Fall 2005

Improving Pro Forma Analysis through Better Terminal Value Estimates

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Basic pro forma analysis often estimates the terminal value input using a simple growing perpetuity assumption. While this assumption is easy to implement, it potentially creates an upward bias in some inputs leading to lower firm or project value outputs. The purpose of this paper is to demonstrate a more accurate way to estimate the terminal value input. Further, by allowing for multiple sales growth rates and by not restricting other input variables to necessarily grow at these same rates, a more accurate, flexible, compact, and thorough analysis is possible.

INTRODUCTION

Basic pro forma analysis often estimates the terminal value input using a simple growing perpetuity assumption. While this assumption is easy to implement, it potentially creates an upward bias in some inputs leading to lower firm or project value outputs. The purpose of this paper is to demonstrate a more accurate way to estimate the terminal value input. Further, by allowing for multiple sales growth rates and by not restricting other input variables to necessarily grow at these same rates, a more accurate, flexible, compact, and thorough analysis is possible.

Projecting the future cash flows using pro forma analysis is one of the foundation tools for firm, project, and security valuation. Students learn about basic or fundamental pro forma analysis in most introductory finance classes using methods like those presented in Benninga and Sarig (1997). Recently, Arnold and James (2000 and 2003) develop methods to stream-line the pro forma process and make sensitivity analysis of input variables a much easier task. However, all three processes, the basic pro forma and these recent modifications, suffer from a problem that emerges when calculating the terminal value of the cash flows.

The terminal value is calculated by taking the final cash flow from the initial growth phase and allowing the cash flow to grow at a lower rate into perpetuity. This is a standard calculation step similar to that used in the valuation of a common stock when dividends and earnings are expected to grow at abnormal or varying rates in the near-term before settling down to more normal rates of growth in the later periods. Because free cash flow calculations often use intermediate calculations based upon changes between the current and the previous balance sheets (e.g. the change in net working capital), the growth perpetuity calculation becomes incorrect (the following section illustrates this problem numerically).

The purpose of this paper is to demonstrate an estimation adjustment that corrects for the bias in terminal value estimates produced in the Benninga and Sarig-type and Arnold and James-type pro forma models. Further, by allowing for multiple sales growth rates and by not limiting other pro forma inputs to necessarily grow at the same rate as sales, the firm value model generated in this paper creates an analysis of the firm that is more accurate, flexible, and thorough. The model is also more parsimonious to other Excel features, such as data tables and "spinner" toggles, because it retains the compactness of the Arnold and James' models.

In next section, we illustrate the terminal value problem and develop a "corrected" firm value model in Excel. We discuss the benefits of this "corrected" firm value model using the better terminal value assumption in the section that follows. Finally, implications are addressed in conclusion section .

SOLVING THE TERMINAL VALUE PROBLEM

In this section, we demonstrate the solution to the terminal value problem in several steps. First, we present the traditional Benninga-Sarig pro forma approach and the correction for it. Next, we present the Arnold-James approach. Finally, we extend this method by demonstrating an adjustment that corrects for the bias resulting from the use of a growing perpetuity assumption for the terminal value.

Defining the Terminal Value Problem

Traditional pro forma analyses (e.g. Benninga and Sarig) and newer modifications of traditional pro forma analyses by Arnold and James suffer from a "terminal value problem" based on the assumption that the final free cash flow from an initial growth phase can be taken into perpetuity to produce the terminal value. For example, take the 2004 annual report for Intel and use information for Intel gathered from the Value Line Survey (January 14, 2005) to produce forecasted cash flows through 2009 (see Figure 1). Note: this pro forma analysis is not the exact specification of Benninga and Sarig, but is within the scope of how Benninga and Sarig calculate the terminal value within a pro forma analysis.

The terminal value, which is the calculation of all of the cash flows from the year

Figure 1. Intel Forecasts Using Traditional Pro Forma Methods (All Values in Millions Except Share Price)

	A	B	C	D	E	F	G
1	*Constant Inputs:*						
2	Tax Rate:	30.00%					
3	Terminal Growth Rate:	4.40%					
4	WACC:	14.00%					
5	Debt (millions):	900					
6	Shares Outstdg. (2004):	6,400					
7							
8	*Time Varying Inputs:*	2004	2005	2006	2007	2008	2009
9	Sales Growth:		6.70%	8.00%	7.50%	7.00%	7.00%
10	Operating Expense*:		54.00%	52.00%	51.00%	50.00%	50.00%
11	Depreciation*:		13.30%	13.50%	13.26%	13.33%	13.33%
12	Curr. Assets*:		71.00%	72.00%	72.00%	73.00%	73.00%
13	Curr. Liabilities*:		23.00%	22.00%	22.00%	21.00%	21.00%
14	Net Cap. Spending*:		11.46%	11.61%	11.76%	12.00%	12.00%
15							
16	*FCF Components:*	Actual:	Forecasted:	Forecasted:	Forecasted:	Forecasted:	Forecasted:
17	Sales:	$ 34,209.0	$ 36,501.0	$ 39,421.1	$ 42,377.7	$ 45,344.1	$ 48,518.2
18	Operating Expenses:	$ 19,379.0	$ 19,710.5	$ 20,499.0	$ 21,612.6	$ 22,672.1	$ 24,259.1
19	Depreciation:	$ 4,600.0	$ 4,854.6	$ 5,321.8	$ 5,619.3	$ 6,044.4	$ 6,467.5
20	EBIT:	$ 10,230.0	$ 11,935.8	$ 13,600.3	$ 15,145.8	$ 16,627.7	$ 17,791.6
21	EBIT*(1 – Tax Rate):	$ 7,161.0	$ 8,355.1	$ 9,520.2	$ 10,602.0	$ 11,639.4	$ 12,454.1
22	Current Assets:	$ 24,058.0	$ 25,915.7	$ 28,383.2	$ 30,511.9	$ 33,101.2	$ 35,418.3
23	Current Liabilities:	$ 8,006.0	$ 8,395.2	$ 8,672.6	$ 9,323.1	$ 9,522.3	$ 10,188.8
24	Net Working Capital:	$ 16,052.0	$ 17,520.5	$ 19,710.5	$ 21,188.8	$ 23,578.9	$ 25,229.5
25	Net Cap. Spending:		$ 4,183.0	$ 4,576.8	$ 4,983.6	$ 5,441.3	$ 5,822.2
26	**Free Cash Flow:**		$ 7,558.2	$ 8,075.2	$ 9,759.4	$ 9,852.4	$ 11,448.9
27	**Terminal Value:**						$ 124,506.8
28	**Discounted FCF:**		$ 6,630.0	$ 6,213.6	$ 6,587.3	$ 5,833.4	$ 70,611.1
29	**Sum Discounted FCF:**	$ 95,875.5					
30	**Debt:**	$ 900.0					
31	**Value of Equity:**	$ 94,975.5					
32	**Share Price:**	$ 14.84					

*Input taken as a percentage of Sales.

WACC: Weighted Average Cost of Capital

EBIT (Earnings Before Interest and Taxes) = Sales - Operating Expenses - Depreciation

Free Cash Flow (FCF) = EBIT*(1 – Tax Rate) + Depreciation - Change in Net Working Capital - Net Capital Spending

Terminal Value = $11,448.9*(1 + 4.40%) ÷ (14.00% - 4.40%)

Share Price= (Sum of Discounted FCF – Value of Debt) ÷ Number of Shares Outstanding

Inputs are from the 2004 Annual Report for Intel with forecasted values derived from the January 14, 2005 Value Line Survey

2010 into perpetuity is the free cash flow from year 2009 grown at a rate of 4.40% annually and discounted at an assumed weighted average cost of capital (WACC) of 14%.

$$\frac{(\$11{,}448.9 * [1 + 4.40\%])}{(14.00\% - 4.40\%)} = \$124{,}506.8 \text{ million} \quad (1)$$

As performed in Figure 1, the terminal value is discounted as if it occurs in 2009 and is simply added to the discounted free cash flows from the years 2005 through 2009 to produce the estimated value of the Intel ($95,875.5 million). After subtracting the value of the debt from the firm value and dividing the result by the number of Intel shares outstanding, the estimated share price of Intel emerges as $14.84.

If the forecast is extended one more period into 2010 so as to include the first free cash flow that grows at 4.40% (the value of the 2010 estimated cash flow becomes $12,565.7 million), the terminal value (and correspondingly, the share price) can be recalculated using the 2010 free cash flow estimate:

$$\frac{\$12{,}565.7}{(14.00\% - 4.40\%)} = \$130{,}892.8 \text{ million} \quad (2)$$

Note: This terminal value is still discounted as if it is an additional cash flow in 2009

This leads to a share price of $15.36 that is $0.52 higher than the previous share price calculation.

Although both techniques are discounted appropriately and on the surface appear to be the same calculation, the very different answers indicate that one of the techniques is incorrect. To determine the validity of one technique over the other, simply increase the growth rate of sales and notice what happens to the firm value. With the traditional technique, firm value decreases as the sales growth rate increases. With the second technique (extending the analysis an additional period at the terminal growth rate of 4.40%), a sales growth rate increase leads to an increase in firm value. Consequently, the traditional method leads to a counter-intuitive result (the reason is demonstrated mathematically in Section II of this paper) making the second method the preferred method of valuation. This second method is consistent with Damodaran (1994).

Despite improving the pro forma analysis by extending it one period prior to calculating the terminal value, this terminal value estimation deserves further examination given its impact on firm value. In the next subsection, an algorithm is developed based on Arnold and James (2000 and 2003) to produce a better metric for terminal value. Unlike Arnold and James, the calculation does not suffer from the "terminal value problem" and will be used to generate a terminal value rather than the total firm value, the latter being more consistent with the work of Arnold and James. While we could use the proposed algorithm to estimate total firm value, we prefer to use it as a terminal value calculation because, in practice, one usually forecasts three to seven years into the future to make immediate decisions.[2] Additionally, the proposed algorithm would prevent the user from viewing any future cash flows when used as a total firm value calculator, which is the disadvantage of the Arnold and James-type models.

A Three-Phase Terminal Value Model

From Arnold and James (2000), we use the growth-adjusted discount rate, "k^*", which will allow the cash flow to grow over time and will also discount this growing cash flow. k^* is defined as follows:

$$k^* = \frac{(1+k)}{(1+g)} - 1 \tag{3}$$

where "k" is the discount rate and "g" is the constant growth rate.

Using the adjusted discount rate in equation (3), one can generate the necessary set of pro forma mathematics as standard annuity equations. Equations (4) and (5) allow for the discounting of a fixed set of cash flows growing at a constant rate and the differencing (i.e. the current cash flow less the previous cash flow) of these same cash flows as follows:

$$\frac{CF_0}{k^*}\left[1 - \frac{1}{(1+k^*)^N}\right] = \frac{CF_0(1+g)}{(1+k)} + \frac{CF_0(1+g)^2}{(1+k)^2} + \ldots + \frac{CF_0(1+g)^*}{(1+k)^N} \tag{4}$$

$$\frac{CF_0}{k^*}\left[1 - \frac{1}{(1+k^*)^N}\right]\left[1 - \frac{1}{(1+g)}\right] = \frac{CF_0(1+g) - CF_0}{(1+k)} + \ldots + \frac{CF_0(1+g)^N - CF_0(1+g)^{N-1}}{(1+k)^N} \tag{5}$$

where "CF_0" is the initial cash flow that is growing.

Although somewhat cumbersome in the above form, the growth annuity with its first difference" become fairly easy Excel commands:

=PV((1+k)/(1+g)-1, N, -CF_0) and
=PV((1+k)/(1+g)-1, N, -CF_0)*(1 – 1/(1+g))

{Note: the negative sign on the cash flow is the result of Excel's default to make all cash flows negative; the negative sign will offset the default negative cash flow... the format of the function is =PV(rate, number of periods, cash flow if annuity, cash flow if a single cash flow, "0" for regular annuity (default setting) and "1" for an annuity due), when dealing with a regular annuity, the last two function entries can be ignored}. These Excel commands can be further simplified by creating a separate cell assignment for the calculation of the growth adjusted discount rate, "k^*."

Arnold and James continue to create a firm value calculator by allowing cash flows to grow at a lower perpetual rate at some point in the future and further assuming that many of the parameters for the calculator are proportional to revenue (or alternatively, assuming these other parameters grow at the same rate as revenue). In this paper, we deviate at this point to generate a model with three distinctive growth periods: an initial phase, a second phase, and a terminal long-run phase. Further, we allow the different line item accounts that affect the cash flows to grow at rates based on differing assumptions rather than presuming that all accounts vary at the same sales growth rate.

To create the model, adjust the mathematics from equations (3) through (5). Keep "g" as the initial growth rate for the first "N" periods. Let "p" be the second phase of growth for "M" periods. The final period is evaluated as a perpetuity growing at a rate "q." This final rate is generally very low and only considers firm maintenance and inflation. Consequently, an account with an initial cash flow of CF_0 being present valued throughout the three growth phases has the following equation:

$$k_1^* = \frac{(1+k)}{(1+g)} - 1 \tag{6}$$

$$k_1^* = \frac{(1+k)}{(1+p)} - 1$$

$$\frac{CF_0}{k_1^*}\left[1 - \frac{1}{(1+k_1^*)^N}\right] + \frac{CF_0}{k_2^*}\left[1 - \frac{1}{(1+k_2^*)^M}\right] \div (1+k_1^*)^N + \frac{CF_0 * (1+q)}{(k-q)(1+k_1^*)^N(1+k_2^*)^M}$$

Each portion of the equation can be adjusted to produce the first difference by multiplying by (1 – 1/[1 + associated growth rate]).

$$
\begin{aligned}
&\frac{CF_0}{k_1^*}\left[1-\frac{1}{(1+k_1^*)^N}\right]*\left[1-\frac{1}{(1+g)}\right] \\
&+\frac{CF_0}{k_2^*}\left[1-\frac{1}{(1+k_2^*)^M}\right]*\left[1-\frac{1}{(1+p)}\right]\div(1+k_1^*)^N \\
&+\frac{CF_0*(1+q)}{(k-q)(1+k_1^*)^N(1+k_2^*)^M}*\left[1-\frac{1}{(1+q)}\right] \\
&=\frac{CF_0}{k_1^*}\left[1-\frac{1}{(1+k_1^*)^N}\right]*\left[1-\frac{1}{(1+g)}\right] \\
&+\frac{CF_0}{k_2^*}\left[1-\frac{1}{(1+k_2^*)^M}\right]*\left[1-\frac{1}{(1+p)}\right]\div(1+k_1^*)^N \\
&+\frac{CF_0*q}{(k-q)(1+k_1^*)^N(1+k_2^*)^M}
\end{aligned}
\tag{7}
$$

The model from which our terminal value analysis is derived, calculates the discounted value of the free cash flow (FCF): FCF = (Revenue – Operating Expenses – Depreciation)*(1 – Tax Rate) + Depreciation – Change in Net Working Capital – Net Capital Spending, for all three phases. The FCF equation is expanded by redefining the Change in Net Working Capital as the Change in Current Assets less the Change in Current Liabilities. Further, it should be noted that EBIT (Earnings Before Interest and Taxes) is equal to (Revenue – Operating Expenses – Depreciation) and is often used as an intermediate calculation for finding the FCF. Other definitions of cash flow can be substituted as in Arnold and James (2003). However, this definition of cash flow is adequate for this investigation. Unlike a sales-driven pro forma analysis, each part (i.e. line item account) of the FCF equation has its own individual growth rate.

To generate the Damodaran-type terminal value analysis for Intel from above, all line item inputs for the three phase model (sales, operating expenses, depreciation, net capital spending, current assets, current liabilities) all grow at the same rate as sales for all three phases, i.e. at 4.40% annually into perpetuity. The model allows for more flexibility in the selection of growth rates for each line item input and for the length of each growth phase, but these features of the model are explored later in the paper.

Figure 2. Three Phase Model for Intel's Terminal Value Calculation (All Values in Millions Except Share Price)

	A	B	C	D	E	F
1	Inputs:	Initial Values[A]:		g:	p:	q:
2	Sales:	$ 48,518.2		4.40%	4.40%	4.40%
3	Operating Expenses:	$ 24,259.1		4.40%	4.40%	4.40%
4	Depreciation:	$ 6,467.5		4.40%	4.40%	4.40%
5	Net Capital Spending:	$ 5,822.2		4.40%	4.40%	4.40%
6	Current Assets:	$ 35,418.3		4.40%	4.40%	4.40%
7	Current Liabilities:	$ 10,188.8		4.40%	4.40%	4.40%
8	Discount Rates:			14.00%	14.00%	14.00%
9	Tax Rate:	30.00%				
10	Length of Phase 1:	5				
11	Length of Phase 2:	10				
12						
13	Growth Adjusted Rates:	Phase 1[B]:	Phase 2[C]:			
14	Sales:	9.20%	9.20%			
15	Operating Expenses:	9.20%	9.20%			
16	Depreciation:	9.20%	9.20%			
17	Net Capital Spending:	9.20%	9.20%			
18	Current Assets:	9.20%	9.20%			
19	Current Liabilities:	9.20%	9.20%			
20						
21	Valuation:	Phase 1:	Phase 2:	Phase 3:		
22	Sales:	$187,765.9[D]	$198,853.4[M]	$141,016.1[S]		
23	Operating Expenses:	$93,882.9[E]	$99,426.7[N]	$70,508.0[T]		
24	Depreciation:	$25,029.2[F]	$26,507.2[O]	$18,797.4[U]		
25	EBIT[G]:	$68,853.8	$72,919.5	$51,710.6		
26	EBIT*(1 – Tax Rate):	$48,197.6	$51,043.7	$36,197.4		
27	Change in Current Assets:	$5,776.9[H]	$6,118.0[P]	$4,338.5[V]		
28	Change in Current Liabilities:	$1,661.8[I]	$1,760.0[Q]	$1,248.1[W]		
29	Net Capital Spending:	$22,531.9[J]	$23,862.4[R]	$16,921.9[X]		
30	Free Cash Flow[K]:	$46,579.9	$49,330.4	$34,982.5		
31	FCF (Terminal) Valuation:	$130,892.8[L]				
32						
33	Firm Valuation:					
34	Discounted FCF (2005 - 09):	$31,210.5[Y]				
35	Discounted Terminal Value:	$67,981.6[Z]				
36	Value of Firm:	$99,192.1[a]				
37	Value of Debt[*]:	$900.0				
38	Value of Equity:	$98,292.1[b]				
39	Shares Outstanding[*]:	6,400.0				
40	Estimated Share Price:	$15.36[c]				

Figure 2 displays the three phase model in Excel for the terminal value in the Intel example. The appendix contains the cell formulas for the model.

Granted the calculation of the terminal value using the three phase model is more complicated than equation (2). However, the three phase model only requires information from 2009 (recall, the 2010 information is necessary for equation (2), but it was not displayed) and the ability to vary model parameters is extensive. At the moment, the model looks more complex than necessary because the current example is not very complex.

To illustrate how minor changes in the analysis can be easily implemented into the pro forma analysis using the three phase model, change the growth rate of the initial phase to 6%, change the growth rate of the second phase to 5%, and change the growth rate of the third phase to 4%. Using these parameters over a fifty year horizon produces a geometric mean growth rate of 4.40% (i.e. the terminal value growth rate from the initial Intel example). Figure 3 displays the new terminal value calculation of $139,770.8 million which produces a share price of $16.08 when including the 2005 through 2009 free cash forecasts from Figure 1.

Although the tendency to simply allow the terminal value to grow at a perpetual rate that is believed to be the correct rate "on average" is standard practice, Figure 3 demonstrates this practice to be very arbitrary and possibly very inaccurate. The share price of $16.08 is $0.72 higher than the $15.36 price found using the "better" model associated with equation (2). Consequently, the three phase model allows the user to perform sensitivity analysis on the terminal value calculation. Such an analysis has not been considered in the past, which is surprising, given how much of the firm value is dictated by the terminal value calculation. In the next section, the benefits of the three phase model are defined more extensively and the use of Excel's data tables in conjunction with the three phase model is illustrated.

THE BENEFITS OF THE THREE PHASE MODEL

The Terminal Value Problem is Mitigated

As noted in the previous section, the Three Phase Model developed here does not suffer from the same terminal value problem as other analyses because the terminal value is adjusted for the transition between growth rates. To illustrate this facet of the model, eliminate the second phase of growth in equation (6), (i.e. set $p = 0$ and $M = 0$):

$$\frac{CF_0}{k_1^*}\left[1-\frac{1}{(1+k_1^*)^N}\right]+\frac{CF_0*(1+q)}{(k-q)(1+k_1^*)^N} \tag{8}$$

Figure 3. Three Phase Model for Intel's Terminal Value Calculation with Alternative Growth Rates (All Values in Millions Except Share Price)

	A	B	C	D	E	F
1	Inputs:	Initial Values:		g:	p:	q:
2	Sales:	$ 48,518.2		6.00%	5.00%	4.00%
3	Operating Expenses:	$ 24,259.1		6.00%	5.00%	4.00%
4	Depreciation:	$ 6,467.5		6.00%	5.00%	4.00%
5	Net Capital Spending:	$ 5,822.2		6.00%	5.00%	4.00%
6	Current Assets:	$ 35,418.3		6.00%	5.00%	4.00%
7	Current Liabilities:	$ 10,188.8		6.00%	5.00%	4.00%
8	Discount Rates:			14.00%	14.00%	14.00%
9	Tax Rate:	30.00%				
10	Length of Phase 1:	5				
11	Length of Phase 2:	10				
12						
13	Growth Adjusted Rates:	Phase 1:	Phase 2:			
14	Sales:	7.55%	8.57%			
15	Operating Expenses:	7.55%	8.57%			
16	Depreciation:	7.55%	8.57%			
17	Net Capital Spending:	7.55%	8.57%			
18	Current Assets:	7.55%	8.57%			
19	Current Liabilities:	7.55%	8.57%			
20						
21	Valuation:	Phase 1:	Phase 2:	Phase 3:		
22	Sales:	$ 196,053.3	$ 220,557.5	$ 154,094.6		
23	Operating Expenses:	$ 98,026.6	$ 110,278.7	$ 77,047.3		
24	Depreciation:	$ 26,133.9	$ 29,400.3	$ 20,540.8		
25	EBIT:	$ 71,892.7	$ 80,878.4	$ 56,506.5		
26	EBIT*(1 – Tax Rate):	$ 50,324.9	$ 56,614.9	$ 39,554.5		
27	Change in Current Assets:	$ 8,101.1	$ 7,667.0	$ 4,326.5		
28	Change in Current Liabilities:	$ 2,330.4	$ 2,205.6	$ 1,244.6		
29	Net Capital Spending:	$ 23,526.4	$ 26,466.9	$ 18,491.4		
30	Free Cash Flow:	$ 47,161.8	$ 54,086.9	$ 38,522.1		
31	FCF (Terminal) Valuation:	$ 139,770.8				
32						
33	Firm Valuation:					
34	Discounted FCF (2005 - 09):	$ 31,210.5				
35	Discounted Terminal Value:	$ 72,592.6				
36	Value of Firm:	$ 103,803.1				
37	Value of Debt:	$ 900.0				
38	Value of Equity:	$ 102,903.1				
39	Shares Outstanding:	6,400.0				
40	Estimated Share Price:	$ 16.08				

Next apply, the first difference algorithm to equation (8):

$$\frac{CF_0}{k_1^*}\left[1-\frac{1}{(1+k_1^*)^N}\right]*\left[1-\frac{1}{(1+g)}\right]+\frac{CF_0*(1+q)}{(k-q)(1+k_1^*)^N}*\left[1-\frac{1}{(1+q)}\right] \qquad (9)$$

In the previous Arnold and James studies (and consistent with Benninga and Sarig), the associated equation is:

$$\left[\frac{CF_0}{k_1^*}\left[1-\frac{1}{(1+k_1^*)^N}\right]+\frac{CF_0*(1+q)}{(k-q)(1+k_1^*)^N}\right]*\left[1-\frac{1}{(1+g)}\right] \qquad (10)$$

If "g" is greater than "q" (a somewhat standard assumption), equation (10) is greater than equation (9) and illustrates how calculations for the change in net working capital (or the change in current assets less the change in current liabilities) become over-valued, thus resulting in an under-valued free cash flow.

Ability to Perform Sensitivity Analysis on the Terminal Value Calculation

Once the three phase model is created in Excel, it is very easy to perform sensitivity analysis using Excel's data table feature or "spinners" feature. As illustrated in Figure 3, subtle changes in the calculation of the terminal value can have profound effects on the estimated firm value/share price even when the procedures appear to be basically the same (e.g. 4.40% perpetual growth is virtually equivalent to 6% for 5 years, followed by 5% growth for 10 years, followed by 4% perpetual growth).

The data table feature (described more thoroughly in the appendix) allows the user to vary one or two parameters in the three phase model and display the effect on the estimated firm value or estimated share price in a tabular fashion. Table 1 displays an example of data table information for the estimated share price of Intel in which the sales growth rate and length of the first phase of the model is permitted to vary.

A "spinner" is a toggle switch that allows the user to conveniently change a particular parameter value in an iterative fashion upward or downward using a particular increment. The spinner values can be bounded above or below certain values and allows flexibility for the user to test scenarios very quickly. However, the "spinner" does not provide a table of values that are convenient for presentation purposes. Again, the appendix provides a more in-depth discussion of implementing a spinner in Excel.

Table 1. Excel Data Table Information for Intel's Estimated Stock Price (Based on Varying the Sales Growth Rate for Phase 1 and Varying the Length of Phase 1 in Figure 3)

Growth	*Length of Phase 1:*				
Rate:	1 Year	2 Years	3 Years	4 Years	5 Years
4.00%	$ 15.09	$ 14.66	$ 14.26	$ 13.90	$ 13.56
5.00%	$ 15.38	$ 15.22	$ 15.07	$ 14.93	$ 14.80
6.00%.	$ 15.67	$ 15.78	$ 15.89	$ 15.99	$ 16.08
7.00%	$ 15.96	$ 16.36	$ 16.73	$ 17.08	$ 17.41
8.00%	$ 16.26	$ 16.93	$ 17.58	$ 18.19	$ 18.78

Consult the appendix for instructions on implementing a data table in Excel

Finally, the use of software packages that allow for Monte Carlo simulation is particularly effective when used with the three phase model. Every parameter within the model can be analyzed individually or simultaneously to produce a very robust monte carlo type of analysis. Traditional models that simply use a particular free cash flow to produce the terminal value have an implicit assumption that all components of the free cash flow grow at the same rate as sales into perpetuity. Because the growth rates of the components of the free cash flow are independent parameter values within the three phase model, all aspects about the free cash flow calculation can be examined and simulated separately or together. Such dynamic analysis has simply not been able to be performed using traditional pro forma analysis in the past.

Implementation of Target Ratios within the Analysis

A third benefit of the three phase model is actually hidden by the compact nature of the model. In the Arnold and James and Benninga and Sarig models, many of the accounts: operating expenses, current assets, current liabilities, fixed assets, and implicitly depreciation expense (because the value is connected to the fixed assets in thse models), are assumed to change proportionately to sales. Because the three phase model allows the user to enter different growth rates for each account, each account can differ proportionately from the sales figure through time (except if the account actually does grow at the same rate as sales which is the implicit result of making an account a fixed proportion of sales). The compactness of the three phase model actually hides this dynamic aspect of the model.

For example, in Figure 3, operating expenses are 50% of sales in 2009 and are set to grow at the same rate as sales throughout the three phase model. Consequently, operating expenses will remain 50% of sales. Suppose it is believed that operating expenses will be 49% of sales at the end of phase one and be 45% of sales by the end of phase two. Thereafter, operating expenses will grow at 4.00% annually.

Because, the user knows how large operating expenses are going to be relative to sales, "g" and "p" for phases one and two can be selected within the model to produce the desired effect in regard to operating expenses. More generically, let "X" be the value of the account at the start of the given phase (as a proportion of sales) and let "Y" be the value of the account (as a proportion of sales) at the end of the given phase. The phase is expected to last "N" periods, during which, sales grow at a rate "y". The goal is to determine the growth rate for the account, "z" that will create the desired account value (as a proportion of sales) at the end of the phase. The relationship between all of these variables is displayed in equation (11).

$$Y = X * \frac{(1+z)^N}{(1+y)^N} \tag{11}$$

Solving for "z" in equation (11) generates the growth rate for the account that should be used as an input in the three phase model.

$$z = \left[\frac{Y}{X} * (1+y)^N\right]^{\frac{1}{N}} - 1 = \left[\frac{Y}{X}\right]^{\frac{1}{N}} * (1+y) - 1 \tag{12}$$

Applying equation (12) to find the appropriate "g" and "p" for operating expenses yields:

$$g = \left[\frac{49\%}{50\%}\right]^{\frac{1}{5}} * (1 + 6.00\%) - 1 = 5.573\% \tag{13}$$

$$p = \left[\frac{45\%}{49\%}\right]^{\frac{1}{10}} * (1 + 5.00\%) - 1 = 4.110\% \tag{13}$$

Figure 4 displays the effect this change in operating expenses has on the estimated firm value and estimated share price of Intel.

Further, it should also be noted that even knowing information regarding particular

Figure 4. Three Phase Model for Intel's Terminal Value Calculation with Variation in the Growth Rates for Operating Expenses (All Values in Millions Except Share Price)

	A	B	C	D	E	F
1	Inputs:	Initial Values:		g:	p:	q:
2	Sales:	$ 48,518.2		6.00%	5.00%	4.00%
3	Operating Expenses:	$ 24,259.1		5.57%	4.11%	4.00%
4	Depreciation:	$ 6,467.5		6.00%	5.00%	4.00%
5	Net Capital Spending:	$ 5,822.2		6.00%	5.00%	4.00%
6	Current Assets:	$ 35,418.3		6.00%	5.00%	4.00%
7	Current Liabilities:	$ 10,188.8		6.00%	5.00%	4.00%
8	Discount Rates:			14.00%	14.00%	14.00%
9	Tax Rate:	30.00%				
10	Length of Phase 1:	5				
11	Length of Phase 2:	10				
12						
13	Growth Adjusted Rates:	Phase 1:	Phase 2:			
14	Sales:	7.55%	8.57%			
15	Operating Expenses:	7.98%	9.50%			
16	Depreciation:	7.55%	8.57%			
17	Net Capital Spending:	7.55%	8.57%			
18	Current Assets:	7.55%	8.57%			
19	Current Liabilities:	7.55%	8.57%			
20						
21	Valuation:	Phase 1:	Phase 2:	Phase 3:		
22	Sales:	$ 196,053.3	$ 220,557.5	$ 154,094.6		
23	Operating Expenses:	$ 96,904.0	$ 103,748.8	$ 69,342.6		
24	Depreciation:	$ 26,133.9	$ 29,400.3	$ 20,540.8		
25	EBIT:	$ 73,015.4	$ 87,408.3	$ 64,211.2		
26	EBIT*(1 – Tax Rate):	$ 51,110.8	$ 61,185.8	$ 44,947.9		
27	Change in Current Assets:	$ 8,101.1	$ 7,667.0	$ 4,326.5		
28	Change in Current Liabilities:	$ 2,330.4	$ 2,205.6	$ 1,244.6		
29	Net Capital Spending:	$ 23,526.4	$ 26,466.9	$ 18,491.4		
30	Free Cash Flow:	$ 47,947.7	$ 58,657.8	$ 43,915.4		
31	FCF (Terminal) Valuation:	$ 150,520.9				
32						
33	Firm Valuation:					
34	Discounted FCF (2005 - 09):	$ 31,210.5				
35	Discounted Terminal Value:	$ 78,175.8				
36	Value of Firm:	$ 109,386.4				
37	Value of Debt:	$ 900.0				
38	Value of Equity:	$ 108,486.4				
39	Shares Outstanding:	6400.0				
40	Estimated Share Price:	$ 16.95				

profitability margins can be re-interpreted to produce the proportion of sales value for specific accounts. For example, a gross margin (defined as {sales - operating expenses} ÷ sales) of 15% implies that operating expenses are 85% of sales or "85%", measured as a proportion of sales. Again, growth rates within the three phases can be adjusted to industry ratios that vary with the maturity of firms. It is very easy to tailor the three phase model to comply with such ratios using equation (12).

Shorten Forecasting Horizon to Relevant Cash Flows

Explicit forecasts of cash flows should be produced until a "steady state" emerges for the growth of the cash flows further into the future, which permits a perpetuity-type terminal value (see Copeland, Koller, and Murrin (2000). The length of time the forecasts must extend varies with individual applications. However, the further the explicit forecasts extend, the less useful the forecasts become because the accuracy is suspect. Also, planning horizons may simply not need forecasts beyond a certain number of periods despite forecasts not reaching the "steady state" for cash flow growth. In these circumstances, the three phase model can be implemented (with additional phases if necessary) by having latter sections of the explicit forecasts replaced by a phase or phases within the model. In other words, one can concatenate the explicit forecasts to only reveal the portion relevant for the appropriate planning horizon. Consequently, even if one is comfortable with a perpetuity-type terminal value, the model proposed in this paper still provides an ability to simplify such an analysis when explicit forecasts extend beyond the planning horizon.

CONCLUSION

Traditional pro forma analysis as well as some of the more recent modifications often estimate the terminal value input using a simple growing perpetuity assumption, which generally leads to downwardly biased firm or project value outputs. By adjusting the transition values between different growth phases, the model proposed in this paper eliminates this bias in the terminal value.

Further, by allowing for multiple sales growth rates over the life of the model, and by not limiting or restricting other input variables to necessarily grow at these same sales growth rates, the three phase model developed in this paper provides a more dynamic/robust analysis. Further, the model can also allow for differing discount rates throughout the life of the analysis (as suggested in Damodaran (1994)). Ultimately, the three phase model allows the analyst to examine a more dynamic notion of a firm's terminal value. This aspect is very important given how much of the estimated firm value is derived from the terminal value.

Alternatively, an analyst can use the model to concatenate a traditional pro forma analysis to only have explicit forecasts that match the planning horizon for the project. In this case, the analyst may not mind having a less dynamic terminal value component, but can still benefit from using the model to eliminate later sections of a pro forma analysis that are not relevant to the planning horizon.

Finally, due to the compact nature of the model proposed in this paper, Excel's data table feature and "spinner" toggle feature, as well as, sensitivity analysis with simulation software can be implemented without much additional complication. In fact, these two Excel features allow analyses that are simply impossible to perform with standard pro forma techniques.

Issues from this paper can be implemented in the classroom in a variety of ways. The discussion regarding the terminal value or the discussion of the implicit assumption of line items growing at the same rate as sales due to being a constant proportion of sales is effective even without the implementation of the model. The model can be scaled down to simply the final phase to illustrate the terminal value problem (and can actually be performed using a hand-held calculator) or fully implemented in a spreadsheet to allow for a lesson on sensitivity analysis. Consequently, utilizing this paper as a whole or in parts, provides a much richer presentation of pro forma analysis and valuation than what is currently available in texts.

ENDNOTES

[1] The authors acknowledge helpful comments by an anonymous referee, Jean Heck, Ted Heilman, and Terry Nixon

[2] Technically, one should produce forecasts until a "steady state" for the free cash flows emerges.

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APPENDIX

Cell Formulas for Figure 2

[A] Values are taken from Year 2009 in Figure 1
[B] Computed as (1 + k) ÷ (1 + g) -1
[C] Computed as (1 + k) ÷ (1 + p) -1
[D] Cell Formula: =PV(B14,B10,-B2)
[E] Cell Formula: =PV(B15,B10,-B3)
[F] Cell Formula: =PV(B16,B10,-B4)
[G] EBIT = Sales - Operating Expenses - Depreciation
[H] Cell Formula: =PV(B18,B10,-B6)*(1-1/(1+D6))
[I] Cell Formula: = PV(B19,B10,-B7)*(1-1/(1+D7))
[J] Cell Formula: = PV(B17,B10,-B5)
[K] FCF = EBIT*(1 – Tax Rate) + Depreciation – Change in C/A + Change in C/L – Change in F/A
[L] Cell Formula: =B30+C30+D30 or =SUM(B30:D30)
[M] Cell Formula: =PV(C14,B11,-B2/(1 + B14)^B10)
[N] Cell Formula: =PV(C15,B11,-B3/(1 + B15)^B10)
[O] Cell Formula: =PV(C16,B11,-B4/(1 + B16)^B10)
[P] Cell Formula: =PV(C18,B11,-B6/(1 + B18)^B10)*(1-1/(1+E6))
[Q] Cell Formula: =PV(C19,B11,-B7/(1 + B19)^B10)*(1-1/(1+E7))
[R] Cell Formula: =PV(C17,B11,-B5/(1 + B17)^B10)
[S] Cell Formula: =B2*(1 + F2)/((F8 – F2)*(1 + B14)^B10*(1 + C14)^B11)
[T] Cell Formula: =B3*(1 + F3)/((F8 – F3)*(1 + B15)^B10*(1 + C15)^B11)
[U] Cell Formula: =B4*(1 + F4)/((F8 – F4)*(1 + B16)^B10*(1 + C16)^B11)
[V] Cell Formula: =B6*F6/((F8 – F6)*(1 + B18)^B10*(1 + C18)^B11)
[W] Cell Formula: =B7*F7/((F8 – F7)*(1 + B19)^B10*(1 + C19)^B11)
[X] Cell Formula: =B5*(1 + F5)/((F8 – F5)*(1 + B17)^B10*(1 + C17)^B11)
[Y] Calculated from Figure 1
[Z] Cell Formula: =B31/(1 + D8)^(2009 - 2004); the terminal value is computed for Year 2009 and the present is considered to be Year 2004.
[a] Cell Formula: =B34 + B35
[b] Cell Formula: =B36 - B37
[c] Cell Formula: =B38/B39
[*] Information taken from Figure 1 "Constant Inputs" section

Spinners and Data Tables

"Spinners" are toggle switches within Excel that allow the user to quickly change the value within a cell by a certain increment specified by the user. The menu sequence for a "spinner" is View/Toolbars/Control Toolbox. A small menu of icons appears, of which, the spinner toggle consists of two buttons (one triangle pointing up and another triangle pointing down). The spinner toggle looks similar to the "scroll bar" toggle, however, the spinner toggle is larger. If in doubt, simply place the curser on top of the icon and Excel will identify what it is. Left-click the spinner toggle and then move your cursor (it will become a cross rather than an arrow) to where the spinner is to be positioned within the spreadsheet. Holding down the left button of the mouse, outline the area for the spinner and release the mouse button to make the spinner appear. The size of the spinner can be adjusted later. Next, right-click the spinner to produce a menu and select "Properties" from the menu. Under "Properties", specify the "linked cell" (i.e. the cell address for which the spinner is to be applied), set the maximum and minimum values for the spinner ("Max" and "Min" in the menu), and set the incremental change for the spinner value ("Small Change" in the menu). Once the spinner is set, simply use the spinner to make changes in the "linked cell's" value.

A "data table" takes a calculated value contained in a cell and displays the calculation for different input values assuming the input values are contained in separate cell locations in the spreadsheet. To illustrate the data table feature, Figure 1A has the value "4" assigned to cell A1, the value "3" assigned to cell A2, and cell A3 is cell A1 multiplied by cell A2 (i.e. "=A1*A2" in Excel coding). Cell A3 acts as the "calculated value" mentioned above. In cell D1, enter the formula "=A3" and in cells C2 through C3 enter the values 1 through 5. This is the framework for a data table in which the value in cell A3 will be altered by changing the value in cell A1. Highlight cells C1 through D6 and follow the menu sequence Data/Table. A menu will appear for a "row input" and a "column input". In this case, the value to be changed is in A3 (via cell D1) using different values for cell A1 (via cells C1 through C6). Because the values for A1 are contained in a column, one should enter "A1" in the column input and click "OK" to close the menu. Values will appear in cells D2 through D6 that are indexed by the values in cells C2 through C6. The values in D2 through D6 correspond to the value in cell A3 if the corresponding value in cells C2 through C6 had been entered into cell A1.

A two input table can be produced in which the values for cells A1 and A2 are altered corresponding to a column and row index. Enter the formula "=A3" into cell A8, type in the numbers 1 through 4 into cells A9 through A12, and type in the numbers 1 through 3 in cells B8 through D8. Highlight cells A8 through D12, use the menu sequence Data/Table, enter cell A1 as the "row input", enter cell A2 as the "column input", and close the menu by clicking the "OK" button. The resulting data table

Figure 1A. Data Table Example

	A	B	C	D	E	F
1	**4**			***12***		
2	**3**		1	3		
3	***12***		2	6		
4			3	9		
5			4	12		
6			5	15		
7						
8	***12***	1	2	3		
9	1	1	2	3		
10	2	2	4	6		
11	3	3	6	9		
12	4	4	8	12		
13						
14						
15						

Cell A3 Formula: =A1*A2 Cell D1 Formula: =A3
Cell A8 Formula: =A3
Bold values are inserted by the user.
Bold Italic values are formulas inserted by the user.
The "data table" feature produces all other values within the spreadsheet.

produces the value for A3 when cells A1 and A2 are altered via the column and row indexes.

Data tables are particularly convenient for sensitivity analysis using the compact model contained in this paper. For example, one can see the effects on firm/project value when comparing the length of time for a given phase versus the growth rate throughout the phase. Such an analysis using traditional pro forma techniques simply can not be performed. Yet, such analysis is often very necessary for the overall assessment of a project/firm value.

Note: Additional information for the Excel features discussed in the Appendix are available in Sengupta (2004).

Case Study

Bell Financial Software, Inc.

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The dance had gone on for over a year and David Bell, the principal owner of Bell Financial Software, Inc., was getting frustrated. Bell Financial Software, Inc., had just completed a record year in revenue and profits, and he wondered how much longer it would take Roberts Professional Publishing[1] to make the decision to buy his company or walk away after an extended period of due diligence and frequent negotiations. It simply wasn't possible, he thought, for them to do any more due diligence on his company. They had already studied the company's financial records, spoken with clients and vendors, and extensively reviewed the software.

He had never imagined when they initially called late the prior summer just how much time and energy would be devoted to general meetings and negotiations with them. Now, in August, 1998, it was reaching the point where well over half of his time was being spent speaking with them, obtaining information for them related to the due diligence review, or working with his attorney and accountant in preparation for a future meetings with someone from Roberts. Plus, he had difficulty concentrating on his regular work with his mind constantly drifting to thoughts about the transaction.

Ironically, David Bell was most worried about how he would respond if and when an offer came from Roberts. How would he know if the Roberts offer was fair? Besides his gut feel, David Bell wasn't sure how much Bell Financial Software, Inc. was worth and until the past few years his primary concern was making the company successful on an ongoing basis, not having a successful exit. How much room would there be for negotiations over the price and terms with Roberts? What would happen, he worried, if Roberts suddenly decided that the market for Bell Financial Software's products was near saturation and/or that PC-based software was a dying business overall, soon to be replaced by applications available from applications services providers (ASPs) on a per use basis versus license fees?

David Bell knew that the decisions were essentially his to make. Should he continue with the dance? If an offer was made by Roberts, how would he assess it? What was his company really worth today and, just as importantly, given the rapid changes in the software industry, how much could it be worth in the future? Fundamentally, David Bell had to determine the value of his company and he needed to be able to support that valuation number with detailed analysis in the future negotiations with Roberts.

Bell kept telling himself that the time and energy was worth the end result - an opportunity to obtain financial independence and, just as important, a real sense of personal achievement. If the deal would go though, his company, Bell Financial Software, Inc., would be the first of its kind to be acquired by one of the world's major professional publishers. Indeed, he knew that less than 2 percent of all software company owners ever have the opportunity to obtain liquidity through sale of their companies, public offerings, or other exits. Besides, for the first several months, he enjoyed the dance; it was exciting to be involved in the negotiations. Doing a deal was much more interesting than day-to-day business.

It was nearly ten months from the initial discussions with Roberts and fifteen months after their first formal meetings with him, and Bell hoped that they were going to come forward with a solid offer. In the back of his mind, he remembered how in the past years, the company had also had discussions with several other of the major professional publishers including, Prentice-Hall, McGraw-Hill and others. None of these discussions had progressed as far as those with Roberts. Obviously, corporate objectives and financial goals had an influence in the earlier discussions, but fundamentally, the key, he thought, was that everyone from both Roberts and Bell had simply "clicked." There seemed in his mind to be a solid foundation for working together.

David Bell knew, however, that simply clicking wasn't enough. They still had to agree on the price and structure of the transaction. He felt that the standard finance models didn't seem to provide the one right approach because of a lack of data on comparable transactions, expectations about future earnings streams and the company's cost of capital, and different perceptions of the value of the company's underlying assets. This was not like valuing the stock of a publicly-traded company where information was readily available on comparable companies and there is usually general consensus among analysts regarding financial projections and earnings.

David Bell was particularly concerned about how to estimate the company's cost of capital and the use of this estimate in the valuation of the company using discounted cash flow analysis. He couldn't use the standard CAPM and WACC methodology that he learned in business school (risk-free rate, beta, risk premium, etc.) given the size and type of his company.

His company had no debt, so essentially he had to estimate the cost of equity capital. To do so using CAPM, he needed to estimate his firm's beta, but the only betas that were available were for publicly-traded software companies like Microsoft, Oracle, and SAP, businesses totally different than his own. Even small cap firms wouldn't be appropriate, since they were much larger than his company and were typically in much larger horizontal markets versus the smaller, vertical markets for Bell. He remembered, furthermore, that his finance professor had discussed the "small-firm effect" and how it was not consistent with CAPM theory. He also knew that the companies in the "small-firm effect" research were huge compared with his.

Bell decided after speaking with one of his B-school professors that the best way to estimate the cost of capital would be to use the "build-up method." Under this approach, he planned to begin with the risk-free rate of return[2] and then consider adding in risk premiums for company size, industry, business risk, liquidity risk, management risk, and equity risk (i.e. uncertainty regarding the company's projected growth rates, scalability, and, overall likelihood of realizing the expected income flows).

Like most mergers and acquisitions, the transaction was too small to justify hiring an investment banking firm, and even if a investment banking firm was a viable option, it would face the same valuation problems due to a lack of data and, more broadly, different perceptions of the parties involved about the variables to be used in the valuation.

Bell had taken the time to learn about many other technology company transactions, but he wasn't sure just how valuable the information was in regards to valuing his company. Most of the information he had related to large software or other types of companies as the buyer. Nearly all of these were well over ten million dollars, a figure out of his league, and some of the transactions involved stock, both preferred and common. Since many of the acquired companies were privately-held, it was not possible to determine detailed price/earnings ratios or other common finance metrics based on sales, revenues, or other data readily available for publicly-traded companies. Many of the deals, moreover, involved pooling accounting and, hence, the publicly-traded companies that were buyers did not disclose the amount of the purchases in their filings with the Securities and Exchange Commission.[3]

He also knew from industry meetings and friends that most transactions involved a combination of initial payments and payouts based on continuing earnings of the acquired companies. Typically, the buyers were paying a multiple of earnings or sales, although some transactions seemed to be based solely on the buyer's interest in the seller's proprietary products or customer lists. Many transactions had large "earnouts" as contrasted with "upfront" payments to minimize the risks for the buyer.[4] Some combination of valuation approaches was obviously needed.

Bell knew that in most transactions involving closely-held companies, the real price is what the buyer is willing to pay and what the seller is willing to take. Internet-focused companies were really in a separate category and with regards to his company, the golden rule really applied – "he who has the gold makes the rules." Still, Bell realized that having a valuation based on solid financial analysis would help him in the negotiations. Indeed, he knew that the more he could provide the negotiators the easier job they would have selling the transaction internally, particularly to the finance staff and senior