in the money, and if the executive decided to exercise it at this time, he would have a payoff of $15 per

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[3] Clark; Boardman; and Callaghan. <u>The Complete Internal Revenue Code</u>. January 1996

share, for a total realizable gain of $1,500. The next day, trading as a restructured company without its subsidiary, ABC closes trading at $40. According to the IRS guidelines, we compute the ratio R as: 1.625 = $60 / $40. Using this ratio, we now compute the new number of shares under the option as: 162.5 = 100*1.625, and the new exercise price as: $30.769 - $50 / 1.625. Thus, after these adjustments, the executive holds options with an intrinsic value of $9.231 = $40 - $30.769 per share, if exercised today. Because he now holds an option for 162.5 shares, his total realizable gain would be $1,500 = $9.231 * 162.5, which is the exactly the same as the day before. With this adjustments, the IRS assures the holder of the stock option the same in-the-money (or out-of-the-money) position before and after the spin-off.

The OCC on the other hand, considers the new company a completely new entity. Because the elimination of a portion of the firm implies the parent will now posses new business characteristics (e.g. volatility, dividend yield, stock price), the OCC requires that existing exchange traded options cover both the parent and the subsidiary. In other words, post-spin-off, the option holder owns a compound option consisting of individual options on both the parent and the subsidiary. This treatment of exchange traded options protects investors by maintaining their claim on the whole set of assets covered by their original transaction.

III. Valuation of Stock Options

In order to analyze the difference between the value of a stock option before and after a spin-off, I used the Black-Scholes model[4] to value the option on one share of the company Panhandle Eastern Corporation. Panhandle, a Houston-based oil-and-gas company, completed the spin-off of Anadarko Petroleum Corporation on October 1, 1986. Stockholders received one Anadarko share for each Panhandle share. Table 1 provides details on the transaction.

Table1

Parent's Name:	Panhandle Eastern Corporation
Subsidiary's Name:	Anadarko Petroleum Corporation
Date of Spin-off:	October 1, 1986
Parent's Stock Price before Spin-off:	$46.50
Parent's Stock Price after Spin-off:	$24.75
Stock Price of spin-off subsidiary:	$20.00

The Black-Scholes Model

The options will be valued using standard option pricing formulas. Specifically, the Black-Scholes model requires the input of the following variables:

1. Stock Price (S): Stock price at the time the valuation is being performed.

2. Exercise Price (X): Price at which the underlying stock can be bought for.

3. Time to Expiration (T): Length of the period during which the option can be exercised, starting from the current date (date of valuation).

4. Discount rate (r): Rate at which the exercise price is discounted to obtain its present value at the current date. It must be a risk-free rate.

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[4] John C. Hull. <u>Tntrnduction to Futures & Options Markets</u>. Second Edition, Upper Saddle River, NJ: Prentice Hall, 1995.

5. Volatility of Returns (σ): Annualized standard deviation of daily stock returns.

With the above parameters, we can use the Black-Scholes formulas to calculate the value of the option:

$$\text{Value of the option} = S\,N(d_1) - X\,e^{-rT}\,N(d_2)$$

where:

$$d_1 = \frac{\ln(S/X) + (r + \sigma^2/2)\,T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$N(d)$ = cumulative probability function for a standardized normal variable

Pre-Spin-Off Values

For the valuation, I first calculated the value of an option on one share of Panhandle's stock, on the last day of trading prior to the spin-off. The closing stock price on October 1, 1986 was used (S = $46.50). The value of the option was calculated using three different exercise prices and three different maturities. The exercise prices are chosen such that the effects of holding (1) an out-of-the-money option (X_1 = $60), (2) an in-the-money option (X_2 = $40) and (3) a deep-in-the-money option (X_3 = $30). To examine the sensitivity of the results to the option's remaining term, maturities are chosen to be 2, 5 and 10 years (T_1 = 2, T_2 = 5, T_3 = 10). The risk-free rate must coincide

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with the maturity of the option; therefore, I used the 2-, 5- and 10-year Treasury Bond rates applicable in October 1986. Volatility was calculated as the annualized standard deviation over one year prior to the spin-off (see Table 2 for results).

Table 2

Statistics Before Spin-off		
	Daily	**Yearly**
Mean Return	0.085%	22.16%
Variance	0.041%	10.63%
Standard Deviation		32.61%

Finally, I adjusted the option price to account for the effect of dividends. The last quarterly dividend prior to the spin-off (that of August 18, 1986 for $0,575), was used as an estimate of future dividends (see Table 3 for a summary of quarterly dividends paid before and after the spin-off). For each of the three periods considered in the analysis, the

Table 3

Before Spin-off			After Spin-off		
Date	Stock Price	Dividend	Date	Stock Price	Dividend
11/18/85	36.625	0.575	11/17/86	26.625	0.500
2/14/86	35.000	0.575	2/17/87	31.500	0.500
5/19/86	37.250	0.575	5/18/87	29.750	0.500
8/18/86	42.500	0.575	8/17/87	33.125	0.500

present value of the predicted quarterly dividends (over the specific period equal to the maturity of the option) was calculated. Since this dividend stream is risky, and is directly related to returns on the equity of the firm, an appropriate return on equity must be determined to discount these cash flows. Historically, firms' return on equity tends to

converge between 10 and 14 percent[5]. Estimating a firm-specific ROE is difficult given that the firm's assets have been altered. Therefore, I used 12% as the discount rate in this case. The present value of the dividends was subtracted from the actual stock price, and this adjusted stock price was used in the Black-Scholes model. Table 4 includes a compilation of the parameters used in the valuation model, and the results obtained. You may notice that the value of the option ranges from $4.19 for a 2-year option with an exercise price of $60, to $20.91 for a 10-year option with exercise price of $30.

Post-Spin-Off Valuation

The procedure to value the option after the spin-off is similar to the one described above. However, the following considerations apply:

1. The stock price (S) used in the model is the parent firm's closing price of the first day of trading after the spin-off is completed. In this case the stock price is $24.75.

2. The ratio (R) of pre-spin-off to post-spin-off stock prices is calculated as $46.50 / $24.75. The ratio is therefore 1.88.

3. Using the above ratio, the three exercise prices used in the analysis were adjusted by dividing them by the ratio. The new exercise prices are therefore $31.94, $21.29 and $15.97.

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[5] Krishna G. Palepu, PhD; Victor L. Bernard, PhD, CPA; and Paul M. Healy, PhD, ACA. Business Analysis ft. Valuation. Cincinnati, OH: South-Western Publishing Co., 1996.

4. Volatility of the new company – without the spun-off subsidiary – is different than before. The problem at the time of revaluing the option is that we do not know ex-ante what the parent firm's volatility will be. We assume that managers have perfect foresight of future volatility. Thus the actual – ex-post – volatility for the first year after the spin-off was computed (σ = 25.42%), which reflects the new characteristics of the business. Table 5 contains summary statistics for Panhandle's returns one year after the spin-off. In this case, volatility decreased after the spin-off, which might be an indication that the spun-off segment was more volatile than the rest of the firm.

Table 5

Statistics After Spin-off	Daily	Yearly
Mean Return	0.081%	21.07%
Variance	0.025%	6.46%
Standard Deviation		25.42%

5. Similar to the problem of determining volatility at the ex-spin-off date, future dividends are uncertain at this time. Again, assuming perfect foresight, the assumption is that management knows future dividend amounts. I assumed all future dividends would be of the same magnitude as the first quarterly dividend after the spin-off (the one on November 17, 1986 for $0.50).

6. All riskless rates and times to maturity are kept the same for purposes of comparison.

7. Although it is likely that the required return on equity will have changed also after the spin-off, I did not have enough information to calculate the new required return, thus the assumption of a long-run rate of 12% was maintained.

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8. Plugging all the new variables into the Black-Scholes formulas, I arrived to the results shown in Table 6. The final value of the option is calculated by multiplying the result from Black-Scoles times the ratio R.

Comparing results from the two scenarios we may notice that the value of the option was greater before the spin-off, for every combination of time to maturity and exercise price. Table 7 compares the gains for an executive holding an option on one share of Panhandle's stock, after the spin-off is completed, when his option is revalued according to the IRS guidelines. One possible explanation for these results includes:

(1) Volatility of the restructured firm (parent) decreased, which reduces the value of the option.

(2) The dividend yield after the spin-off was higher than before. The amount of the quarterly dividend decreased only 13% (from $0,575 to $0.50), while the stock price dropped 47% (from $46.5 to $24.75). Therefore, by subtracting the present value of the dividends from the stock price, we get a smaller adjusted price than the ratio (R) would suggest. A lower stock price means a lower option value. For example, the ratio of the adjusted stock price for a 5-year option before the spin-off, to the same-maturity option after the spin-off, is 2.19 ($37.95 / $17.31), while the ratio of unadjusted stock prices was 1.88.

The above observations suggest that when opposite situations occur - higher volatility and equal or lower dividend yield - the value of the option will be greater after a spin-off. In any case however, the fact that both volatility and dividend yield are very likely to change after a firm completes a restructuring, is evidence that the value of an option on the firm's stock is also very likely to change.

IV. Conclusion

When management decides to implement a restructuring of the company, they have different ways to accomplish it. One of such forms of corporate restructuring is a spin-off, which requires a pro-rata distribution of new stock to the parent company's shareholders, who then own a proportional stake in the spun-off subsidiary. Given the tax-free treatment the IRS requires to revalue options on the parent company's stock, management incentives to pursue a spin-off may be influenced by the amounts of stock options they own. Furthermore, since management has access to private information regarding the expected performance of the restructured firm, they could estimate the effect of a spin-off on the value of their options. And using this information, decide on the form of corporate restructuring to pursue. Specifically, the expected volatility and dividend yield of the parent company after the spin-off will determine whether the options' value (as computed by the Black-Scholes model) will appreciate or depreciate.

With this information, management may decide to pursue the form of restructuring that maximizes the value of their stock options, regardless of whether this scheme maximizes shareholder value.

Table 4

Statistics		Daily	Yearly
Mean Return		0.085%	**22.16%**
Variance		0.041%	**10.63%**
Standard Deviation			**32.61%**
Stock Price		**46.500**	
Ratio		1.88	

Value of Option		Time to Maturity (years)		
	T	**2**	**5**	**10**
	PV(D)	**4.036**	8.555	**13.291**
	Re	**12.00%**	**12.00%**	**12.00%**
Excercise	**Adj S**	**42.464**	**37.945**	**33.209**
Price	**Rf**	**6.33%**	**7.31%**	**7.41%**
	d1	0.001	0.559	1.106
	d2	(0.460)	(0.170)	0.074
60.00	**N(d1)**	0.501	0.712	0.866
	N(d2)	0.323	0.432	0.530
		$4.19	$9.01	$13.60
	d1	0.881	1.115	1.499
	d2	0.419	0.386	0.468
40.00	**N(d1)**	0.811	0.868	0.933
	N(d2)	0.663	0.650	0.680
		$11.08	$14.88	$18.02
	d1	1.504	1.510	1.778
	d2	1.043	0.780	0.747
30.00	**N(d1)**	0.934	0.934	0.962
	N(d2)	0.852	0.782	0.772
		$17.14	$19.17	$20.91

1 Summary statistics calculated from previous year's daily returns
2 Closing stock price on last day before spin-off
3 Ratio of stock prices before and after the spin-
  off
4 Present value of dividends, keeping the last dividend before the spin-off constant,
  and discounting at Re.
5 Cost of equity for Panhandle, estimated at
  13%
6 Adjusted stock price = Stock Price - PV(Dividends)
7 Risk-free rate used to discount exercise price in Black-Scholes model
8 Value of the option for the different exercise prices and
  maturities

Table 7

Gains from Revaluation of Option					
			Time to Maturity (years)		
Excercise	T		2	5	10
Price	Rf		12.00%	12.00%	12.00%
	Oas	1	1.76	3.82	5.30
60.00	Obs	2	4.19	9.01	13.60
	Og	3	($2.43)	($5.19)	($8.29)
	Oas		7.78	8.91	9.23
40.00	Obs		11.08	14.88	18.02
	Og		($3.30)	($5.97)	($8.79)
	Oas		14.11	13.22	12.09
30.00	Obs		17.14	19.17	20.91
	Og		($3.04)	($5.95)	($8.82)

1 Oas = Value of option before the spin-off
2 Obs = Value of option after the spin-off
3 Og = Gain (loss) in revaluation of the option

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