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EMPIRICAL ANALYSIS OF DISCOUNTED CASH FLOW MODEL: EVIDENCE BASED ON PHARMACEUTICAL AND BIOTECHNOLOGY EQUITIES

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ABSTRACT

This thesis explores the efficacy of the discounted cash flow model and empirically analyzes the methodology's ability to predict equity prices one year from implementation. The sample of equities accurately represents the NYSE's Pharmaceutical and Biotechnology subsectors of Healthcare. Model back testing from CY2008 is necessary to match valuation with actual equity prices. The data subsequently applies identical inputs from CY2008 to CY2009 historical figures to evaluate the DCF's ability to forecast CY2010 year-end actual stock prices. Furthermore, the study attempts to structurally alter the standard DCF in order to augment the model's ability to accurately estimate Biotechnology equity prices. The thesis' prognostic results from sample (Pharmaceutical and Biotechnology) equity back tests sufficiently assesses valuation discrepancies and determines the DCF's effectiveness across subsectors of the drug industry.

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Introduction

This thesis plans to investigate the discounted cash flow's predictive abilities when applied to the US healthcare equity markets. Furthermore I will examine the discrepancy in the DCF's accuracy across the two distinct drug subsectors of healthcare: Pharmaceuticals and Biotechnology. I will create a customized DCF model that accurately predicts Pharmaceutical equity prices one year into the future and then apply the exact same model to the Biotechnology subsector to assess the accuracy/performance of the model. Should the DCF demonstrate little predictive value when applied to Biotechnology equities, I will offer potential explanations for said results (intrinsic differences between subsectors and meaningful events that may have altered actual valuations). Additionally I will make a strategic structural adjustment to the model and observe the change in predictive accuracy.

Empirical assessments of widely accepted valuation methodologies, such as the DCF, are essential to learn more about strengths and weaknesses of the approaches. Vigilant valuation performance examination also paves the way for further understanding regarding ideal applicable assets, improvements to methodologies, or even innovation in widely-held theoretical valuation assumptions.

The DCF model constructed and utilized in this study, with back tested inputs from CY2008, predicted stock prices within 12% of the actual equity price for approximately 78% of select large cap Pharmaceutical equities (one year into the future for CY2010). Despite this phenomenal performance, the very same model with the exact same procedural input strategy only predicted stock prices within 45% of the actual equity price for 40% of select Biotechnology equities (one year into the future for CY2010).

As anticipated, Biotechnology valuations were much further off than the Pharmaceutical sample assessed with the same DCF model. Model was subsequently adjusted to include new TV calculation to improve accuracy. Blended Gordon growth and EBITDA exit multiple methodologies were combined in order to augment performance, all other portions of model were held constant to assess EBITDA exit multiple contribution to new valuation. Newly constructed model showed little improvement and predicted stock prices within 25% of the actual equity price for 20% of select Biotechnology equities (one year into the future for CY2010).

Pharmaceutical valuations were fairly predictable due to reliant/diversified cash flows and slower growth. Concerning Biotechnology, both models underestimated 70% of select equities actual stock prices resulting in rather gross miss-valuations. Potential explanations include significant Pharmaceutical patent cliff, buy-out rumors, and significant company sample EV/EBITDA multiple expansion over CY2010.

My findings inherently indicate the intricacies of healthcare equity valuation within the drug industry. Valuations for larger diversified Pharmaceutical firms suffice it to say, are far more preferable assets to analyze via the DCF given the empirical results of my study. Comparatively Biotechnology poses a unique dilemma for valuation approaches, such as the DCF, which usually function strictly off of financial and fundamental metrics. Multiple expansion or contraction, lack of historical financials, market cap size, buy-outs, and product pipelines meaningfully impact the industry creating a milieu of variables that are extremely difficult to gauge and incorporate in valuation.

Literature Review and Relevant Studies

The Gordon Growth Model is arguably one of the greatest conceptual developments in modern valuation. The theory created an effective method for assessing an investment's cash flows into infinity. Published in 1959 the method is named after its founder Myron Gordon. Key assumptions include: a steady growth rate into infinity, company specific discount rate, and an initial cash flow (the growth rate will be applied to selected cash flow). As with every valuation method, the Gordon growth model has certain weaknesses which have been scrutinized in an attempt to improve the valuations reliability.

Aswath Damodaran is a professor at the Stern School of Business at NYU. He has written a number of works regarding Valuation and Corporate Finance over the past decade; with respect to valuation, he has written Damodaran on Valuation (2006), Investment Valuation (2002), and The Dark Side of Valuation (2001). In Damodaran on Valuation, Damodaran examines the role valuation plays in investment strategies. He also explores relative valuation, contingent claim valuation, and discounted cash flow. Considering each methodology one-by-one, Damodaran discusses the necessary inputs and the model's sensitivity to such inputs. His analysis of the relative valuation technique discusses the price-earnings ratio and how the ratio warrants different multiples across industries and company life cycles. Discounted cash flow inputs for growth, discount rates, and cash flow calculations are also scrutinized as Damodaran delves into the process by which equity analysts arrive at the aforementioned figures.

Investment assessment, the DCF, and other issues regarding Equity valuation strategies were also extensively investigated in Streetsmart Guide to Valuing a Stock: the Savvy Investor's Key to Beating the Market by Penn State University's Gary Gray, Patrick Cusatis, and Randall

Woolridge. The book covers everything valuation from the ground up, starting with the ten basics of finance (i.e. risk versus return, time value of money, asset diversification, efficient markets etc.) to some of the most important valuation issues including the derivation of appropriate discount rates.

Streetsmart Guide to Valuing a Stock: the Savvy Investor's Key to Beating the Market also discusses why the DCF is used (rather than other strategies such as EPS) as a means to value equities and the advantages born through the examination of an entity's free cash flow generation. Necessary considerations when modeling cash flows are examined extensively; free cash flow and weighted average cost of capital calculations/intricacies are analyzed and various examples are provided throughout the book.

There have been an enormous amount of studies regarding the spectrum of valuation methodologies. The discounted cash flow model is no exception; in 2000 Hank Berkman, Michael Bradbury, and Jason Ferguson sought to explore "*The Accuracy of Price-Earnings and Discounted Cash Flow Methods of IPO Equity Valuation"*. The team attempted to assess the two models (price-earnings and discounted cash flow) ability to accurately judge real market prices. Forty-five newly listed equities were examined a la New Zealand Stock Exchange. Berkman, Bradbury, and Ferguson wanted to see how the DCF and price-earnings method would perform in a relatively illiquid market environment in comparison to its highly liquid US counterpart. Berkman, Bradbury, and Ferguson also explored industry specific DCF and price-earnings models and compared the results to their standard counterparts. The study concluded:

> "Our results show that the best DCF and P/E valuations have similar accuracy. The methods have median absolute valuation errors of around

> 20% and explain around 70% of the variation in market price scaled by book value. Market and transaction P/Es, and DCF estimates using market-based estimates are the most accurate methods. Industry P/Es and industry-based DCF estimates yield larger valuation errors. We attribute the poor industry results to the inability to find appropriate comparable firms in the thin New Zealand equity market" **(**Berkman, Bradbury, and Ferguson).

The study marked a follow up with intention to corroborate the findings of Kaplan and Ruback's examination of the discounted cash flow models within the US equity markets. Entitled "*The Valuation of Cash Flow Forecasts: an Empirical Analysis*" the paper seeks to examine the difference between the market value of highly levered transactions and their relative cash flow projections. Fifty-one highly levered transactions were examined between 1983-1989:

> "Our estimates of discounted cash flows are within 10%, on average, of the market values of the completed transactions. Our estimates perform at least as well as valuation methods using comparable companies and transactions" (Kaplan and Ruback).

Another interesting study pertains to "*A Comparison of Dividend, Cash Flow, and Earnings Approaches to Equity Valuation*" by Stephen Penman and Theodore Sougiannis. The study attempted to determine the difference between valuing equities on finite realistic horizons rather than into perpetuity. This resulted in problematic terminal value calculations as the study examined the differing time horizons effect on different valuation techniques (including the DCF). Errors were recorded in respect to the abridgement of the time horizon as well.

Different Approaches to Equity Valuation at a Glance

Equity valuation is arguably one of the most fascinating facets of the financial world. The wide array of valuation methodologies exemplifies investors' beliefs that true mispricing occurs in the market and that stock price fluctuation can be explained/predicted. On Wall Street Investment Banks utilize Comparable Companies, Precedent Transaction, Leveraged Buy-Out, Dividend Discount and the Discounted Cash Flows Analyses to offer their clients the best products possible. Valuation can be a determining factor for a client to offer equity, debt, or engage in Mergers and Acquisitions. Mergers and Acquisitions represents the most utilitarian function of valuation as it allows clients to discern whether a target represents an attractive investment or if an offer fairly compensates the current shareholders of the firm (in the event of a takeover). An example of valuation driving an equity offering would typically involve an analysis on how expensive the client's stock was trading relative to peers and relative to its own history. Internally a firm has the best knowledge of its future earnings prospects and would likely understand that the most capital could be raised through an equity issuance while the stock price was at a premium.

As alluded to earlier, a company may be valued using a variety of valuation strategies as each approach possesses innate strengths and weaknesses; accordingly some methodologies will produce superior valuations when assessing inherently different entities (different industries/subsectors). Five primary valuation methods are listed below:

Comparable Companies Analysis (CCA) is pretty self-explanatory. The technique involves acquiring a group of entities that possess similarities with the company being valued. Peers are typically selected on a combination of financial and market characteristics. Financially, ideal

peers have a similar market cap, Earnings before interest depreciation and amortization (EBITDA) margin, capital structure, profit margin, tax rate, and asset base. In regards to market oriented characteristics the peers should have analogous end markets (clients), products, industry classification, geographic exposure, hedging strategies, and supplier relations.

Once these peer companies are gathered various metrics and ratios are calculated averages are subsequently compared to the target company. Some useful ratios include: Enterprise value to EBITDA (EV/EBITDA), enterprise value to sales (EV/S), enterprise value to EBIT (EV/EBIT), price to earnings (P/E), price to book-value (P/BV), and price to earnings to growth (PEG). Other financial aspects will be examined as well such as margins or capital structure; however the aforementioned ratios pertain exclusively to valuation. Finally the ratios are then applied to the target company's figures to arrive at an appropriate price given the industry. The weakness of this valuation method lies in the likeness of the peers. It is often difficult to find perfect peers; however if irrelevant peers are applied to the target company the figures can be extremely misleading. The strength of this technique lies in its ability to value companies that have relatively erratic or unpredictable cash flows. It also is an effective means of valuing a company that may currently be cash flow negative. An example of a comparable set is displayed below:

Example Comparable Set										
					Valuation Multiples					
Company (by mrkt cap)	Ticker	Mrkt Cap	EV	EBITDA	EV/EBITDA	EV/EBIT	P/E	PEG	P/BV	P/S
Company A	AAA	$ 100,000	$ 123,237	$ 23,000	5.4x	7.4x	21.4x	1.4x	4.4x	2.5x
Company B	BBB	89,000	112,500	24,000	4.7	6.7	20.7	1.0	3.7	1.3
Company C	CCC	78,000	99,699	20,000	5.0	7.0	21.0	1.7	4.0	2.0
Company D	DDD	67,000	94,143	10,000	9.4	11.4	22.4	1.3	7.4	4.5
Company E	EEE	56,000	72,501	8,000	9.1	11.1	25.1	1.1	8.1	5.0
Company F	FFF	45,000	71,473	12,000	6.0	8.0	17.0	0.8	5.0	1.5
Company G	GGG	34,000	53,502	7,000	7.6	9.6	23.6	1.0	5.6	2.9
Company H	HHH	23,000	51,451	6,000	8.6	10.6	24.6	0.8	7.6	3.8
Company I	III	12,000	36,409	4,000	9.1	11.1	21.1	1.0	8.1	4.0
Company J	JJJ	1,000	28,428	2,100	13.5	15.5	23.5	2.4	9.5	9.0
Mean		**$ 50,500**	**$ 74,334**	**$ 11,610**	**7.8x**	**9.8x**	**22.0x**	**1.3x**	**6.3x**	**3.7x**
Median		50,500	71,987	9,000	8.1	10.1	21.9	1.1	6.5	3.4
Max		100,000	123,237	24,000	13.5	15.5	25.1	2.4	9.5	9.0
Min		1,000	28,428	2,100	4.7	6.7	17.0	0.8	3.7	1.3

Precedent Transaction Analysis functions almost exactly like CCA except the "peers" are actually similar deals that have been executed. The analysis primarily focuses on the deals/transactions that have transpired in a particular industry among the client's peers. The analysis applies the acquirers purchase price as a function of the targets EBITDA, Sales, etc. Once industry deal averages have been calculated we apply the multiples to the company's metrics. The primary weakness of this strategy lies in the ability to find enough relevant transactions to derive a reliable average and median to assess our own company. Comparatively, this analysis allows us to see the premiums paid by acquirers and potentially dissect the valuation to determine what percentage of the premium can be attributed to control versus synergy rationale; overall valuation is usually highest.

Leveraged Buy-Out Analysis is unique valuation methodology that is often used in hostile takeover situations. The tactic is employed by financial buyers who view the acquisition as an investment they hope to resell at a profit in five to ten years. Ideal targets operate in non-cyclical industries; possess a strong asset base, capable management team, and inherently emanate the opportunity to improve cost structure/efficiency.

Strategically speaking (usually), a private equity firm partnered with an investment bank will utilize a combination of debt and equity to buy out the target. The acquirer(s) will then use the targets own balance sheet to raise debt which usually provides 90% of the transaction's total value. Returns are realized when the target is sold or when the debt is completely paid down allowing all cash flows to be paid out in dividends. The small initial equity investment allows PE and investment banks to earn excellent returns assuming the target's solvency is not threatened by the high interest and principal payments. Interest payments are often problematic as the company's debt/equity ratio (and leverage) usually allows investors to classify the investment as "junk bonds". These risky bonds require larger payouts for investors willing to take on the risk; accordingly interest payments are much higher for the target company. Acquirers justly emphasis the company's operating cash flows to ensure that the target will remain solvent and profitable.

Leveraged buy-out returns can be augmented by increasing the value of the firm, paying down debt (subsequently increasing the equity portion of the company ownership), or reducing the required initial equity contribution. The actual Leveraged Buy-Out model contains a sources and uses table for all capital in the transaction and a fully flowing three statement model of the target's anticipated cash flows. Cash flows generated by the entity are consequently used to pay down the long term debt in order to reduce the strain of exorbitant interest payments/increase the equity ownership of the company. After a significant intrinsic return is imminent, the acquirer will then aim to shop the target around and realize its gains.

Dividend Discount Analysis values companies based on the entity's current dividend, cost of equity, dividend pay-out ratio, and expected dividend growth rate. Historical figures such as

EPS, and return on equity are required to arrive at a realistic growth assumption. Expected dividend growth rate is estimated by the following equation:

Dividend Growth Rate = (1-Payout Ratio)*(Return on Equity)

The next expected dividend payment per share is then multiplied by the calculated growth rate plus one and promptly divided by the cost of equity (ke) less the calculated growth rate. There are several major drawbacks of the DDM. First and foremost the valuation is worthless for any company that doesn't pay dividends; DDM is also extremely sensitive to the growth rate assumption. In particular as the dividend growth rate nears the cost of equity the share price will approach infinity.

Discounted Cash Flow Analysis is considered one of the most in-depth valuation strategies that can be administered. The valuation assumes that a company's stock price is simply a reflection of all the future cash flows of an entity. In order to find share price the model calculates a firm's free cash flow. Free cash flow is the leftover capital an entity has after it has satisfied the needs and demands of its current asset base. This free capital could be used in a multitude of ways to augment shareholders wealth. A firm could pay down debt, issue/increase dividends, acquire an attractive company, expand into new markets, or repurchase shares. Unlevered free cash flow can be calculated as follows:

Unlevered FCF = EBIT*(1-T) + Depreciation & Amortization – Cap. Ex. - Δ Net Working Capital

Unlevered cash flows ignore capital structure and subsequently produce figures that are reflective of the actual cash generating abilities of the underlying firm. Depreciation and amortization satisfies the accounting matching principle by expensing an asset over its useful life rather than entirely in the period it was purchased. Hence it does not reflect an actual cash

outflow and must be added back to show how much FCF the firm genuinely possesses. Capital expenditures represent purchases of long term assets supporting the firm's business/operations. Finally, net working capital represents the amount of assets/capital tied up in running the day to day operations of the company.

Structurally, the DCF can be either two or three-stage. A two-stage model projects out the income statement (and consequently the FCF) over the growth stage of the company and then derives a terminal value. The terminal value quantifies the entity's cash flows beyond the projection period into infinity. A three-stage DCF is more extensive as it projects out the growth period of the entity followed by an additional time period where growth rates are tapered off and margins are leveled. This method places more of the value in the actual projections rather than the terminal value calculation.

Terminal value can frequently represent over 60% of the overall equity valuation and should be calculated diligently with realistic assumptions. Two possible ways to calculate terminal value include the Gordon Growth Model and EBITDA exit multiple. The Gordon Growth approach takes the final FCF figure from the projections portion of the DCF and applies a growth rate to it. The growth rate should be relatively small as this represents the assumed FCF growth into infinity. An example of an unrealistic growth rate would be any percentage above the growth of the US economy. If this assumption is applied it essentially declares that the company will eventually overtake the economy since it is growing faster into perpetuity. Terminal value can be calculated by the following perpetuity equation:

TV = Final FCF*(1+g)/(WACC-g)

EV/EBITDA multiples are an effective means to derive terminal value as well; many investment bankers actually back into an EBITDA multiple given their Gordon Growth TV to see if the assumptions are legitimate. Should multiples seem inflated the growth rate will be adjusted accordingly and vice versa. If an EBITDA exit multiple is applied to gauge terminal value the derivation is fairly straight forward. The TV would simply equal the EBITDA in the final projection period multiplied by an EV/EBITDA multiple (and discounted of course). The multiple could represent the entity's historical EV/EBITDA ratio, a predicted future multiple, or an average of the peer group. The multiple could also be a blend of all three of the aforementioned strategies weighted in any fashion.

Unlevered free cash flow projections and terminal value are then discounted by the company's weighted average cost of capital (WACC). The WACC represents the average cost of one dollar of financing for the company quantifying the necessary return for a project to be NPV positive. WACC can be derived with the following equation:

$$WACC = E/(D+E)*Ke + D/(D+E)*Kd*(1-tc)$$

Ke = Return on equity
Kd = Cost of debt
E = Equity
D = Debt
tc = Tax rate

The capital asset pricing model (CAPM) is incorporated in the WACC through the cost of equity (Ke). The cost of equity reflects the necessary return of shareholders given the risk of the firm, and the intrinsic risk of having the last rights to the firm in the event of bankruptcy. Cost of equity can be achieved by the following equation:

$$Ke = \text{Risk Free Rate} + \beta*(\text{Market Risk} - \text{Risk Free Rate})$$

The discount rate, or WACC, is vitally important to the DCF. An erroneous rate can result in severe valuation fluctuations rendering the DCF worthless.

Once a discount rate has been established it is applied to the projected cash flows and terminal value to discern the NPV (standard TVM equation utilized). The PV cash flows and terminal value are then combined to find the enterprise value of the firm. EV can also be calculated by the following equation:

Equity Value (Mrkt. Cap)
+Debt
+Minority Interest
+Preferred Shares
-Cash
Enterprise Value (EV)

Enterprise Value (EV
-Debt
-Minority Interest
-Preferred Shares
+Cash
Equity Value (Mrkt. Cap)

The net debt is then subtracted from the Enterprise value to find the equity value which in turn is divided by the diluted shares outstanding of the firm at the time the DCF is being administered. Diluted share count accounts for all derivative securities that could be exercised (in the money). Some examples include options and convertible debt securities.

The DCF is an extremely comprehensive valuation model. The model's weakness and strength are one and the same, inputs (growth rates, margins, WACC, etc). The quality of the DCF's projections hinges on the quality of the inputs; if the inputs are questionable a garbage-in garbage-out scenario ensues. The model also suffers from confirmation bias as the analyst utilizing the DCF will likely employ overly optimistic projections resulting in unjustified prices.

Given the breadth of approaches utilized in equity valuation, we can justly infer that this area of finance is relatively subjective and requires an in depth understanding of the underlying

asset and the valuation models in order to make the best predictions. This thesis plans to explore the efficacy of the DCF model through empirical back testing of inputs in regards to Pharmaceutical and Biotechnology firms in the healthcare equity markets.

Data Extraction and Selection

Extraction was facilitated by a number of electronic resources including Bloomberg and FactSet. Income statement historical figures and all data for each respective company were extracted using the FactSet application in tandem with Microsoft Excel. Balance Sheet items such as cash, current portion of LT debt, were pulled using various FactSet codes built into the excel model. Income Statement items were extracted using the same procedure. "Appendix 1: FactSet Codes" has been attached to this thesis for exact code references used for data harvesting.

Bloomberg was also an essential application for data extraction. All discount rates for discounted cash flow valuations in this study were harvested company by company from Bloomberg WACC page. WACC page can be accessed via command "TICKER EQUITY WACC". Once at the WACC main page companies can be readily shifted by entering new tickers, WACC figure appears in large white numbers on the left side of the screen. Furthermore, historical WACCs can be accessed by typing "91" in the command bar.

The equities chosen for this study were all large drug producers that traded on the NYSE (further requirements discussed later). However, despite the fact that they all produced drugs, their products offerings and actual drug compositions were intrinsically different and consequently needed to be categorized correctly. Selected equities were allocated to the

Pharmaceutical or Biotechnology segments of the market in order to successfully test the discounted cash flow model across subsectors of healthcare.

Large Pharmaceutical companies usually market a wide variety of drugs (many of which are not derived from living cells) across a multitude of indications; drugs are developed from known products and re-engineered in order to eliminate portions of the compound that cause adverse side-effects. Large cap Pharmaceutical companies also boast diversified revenue pipelines that incorporate medtech devices or even consumer goods. Moreover, many Pharmaceutical companies offer generic forms of drugs whose patents have previously expired. Capital structure is usually a calculated efficient balance between debt and equity.

Biotechnology firms are far more specialized and usually exclusively offer drugs (often in a single indication); a Biotechnology drug fundamentally differs from a traditional Pharmaceutical product since it is developed from a living molecules rather than a chemical compound. The vast majority of Biotech companies are privately held and have no revenues; analogous to an all or nothing bet, a fledging Biotech's first product outcome will usually dictate the path of the entire firm. The FDA approval process facilitates this cash flow deficiency considering the average drug approval usually requires twelve years before the product can be brought to market. In regards to largest Biotech firms, most have positive operating cash flows; however, attaining the aforementioned sustainable cash flows rarely occurs in this subsector. Generally, Biotech capital structure is primarily equity given the riskiness of the business and lack of cash flows. Despite the ultimate differences between the two subsectors, the differentiation continues to blur as mergers, acquisitions, and a shifting landscape breed hybrid entities.

Sample Pharmaceutical equities were chosen by market cap. Ten largest companies were selected with two mutually exclusive stipulations: equities could be based outside of US or derive revenues from sources other than drugs. Despite Alcon Inc's approximately $50 billion market cap, the firm is based in Switzerland and derives a large portion of revenues from surgical medical instruments and consumer eye products, disqualifying its participation in the study. Subsequently, the smaller Eli Lilly & Co (approximately $40 billion market cap) captured the number ten position for this study. A comparable set of the selected Pharmaceutical equities can be seen in the figure below:

Pharmaceutical Overview

Company (by mrkt cap)	Ticker	Mrkt Cap	EV	Sales	EBITDA	LT Earnings Growth	Dividend Yield	EV/EBITDA	P/E	P/Sales
Johnson & Johnson	JNJ	$ 163,566	$ 155,885	$ 61,639	$ 19,761	7.20%	3.61%	7.9x	12.9x	2.7x
Pfizer Inc.	PFE	163,502	181,638	67,809	26,503	1.50	3.91	6.9	17.2	2.4
Novartis AG ADS	NVS	125,645	148,249	50,634	13,301	4.92	3.65	11.1	13.8	2.5
GlaxoSmithKline PLC ADS	GSK	102,938	116,684	43,823	10,372	7.27	5.15	11.2	39.6	2.3
Merck & Co Inc	MRK	102,235	111,569	45,913	10,768	5.25	4.58	10.4	128.7	2.2
Sanofi-Aventis S.A. ADS	SNY	94,085	96,595	40,161	13,944	1.13	3.06	6.9	11.6	2.3
Abbott Laboratories	ABT	77,364	89,468	35,167	9,541	10.60	3.84	9.4	16.1	2.2
AstraZeneca PLC ADS	AZN	66,872	65,265	33,303	14,531	0.72	5.37	4.5	8.2	2.0
Eli Lilly & Co.	LLY	40,530	38,907	23,076	8,100	-10.00	5.60	4.8	7.7	1.8

Sample Biotechnology equities were chosen by market cap in similar fashion. Stipulations were reduced to companies solely based in the US. Omission of diversified product line stipulation can be attributed to subsector relevance, as well as relatively scarce large Biotechnology population available for sample selection. A comparable set of the selected Biotechnology equities utilized in this study can be seen in the figure below:

Biotechnology Overview										
Company (by mrkt cap)	Ticker	Mrkt Cap	EV	Sales	EBITDA	LT Earnings Growth	Dividend Yield	EV/EBITDA	P/E	P/Sales
Amgen Inc.	AMGN	$ 50,418	$ 48,118	$ 15,053	$ 6,608	7.82%	0.00%	7.3x	11.5x	3.3x
Gilead Sciences Inc.	GILD	33,274	38,187	7,949	4,242	12.02	0.00	9.0	10.9	4.2
Celgene Corp.	CELG	25,988	24,924	3,578	1,248	26.19	0.00	20.0	31.5	7.3
Genzyme Corp.	GENZ	19,936	21,093	4,049	707	22.83	0.00	29.8	45.4	4.9
Biogen Idec Inc.	BIIB	17,647	18,718	4,716	1,923	8.73	0.00	9.7	17.0	3.7
Life Technologies Corp.	LIFE	9,501	12,284	3,588	1,130	10.33	0.00	10.9	27.9	2.6
Illumina Inc.	ILMN	8,810	9,318	903	245	27.22	0.00	38.1	72.8	9.8
Dendreon Corp.	DNDN	5,624	5,146	48	-276	NA	0.00	-18.6	NA	117.0
Regeneron Pharmaceuticals I	REGN	4,152	3,738	459	-78	4.00	0.00	-48.1	NA	9.0
Cambrex Corp.	CBM	161	248	227	44	NA	0.00	5.6	15.7	0.7

Components and Structure of DCF Model Employed in Empirical Study

In order to build an effective DCF model I had to project and construct the necessary financial figures to arrive at unlevered FCF; accordingly I created a detailed income statement and operating working capital (NWC) table:

GSK	Historical				
	2005A	2006A	2007A	2008A	2009A
Capex and OWC Projections					
Capex	$ 2,142	$ 2,954	$ 4,303	$ 3,811	$ 2,943
% revenue	*5.5%*	*6.8%*	*9.4%*	*8.5%*	*6.6%*
OWC					
Total Assets	42928	45851	57157	53479	65409
% growth	*NA*	*6.8%*	*24.7%*	*-6.4%*	*22.3%*
Total Liabilities	29921	26971	37494	41336	48055
% assets	*69.7%*	*58.8%*	*65.6%*	*77.3%*	*73.5%*
Cash	8993	5949	9935	10029	11215
% total assets	*20.9%*	*13.0%*	*17.4%*	*18.8%*	*17.1%*
Current Assets	22641	21511	27036	25210	28385
% total assets	*52.7%*	*46.9%*	*47.3%*	*47.1%*	*43.4%*
Curr. Portion of LT Debt	2062	1405	6952	1396	2375
% total liabilities	*6.9%*	*5.2%*	*18.5%*	*3.4%*	*4.9%*
Current Liabilities	16342	14217	20526	14623	19577
% total liabilities	*54.6%*	*52.7%*	*54.7%*	*35.4%*	*40.7%*
OWC	-632	2750	3528	1953	-32
Δ in OWC	**NA**	**3382**	**778**	**1575**	**1985**

GSK	Historical				
	2004A	2005A	2006A	2007A	2008A
Income Statement					
Revenue	$ 37,442	$ 39,277	$ 43,151	$ 45,607	$ 44,857
% growth	*NA*	*4.9%*	*9.9%*	*5.7%*	*-1.6%*
COGS	6286	6999	7528	8790	8875
% margin	*16.8%*	*17.8%*	*17.4%*	*19.3%*	*19.8%*
Gross Margin	31156	32277	35622	36818	35982
% margin	*83.2%*	*82.2%*	*82.6%*	*80.7%*	*80.2%*
SG&A	12986	13147	13483	13440	13209
% margin	*34.7%*	*33.5%*	*31.2%*	*29.5%*	*29.4%*
R&D	5221	5687	6423	6356	6281
% margin	*13.9%*	*14.5%*	*14.9%*	*13.9%*	*14.0%*
D&A	1639	1639	1780	2052	2268
% margin	*4.4%*	*4.2%*	*4.1%*	*4.5%*	*5.1%*
Other Oper. Exp.	544	0	0	0	7
EBIT	10766	11805	13936	14970	14217
% margin	*28.8%*	*30.1%*	*32.3%*	*32.8%*	*31.7%*
Non-Oper. Income (Exp)	874	1353	1341	1624	1671
Interest Income					
% cash interest					
Interest Expense	548	820	650	871	1527
LT Debt	8409	9057	9339	14022	22235
% cost of debt	*6.5%*	*9.0%*	*7.0%*	*6.2%*	*6.9%*
Unusual Expense (Inc)	0	225	242	861	2183
Pre-tax Income	11092	12113	14386	14861	12178
Income taxes	3055	3474	4275	4301	3586
Implied tax rate	*27.5%*	*28.7%*	*29.7%*	*28.9%*	*29.5%*
MI Expense	121	136	98	92	114
Net Income	7915	8503	10012	10468	8477
% profit margin	*21.1%*	*21.6%*	*23.2%*	*23.0%*	*18.9%*

The income statement provided the EBIT, tax rate, and depreciation and amortization portion of FCF equation. Five years of historical data were cited before projections to provide a reference for future growth rates and margins. This particular model also uses an operating working capital (OWC) projection which subtly differs from the classic net working capital figure. NWC

is calculated by taking Current Assets less Current Liabilities. Comparatively OWC excludes non-operating items such as cash and interest bearing current liabilities.

The actual DCF portion of the model consists of two stages. The growth, or first, stage is comprised of a five year projection of the company's income statement and net working capital table. Figures are estimated through a combination of growth and margin projections which will be addressed in greater detail later. The unlevered free cash flow projection pulls the calculated values from the income statement and OWC table as demonstrated below:

GSK	Historical					Projections				
	2004A	2005A	2006A	2007A	2008A	2009E	2010E	2011E	2012E	2013E
Discounted Cash Flow Analysis										
EBIT*(1-t)	$ 7,801	$ 8,419	$ 9,795	$ 10,638	$ 10,030	$ 10,194	$ 10,425	$ 10,689	$ 11,043	$ 11,471
Plus: D&A	1639	1639	1780	2052	2268	2240	2226	2227	2241	2270
Less: Capex	1918	2142	2954	4303	3811	3646	3506	3388	3290	3209
Less: Δ in OWC	NA	-1068	3382	778	-1575	-1128	864	304	108	443
Unlevered FCF	7521	8985	5239	7609	10061	9915	8281	9223	9887	10088

The second stage, or terminal value portion of the DCF, uses the Gordon Growth Model. Present values of the stages are calculated using the firm's WACC. I added a sensitivity analysis (SA) to provide alternate valuations and a range of potential equity prices. A representation of the SA on the two stages of the DCF is shown below:

		Terminal Value GG Model Selected Growth Rates		
WACC	**NPV of Future Cash Flows**	*2.0%*	*2.5%*	*3.0%*
9.5%	$36,243	$86,687	$93,307	$100,942
9.8%	36009	82950	89082	96118
10.0%	*35776*	79459	*85150*	91652
10.3%	35546	76190	81484	87505
10.5%	35319	73125	78059	83648

The SA provides a look at the valuation given different discount rates and terminal growth rates. This array help's expedite a modeler's input entry process in addition to giving best and worst case scenario valuations.

Biotech was valued using the aforementioned model as well as an altered discounted cash flow model in an attempt to improve accuracy. The altered model functioned exactly like the previous save for the terminal value calculation. Terminal value calculations were a sum of two separate TV methodologies weighted on a company by company basis. The two TV calculation employed were the Gordon Growth Method and the EBITDA exit multiple approaches. Weightings were correlated to the market cap of the firm. The size of the firm had a positive correlation with the weighting on the Gordon Growth Method of the calculation and vice versa. An example of the EV derivation can be seen below:

WACC	NPV of Future Cash Flows
6.8%	$16,749
7.0%	16641
7.3%	*16533*
7.5%	16427
7.8%	16322

+

		40.0%			*60.0%*			
TV Gordon Growth Model Selected Growth Rates				**TV EBITDA Exit Multiple** Selected Multiples				**Enterprise Value** Selected Growth Rates		
1.0%	*1.5%*	*2.0%*		*8.1x*	*8.6x*	*9.1x*		*1.0%*	*1.5%*	*2.0%*
$45,935	$50,550	$56,135		$30,972	$32,892	$34,812		$53,706	$56,705	$60,091
43512	47696	52714		$30,612	$32,510	$34,407		$52,413	$55,225	$58,371
41290	*45096*	49626	+	$30,257	*32133*	$34,008	=	$51,203	*53851*	$56,789
39245	42720	46826		$29,907	$31,761	$33,615		$50,069	$52,572	$55,327
37357	40540	44277		$29,561	$31,394	$33,227		$49,002	$51,375	$53,969

Summary of Inputs

The model functions off of several important inputs. Projections over the growth (first) stage of the DCF represent an assortment of rolling averages and uniform expansion or contraction of margins or growth rates. The following inputs are required to run the model on a stock:

- Income Statement
    - Revenue growth – gradually tapered or expanded to meet desired growth rate in final projection year;
    - COGS, SG&A, R&D, and D&A margins – margin based analysis, calculated on a percentage of revenue basis;
    - Tax rate – due to lack of predictability three year rolling average applied to each year of projections.
- Net Working Capital & Capital Expenditure Tables
    - Capital Expenditures – margin based analysis, calculated as a percentage of revenue (can be calculated as a percentage of assets/D&A as well);
    - Total Assets - gradually tapered or expanded to meet desired growth rate of one percent in final projection year;
    - Total Liabilities, Cash, and Current Assets – margin based analysis, calculated as a percentage of total assets;
    - Current Portion of LT Debt and Current Liabilities – margin based analysis, calculated as a percentage of total liabilities.
- Discounted Cash Flow
    - Discount rate – weighted average cost of capital, company specific;

- Terminal value growth rate – realistic percentage given US economic growth (TVG< 3%);
- Terminal value exit multiple (Biotech only) – previous year's latest EV/EBITDA ratio from historical financials.

The following function was applied to several line items in the income statement and net working capital table to appropriately taper/expand inputs over the five year growth stage:

```
=previous year input-((historical figure-desired terminal value)/COUNTA(amount of projection periods))
```

Overview Regarding Derivation of Inputs

Inputs were calculated and calibrated to reflect the actual equity price (December 31, 2009) using CY2008 historical figures. Exact same inputs (margins, growth, multiples, and discount rates) were then applied to CY2009 historical figures to predict December 31, 2010 actual equity prices. The general integrity of each equities margins, revenue growth, and WACC were preserved. Historical figures provided significant guidance on future projections for each equity as well. Terminal value calculations were sanity checked with fifth year projection EBITDA figures to ensure realistic multiples. As evidenced by the Pharmaceutical test group whose multiples were realistic and confined to a range of 4.0x to 9.0x EBITDA.

Results and Analysis

Results painted a very interesting picture and provided insight into the valuation of drug producing healthcare equities. The results from the Pharmaceutical sample group are displayed below:

Pharmaceutical Standard DCF Performance

Company	Ticker	Mrkt Cap	Projected Stock Valuation as of 1/1/2010	Actual Stock Price 12/31/2010	Mrkt Price Over/Under Valued	Absolute Value of Nominal Difference	Accuracy
Eli Lilly & Co.	LLY	$ 40,530	$ 35.31	$ 35.04	Under	$0.27	0.77%
Abbott Laboratories	ABT	77,364	48.39	47.91	Under	$0.48	1.01%
Johnson & Johnson	JNJ	163,566	59.81	61.85	Over	$2.04	3.30%
Novartis AG ADS	NVS	125,645	56.72	58.95	Over	$2.23	3.79%
Sanofi-Aventis S.A. ADS	SNY	94,085	34.01	32.23	Under	$1.78	5.51%
GlaxoSmithKline PLC ADS	GSK	102,938	42.90	39.22	Under	$3.68	9.38%
AstraZeneca PLC ADS	AZN	66,872	51.71	46.19	Under	$5.52	11.96%
Pfizer Inc.	PFE	163,502	12.12	17.51	Over	$5.39	30.76%
Merck & Co Inc	MRK	102,235	54.51	36.04	Under	$18.47	51.24%
Average		$ 104,082	$ 43.94	$ 41.66	Under	$2.28	5.48%

On average projections were within 5.48% of actual stock prices. The model overvalued approximately 67% of the Pharmaceutical test group, but still demonstrated very accurate predictions. Of the nine sample companies the model successfully predicted six of selected equities within 9.5% of the actual stock price. Furthermore, seven of the selected equities were valued within 12% of actual stock price:

- Eli Lilly & Co;
- Abbott Laboratories;
- Johnson & Johnson;
- Novartis AG;
- Sanofi-Aventis;
- Glaxo Smith Kline PLC;
- AstraZeneca PLC.

Pfizer Inc. and Merck & Co were the only two companies whose valuations were meaningfully inaccurate. Pfizer's projected valuation experienced a 31% error while Merck was incorrectly valued by 51%. These miss valuations can be easily quantified by the significant events that transpired through CY2009 for each respective company. I will examine the impact of each event and explain the implications regarding the model's assumptions that led to the significant miss valuations.

Pfizer Inc. engaged in a landmark acquisition of Wyeth in January 2009 for a whopping $68 billion. As a result total company assets surged from $110 billion to $211 billion; total liabilities also grew from $52 billion to $121 billion (highlighted in yellow below):

PFE	Historical					Projections				
OWC	2005A	2006A	2007A	2008A	2009A	2010E	2011E	2012E	2013E	2014E
Total Assets	116844	114483	112827	109892	211621	208064	206481	206810	209043	213224
% growth	*NA*	*-2.0%*	*-1.4%*	*-2.6%*	*92.6%*	*-1.7%*	*-0.8%*	*0.2%*	*1.1%*	*2.0%*
Total Liabilities	51217	43125	47703	52152	121175	113275	106595	100938	96138	92052
% assets	*43.8%*	*37.7%*	*42.3%*	*47.5%*	*57.3%*	*54.4%*	*51.6%*	*48.8%*	*46.0%*	*43.2%*
Cash	22226	27713	25475	23731	25969	39147	36259	33536	36646	36466
% total assets	*19.0%*	*24.2%*	*22.6%*	*21.6%*	*12.3%*	18.8%	17.6%	16.2%	17.5%	17.1%
Current Assets	41896	46949	46849	43076	61670	76195	72242	69454	73298	73658
% total assets	*35.9%*	*41.0%*	*41.5%*	*39.2%*	*29.1%*	36.6%	35.0%	33.6%	35.1%	34.5%
Curr. Portion of LT Debt	11589	2434	5825	9320	5469	13063	12051	9202	10240	9535
% total liabilities	*22.6%*	*5.6%*	*12.2%*	*17.9%*	*4.5%*	11.5%	11.3%	9.1%	10.7%	10.4%
Current Liabilities	28448	21389	21835	27009	37225	48437	44511	38773	39394	37172
% total liabilities	*55.5%*	*49.6%*	*45.8%*	*51.8%*	*30.7%*	42.8%	41.8%	38.4%	41.0%	40.4%
OWC	2811	281	5364	1656	3945	1673	3523	6347	7498	9554
Δ in OWC	**NA**	**2530**	**5083**	**3708**	**2289**	**2272**	**1850**	**2825**	**1151**	**2055**

Consequently the historical financials were meaningfully altered causing an erroneous ripple through the OWC portion of the discounted cash flow. Cash, current assets, current portion of LT debt, and current liabilities were projected based off the bloated figures (total assets and total liabilities) leading to erratic and unrealistic OWC projections (displayed in red above). These

inflated figures in turn eroded FCF projections which ultimately resulted in the model severely undervaluing the equity of Pfizer (Projection: $12.12; Actual: $17.51).

Merck & Co underwent a similar transaction and experienced similar valuation complications as Pfizer Inc. March 2009 marked the acquisition agreement between Merck and Schering Plough representing a mammoth acquisition valued at $41 Billion. Total assets leapt from $46 billion to $112 billion and total liabilities doubled from $24 billion to $50 billion (highlighted in yellow below):

MRK	Historical					Projections				
OWC	2005A	2006A	2007A	2008A	2009A	2010E	2011E	2012E	2013E	2014E
Total Assets	44777	44386	45527	45529	111589	111816	112266	112942	113846	114985
% growth	*NA*	*-0.9%*	*2.6%*	*0.0%*	*145.1%*	*0.2%*	*0.4%*	*0.6%*	*0.8%*	*1.0%*
Total Liabilities	24454	24420	24936	24362	50096	52308	54637	57096	59701	62468
% assets	*54.6%*	*55.0%*	*54.8%*	*53.5%*	*44.9%*	*46.8%*	*48.7%*	*50.6%*	*52.4%*	*54.3%*
Cash	15638	8713	8231	5486	9605	14438	12562	12314	13284	12940
% total assets	*34.9%*	*19.6%*	*18.1%*	*12.1%*	*8.6%*	12.9%	11.2%	10.9%	11.7%	11.3%
Current Assets	21049	15230	15045	19305	28429	37617	37991	34996	37367	37427
% total assets	*47.0%*	*34.3%*	*33.0%*	*42.4%*	*25.5%*	33.6%	33.8%	31.0%	32.8%	32.5%
Curr. Portion of LT Debt	2972	1285	1824	2297	1586	3471	3502	3085	3672	3741
% total liabilities	*12.2%*	*5.3%*	*7.3%*	*9.4%*	*3.2%*	6.6%	6.4%	5.4%	6.1%	6.0%
Current Liabilities	13304	12723	12258	14319	15751	24301	24891	23496	26501	27298
% total liabilities	*54.4%*	*52.1%*	*49.2%*	*58.8%*	*31.4%*	46.5%	45.6%	41.2%	44.4%	43.7%
OWC	-4920	-4920	-3620	1797	4659	2349	4039	2271	1253	929
Δ in OWC	**NA**	**1**	**1300**	**5417**	**2862**	**2311**	**1690**	**1768**	**1017**	**325**

The resulting implications mirrored that of Pfizer's acquisition except the OWC ended up being severely understated, while Pfizer's OWC was overstated. This discrepancy can be attributed to each firms' average balances (as a percentage of total assets and total liabilities) of cash, current assets, current portion of LT debt, and current liabilities (reflective of individual firms' strategic balance sheet proportions). Subsequently, current liabilities were inordinately grown resulting in deflated OWC figures. FCF projections, in turn, were augmented resulting in the overvaluation of Merck's stock (Projection: $54.51; Actual: $36.04).

The results from the standard DCF's performance in valuing the Biotechnology sample group are displayed below:

Biotechnology Standard DCF Performance						
Company	Ticker	Mrkt Cap	Projected Stock Valuation as of 1/1/2010	Actual Stock Price 12/31/2010	Mrkt Price Over/Under Valued	Absolute Value of Nominal Difference	Accuracy
Amgen Inc.	AMGN	$ 59,229	$ 63.14	$ 54.90	Under	$8.24	15.02%
Celgene Corp.	CELG	25,573	44.58	59.14	Over	$14.56	24.62%
Biogen Idec Inc.	BIIB	14,705	47.37	67.05	Over	$19.68	29.35%
Regeneron Pharmaceuticals	REGN	1,961	19.69	32.83	Over	$13.14	40.02%
Gilead Sciences Inc.	GILD	38,932	52.72	36.24	Under	$16.48	45.48%
Genzyme Corp.	GENZ	13,022	34.85	71.20	Over	$36.35	51.05%
Illumina Inc.	ILMN	3,666	18.79	63.34	Over	$44.55	70.33%
Dendreon Corp.	DNDN	3,446	0.00	34.92	Over	$34.92	100.00%
Cambrex Corp.	CBM	163	0.00	5.17	Over	$5.17	100.00%
Life Technologies Corp.	LIFE	9,404	259.30	55.50	Under	$203.80	367.20%
Average		$ 17,010	$ 54.04	$ 48.03	Under	$6.02	12.52%

On average projections were within 12.52% of actual stock prices. The model undervalued 70% of the Biotechnology test group and yielded inconsistent results. Of the ten sample companies the model successfully predicted three of selected equities within 30% of the actual stock price; these companies also represented three of the four largest companies surveyed:

- Amgen Inc;
- Celgene Corp;
- Biogen Idec Inc.

It is apparent that market cap size of the Biotech companies had a bearing on the predictability of future stock price (reliability of cash flows etc.). The inaccuracy of the model can also be attributed to a number of qualitative factors that are neglected when examining the

fundamentals/financials of a company with the discounted cash flow. Factors can include: FDA drug phase developments, mergers & acquisition rumors, lawsuits regarding royalties/patents, and the general pharmaceutical landscape.

Empirical results vastly undervalued the majority of the Biotech sample group. First and foremost the Pharmaceutical landscape is amidst unprecedented times given the patent cliff that is currently afflicting the industry. IMS health concluded in May 2007 that of the $643 billion drug revenue earned by large cap Pharmaceuticals in 2006, over $140 billion would lose patent protection by 2016. Industry analysts also designated 2011-2012 as the patent cliff's climax due to patent expirations of some of the market's largest blockbuster drugs including: Pfizer's Lipitor, Sanofi Aventis' Plavix, and AstraZeneca's Seroquel. Market sentiment and analysts expectations subsequently identified Biotechnology acquisitions as a primary means for bolstering lost revenues. Biotech's fundamental cash flows do not reflect this qualitative sentiment and accordingly display market value superior to the discounted cash flow's projections. Furthermore, Biotech's undiversified business model stresses drug pipelines as a primary means of future cash flows despite the fact that drugs pending approval contribute nothing to the top or bottom line. As a result anticipated pipeline approvals are unaccounted for in the discounted cash flow model's valuation causing projected financials to severely undervalue the company's actual worth/equity.

In addition to the unaccounted for qualitative aspects of the Biotech industry, erratic historical financial movements can also adversely affect the DCF's accuracy (as experienced in the Pharmaceutical sample group). A particular example pertains to the valuation of Life Technologies Corp which was off by an astronomical 367%. The model severely overvalued

the company because of the doubled revenue realized in the 2009 historical financials (highlighted in yellow below):

LIFE	Historical					Projections				
	2005A	2006A	2007A	2008A	2009A	2010E	2011E	2012E	2013E	2014E
Income Statement										
Revenue	$ 1,198	$ 1,263	$ 1,282	$ 1,620	$ 3,280	$ 6,061	$ 10,126	$ 15,126	$ 19,919	$ 22,708
% growth	*NA*	*5.4%*	*1.4%*	*26.4%*	*102.5%*	*84.8%*	*67.1%*	*49.4%*	*31.7%*	*14.0%*
COGS	453	467	430	547	1044	1882	3068	4467	5730	6358
% margin	*37.8%*	*36.9%*	*33.5%*	*33.8%*	*31.8%*	*31.1%*	*30.3%*	*29.5%*	*28.8%*	*28.0%*
Gross Margin	746	797	852	1073	2236	4178	7058	10659	14189	16350

This drastic growth augmented all the future growth rates applied to the revenue line item of the income statement ballooning the EBIAT portion of the FCF calculation and finally the projected stock price (Projection: $259.30; Actual: $55.50).

Two of the sample equities, Dendreon Corp and Cambrex Corp, did not even have historical revenues to project future cash flows. As a result valuations were negative and consequently neglected in the overall Biotech analysis. They did however provide excellent examples of other valuation problems with the Biotechnology subsector of Healthcare.

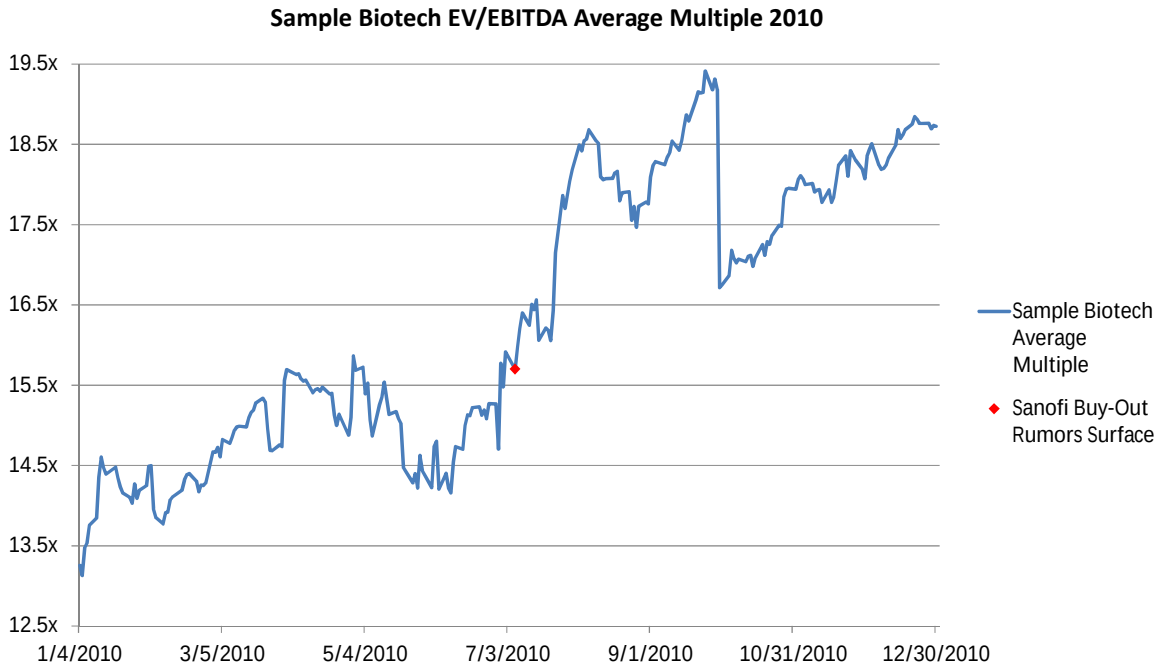
In order to try and improve results the discounted cash flow model was altered to incorporate a multiple (EV/EBITDA) that would capture some of these non-fundamental (qualitative) variables. The results from the Blended TV DCF's performance in valuing the Biotechnology sample group are displayed below:

Biotechnology DCF Blended TV Performance						
Company	Ticker	Mrkt Cap	Projected Stock Valuation as of 1/1/2010	Actual Stock Price 12/31/2010	Mrkt Price Over/Under Valued	Absolute Value of Nominal Difference	Accuracy
Amgen Inc.	AMGN	$ 59,229	$ 55.53	$ 54.90	Under	$0.63	1.14%
Gilead Sciences Inc.	GILD	38,932	44.22	36.24	Under	$7.98	22.02%
Biogen Idec Inc.	BIIB	14,705	46.44	67.05	Over	$20.61	30.74%
Regeneron Pharmaceuticals	REGN	1,961	19.62	32.83	Over	$13.21	40.24%
Celgene Corp.	CELG	25,573	33.22	59.14	Over	$25.92	43.82%
Genzyme Corp.	GENZ	13,022	29.84	71.20	Over	$41.36	58.08%
Illumina Inc.	ILMN	3,666	22.90	63.34	Over	$40.44	63.85%
Dendreon Corp.	DNDN	3,446	0.00	34.92	Over	$34.92	100.00%
Cambrex Corp.	CBM	163	0.00	5.17	Over	$5.17	100.00%
Life Technologies Corp.	LIFE	9,404	200.12	55.50	Under	$144.62	260.57%
Average		$ 17,010	$ 45.19	$ 48.03	Over	$2.84	5.91%

On average projections were within (a deceptive) 5.91% of actual stock prices. The new model undervalued 70% of the Biotechnology test group and yielded inconsistent results exactly like the standard discounted cash flow model utilized in this study. Of the ten sample companies the model successfully predicted two of selected equities within 25% of the actual stock price; these companies also represented the two largest companies surveyed (Amgen Inc and Gilead Sciences Inc).

Although the newly structured TV calculation in this model attempted to quantify some elements that were neglected in its predecessor, results were still disappointing. However, upon closer examination of the Biotech EV/EBITDA multiples over the one year time horizon an explanation presented itself. In July of 2010 Biotech equities realized massive multiple expansion because of confirmed rumors of Pharmaceutical giant Sanofi-Aventis' desire to make an acquisition in the $20 billion price range. This newly presented information nearly negated the usefulness of any of our multiples as our outdated multiples from CY2009 historical

financials were no longer an accurate representation of Biotech's intrinsic worth. The multiple expansion also explains why the majority of the Biotechnology Sample Group were undervalued using the model. A graph of the Biotech sample group's average EV/EBITDA multiple over CY2010 is displayed below:



On average, EV/EBITDA multiples increased from 13.5 to 15.5x before rumors began circulating. Following the announcement multiples expanded from 15.5 to 18.5x, peaking in late September around 19.5x. This empirical evidence demonstrates that despite the fact that an attempted multiple valuation was implemented, the qualitative developments in the market completely annulled the multiple's predictive ability as market valuations spiked.

Conclusion

Exploration of the discounted cash flow model's effectiveness in this study empirically analyzed the methodology's ability to predict equity prices one year from implementation. Healthcare drug producers were assessed and Pharmaceutical price movements were far more predictable then the Biotechnology sample group. The magnitude and diversification of the Pharmaceutical companies presented reliant/steady cash flows that enabled the DCF to perform splendidly. However, as with every industry, significant M&A activity often extinguishes the model's ability to correctly forecast future stock price. Implied synergies and deal financing alter company financials fundamentally which in turn leads to miss valuations.

Comparatively, issues with Biotechnology valuation exemplified the multitude of variables in the industry that could not be accurately appraised without far more detailed and specific valuation tactics. Epitomizing the "pick your poison" dilemma when choosing the most appropriate valuation methodology, Biotechnology represents an extremely dynamic sample of equities whose volatility is arguably unpredictable; Qualitatively, product pipelines, anticipated drug approvals, Pharmaceutical/drug landscape, and even litigation ultimately defied the DCF's best efforts to ascertain equity prices one year in advance. Quantitatively, financial growth fluctuation and margin movements also inhibited the DCF's performance. It is apparent that each subsector of healthcare requires tailored model's whose assumptions accurately account for the variables confronting the industry. Drug companies may seem the same, however in reality they possess so many innate differences that they must be examined separately with differing methodologies.

The discounted cash flow valuation methodology works and can be wonderfully accurate as long as you are applying it to the right underlying asset. Companies and business models must be understood before any valuation can take place, for without an understanding of an asset's risk, competitive environment, and fundamentals the valuation process is drastically compromised.

Appendix 1: FactSet Codes

1) **Income Statement**
    a. Revenue =FDS(TICKER,"FF_SALES(ANN,YEAR)")
    b. COGS =FDS(TICKER,"FF_COGS(ANN, YEAR)")
    c. SG&A =FDS(TICKER,"FF_SGA(ANN, YEAR)")
    d. R&D =FDS(TICKER,"FF_RD_EXP(ANN, YEAR)")
    e. D&A =FDS(TICKER,"FF_DEP_AMORT_EXP(ANN, YEAR)")
    f. Other Operating Expenses
    =FDS(TICKER,"FF_OPER_EXP_OTH(ANN, YEAR)")
    g. Non-Operating Income
    =(FDS(TICKER,"FF_NON_OPER_INC(ANN, YEAR)"))
    h. Interest Expense =FDS(TICKER,"FF_INT_EXP_NET(ANN, YEAR)")
    i. Unusual Expense =FDS(TICKER,"FF_UNUSUAL_EXP(ANN, YEAR)")
    j. Income Taxes =FDS(TICKER,"FF_INC_TAX(ANN, YEAR)")
    k. Net Income =FDS(TICKER,"FF_NET_INC(ANN, YEAR)")

2) **Balance Sheet**
    a. Cash =FDS(TICKER,"FF_CASH_ST(ANN, YEAR)")
    b. Current Assets =FDS(TICKER,"FF_ASSETS_CURR(ANN, YEAR)")
    c. Current Portion of LT Debt =FDS(TICKER,"FF_DEBT_ST(ANN, YEAR)")
    d. Current Liabilities =FDS(TICKER,"FF_LIABS_CURR(ANN, YEAR)")
    e. Total Assets =FDS(TICKER,"FF_ASSETS(ANN, YEAR)")
    f. Total Liabilities =FDS(TICKER,"FF_LIABS(ANN, YEAR)")
    g. LT Debt =FDS(TICKER,"FF_DEBT_LT(ANN, YEAR)")

3) **Other Financial Metrics**
    a. Market Cap =FDS(TICKER,"FG_MKT_VALUE("&DATE&")")
    b. Stock Price =FDS(TICKER,"FG_PRICE("&DATE&")")
    c. Capital Expenditures =FDS(TICKER,"FF_CAPEX(ANN, YEAR)")
    d. Diluted Shares Outstanding
    =FDS(TICKER,"FF_COM_SHS_OUT_EPS_DIL(ANN, YEAR)

Appendix 2: Optimal Pharmaceutical Valuation, Abbott Laboratories (Projection: 1.01% Error)

	Historical					Projections					TV
	2005A	2006A	2007A	2008A	2009A	2010E	2011E	2012E	2013E	2014E	
Income Statement											
Revenue	$ 22,338	$ 22,476	$ 25,914	$ 29,528	$ 30,765	$ 31,888	$ 32,881	$ 33,728	$ 34,416	$ 34,932	
% growth	*NA*	*0.6%*	*15.3%*	*13.9%*	*4.2%*	*3.7%*	*3.1%*	*2.6%*	*2.0%*	*1.5%*	*1.5%*
COGS	9108	8075	9473	10628	11066	11759	12423	13049	13626	14147	
% margin	*40.8%*	*35.9%*	*36.6%*	*36.0%*	*36.0%*	*36.9%*	*37.8%*	*38.7%*	*39.6%*	*40.5%*	*40.5%*
Gross Margin	13230	14401	16441	18899	19699	20129	20458	20680	20789	20784	
% margin	*59.2%*	*64.1%*	*63.4%*	*64.0%*	*64.0%*	*63.1%*	*62.2%*	*61.3%*	*60.4%*	*59.5%*	
SG&A	5414	6350	7398	8400	8292	8662	9000	9303	9564	9781	
% margin	*24.2%*	*28.3%*	*28.5%*	*28.4%*	*27.0%*	*27.2%*	*27.4%*	*27.6%*	*27.8%*	*28.0%*	*28.0%*
R&D	1821	2226	2503	2689	2744	3040	3338	3632	3918	4192	
% margin	*8.2%*	*9.9%*	*9.7%*	*9.1%*	*8.9%*	*9.5%*	*10.2%*	*10.8%*	*11.4%*	*12.0%*	*12.0%*
D&A	1359	1559	1855	1839	2090	1988	1866	1726	1569	1397	
% margin	*6.1%*	*6.9%*	*7.2%*	*6.2%*	*6.8%*	*6.2%*	*5.7%*	*5.1%*	*4.6%*	*4.0%*	*4.0%*
Other Oper. Exp.	0	0	0	0	0	0	0	0	0	0	*0*
EBIT	4635	4266	4686	5972	6574	6440	6254	6020	5738	5414	
% margin	*20.8%*	*19.0%*	*18.1%*	*20.2%*	*21.4%*	*20.2%*	*19.0%*	*17.8%*	*16.7%*	*15.5%*	
Non-Oper. Income (Exp)	58	175	176	478	394	315	236	157	79	0	*0*
Interest Expense	241	416	593	528	520	554	540	541	546	543	
LT Debt	4572	7010	9488	8713	11266	9822	9934	10341	10032	10102	*Average*
% cost of debt	*5.3%*	*5.9%*	*6.3%*	*6.1%*	*4.6%*	*5.6%*	*5.4%*	*5.2%*	*5.4%*	*5.4%*	*Average*
Unusual Expense (Inc)	273	2224	297	184	746	597	448	298	149	0	*0*
Pre-tax Income	4179	1801	3972	5737	7194	6797	6398	5934	5421	4872	
Income taxes	1248	560	863	1122	1448	1392	1283	1200	1098	983	
Implied tax rate	*29.9%*	*31.1%*	*21.7%*	*19.6%*	*20.1%*	*20.5%*	*20.1%*	*20.2%*	*20.2%*	*20.2%*	*Average*
MI Expense	441	476	498	119	0	91	67	299	332	297	*Random*
Net Income	3372	1717	3606	4734	5746	5314	5048	4436	3991	3592	
% profit margin	*15.1%*	*7.6%*	*13.9%*	*16.0%*	*18.7%*	*16.7%*	*15.4%*	*13.2%*	*11.6%*	*10.3%*	

Appendix 2: Optimal Pharmaceutical Valuation, Abbott Laboratories (continued)

	Historical					Projections					TV
	2005A	2006A	2007A	2008A	2009A	2010E	2011E	2012E	2013E	2014E	
Capex and OWC Projections											
Capex	$ 1,207	$ 1,338	$ 1,656	$ 1,288	$ 1,089	$ 1,349	$ 1,619	$ 1,894	$ 2,171	$ 2,445	
% revenue	*5.4%*	*6.0%*	*6.4%*	*4.4%*	*3.5%*	*4.2%*	*4.9%*	*5.6%*	*6.3%*	*7.0%*	*7.0%*
OWC											
Total Assets	29141	35311	38535	40474	51558	62958	73555	82054	87205	88077	
% growth	*NA*	*21.2%*	*9.1%*	*5.0%*	*27.4%*	*22.1%*	*16.8%*	*11.6%*	*6.3%*	*1.0%*	*1.0%*
Total Liabilities	14726	21257	20757	22994	28660	34837	40515	44988	47592	47845	
% assets	*50.5%*	*60.2%*	*53.9%*	*56.8%*	*55.6%*	*55.3%*	*55.1%*	*54.8%*	*54.6%*	*54.3%*	*54.3%*
Cash	2956	1373	2821	5080	9932	8213	10999	12927	12718	13297	
% total assets	*10.1%*	*3.9%*	*7.3%*	*12.6%*	*19.3%*	13.0%	15.0%	15.8%	14.6%	15.1%	*Average*
Current Assets	11386	11282	14043	17043	23314	25974	31526	35375	36983	37691	
% total assets	*39.1%*	*31.9%*	*36.4%*	*42.1%*	*45.2%*	41.3%	42.9%	43.1%	42.4%	42.8%	*Average*
Curr. Portion of LT Debt	2062	5401	2726	3648	5226	5485	6731	7587	7808	7956	
% total liabilities	*14.0%*	*25.4%*	*13.1%*	*15.9%*	*18.2%*	15.7%	16.6%	16.9%	16.4%	16.6%	*Average*
Current Liabilities	7416	11951	9103	11592	13049	16234	19251	20942	22315	22480	
% total liabilities	*50.4%*	*56.2%*	*43.9%*	*50.4%*	*45.5%*	46.6%	47.5%	46.5%	46.9%	47.0%	*Average*
OWC	3076	3359	4845	4019	5558	7011	8008	9093	9758	9871	
Δ in OWC	**NA**	**282**	**1486**	**826**	**1539**	**1453**	**997**	**1085**	**665**	**112**	

Appendix 2: Optimal Pharmaceutical Valuation, Abbott Laboratories (continued)

Discounted Cash Flow Analysis										
EBIT*(1-t)	$ 3,251	$ 2,940	$ 3,667	$ 4,804	$ 5,251	$ 5,121	$ 5,000	$ 4,802	$ 4,576	$ 4,322
Plus: D&A	1359	1559	1855	1839	2090	1988	1866	1726	1569	1397
Less: Capex	1207	1338	1656	1288	1089	1349	1619	1894	2171	2445
Less: Δ in OWC	NA	282	1486	-826	1539	1453	997	1085	665	112
Unlevered FCF	3403	2879	2380	6181	4712	4306	4251	3549	3309	3162

WACC	NPV of Future Cash Flows		Terminal Value GG Model Selected Growth Rates				Enterprise Value Selected Growth Rates		
			2.0%	*2.5%*	*3.0%*		*2.0%*	*2.5%*	*3.0%*
5.9%	$15,849		$62,089	$71,569	$84,318		$77,938	$87,418	$100,167
6.2%	15748		57665	65886	76716		73413	81634	92464
6.4%	*15648*	+	53753	*60941*	70244	=	69401	*76589*	85892
6.7%	15549		50269	56602	64669		65819	72151	80219
6.9%	15452		47149	52765	59820		62601	68216	75271

WACC	Plus: Cash	Equity Value Selected Growth Rates				Diluted Shares Outstanding		Intrinsic Value per share Selected Growth Rates		
	$ 9,932	*2.0%*	*2.5%*	*3.0%*		1555.1		*2.0%*	*2.5%*	*3.0%*
5.9%	**Less: Debt**	$76,604	$86,084	$98,833				$49.26	$55.35	$63.55
6.2%	$ 11,266	72079	80300	91130				$46.35	$51.64	$58.60
6.4%		68067	*75255*	84558	÷		=	$43.77	*$48.39*	$54.37
6.7%		64484	70817	78885				$41.47	$45.54	$50.73
6.9%		61267	66882	73937				$39.40	$43.01	$47.54

Appendix 3: Optimal Biotechnology Valuation, Amgen Inc (Projection: 1.14% Error)

	Historical					Projections					TV
	2005A	2006A	2007A	2008A	2009A	2010E	2011E	2012E	2013E	2014E	
Income Statement											
Revenue	$ 12,430	$ 14,268	$ 14,771	$ 15,003	$ 14,642	$ 14,404	$ 14,283	$ 14,274	$ 14,376	$ 14,592	
% growth	*NA*	*14.8%*	*3.5%*	*1.6%*	*-2.4%*	*-1.6%*	*-0.8%*	*-0.1%*	*0.7%*	*1.5%*	*1.5%*
COGS	1541	1502	1494	1511	1305	1402	1506	1622	1751	1897	
% margin	*12.4%*	*10.5%*	*10.1%*	*10.1%*	*8.9%*	*9.7%*	*10.5%*	*11.4%*	*12.2%*	*13.0%*	*13.0%*
Gross Margin	10889	12766	13277	13492	13337	13003	12776	12651	12625	12695	
% margin	*87.6%*	*89.5%*	*89.9%*	*89.9%*	*91.1%*	*90.3%*	*89.5%*	*88.6%*	*87.8%*	*87.0%*	
SG&A	2848	3427	3536	3824	3863	3789	3746	3733	3749	3794	
% margin	*22.9%*	*24.0%*	*23.9%*	*25.5%*	*26.4%*	*26.3%*	*26.2%*	*26.2%*	*26.1%*	*26.0%*	*26.0%*
R&D	2314	3366	3247	3027	2858	2955	3072	3213	3379	3575	
% margin	*18.6%*	*23.6%*	*22.0%*	*20.2%*	*19.5%*	*20.5%*	*21.5%*	*22.5%*	*23.5%*	*24.5%*	*24.5%*
D&A	841	914	1199	1073	1049	970	900	837	781	730	
% margin	*6.8%*	*6.4%*	*8.1%*	*7.2%*	*7.2%*	*6.7%*	*6.3%*	*5.9%*	*5.4%*	*5.0%*	*5.0%*
Other Oper. Exp.	0	0	0	0	0	0	0	0	0	0	*0*
EBIT	4886	5059	5295	5568	5567	5289	5058	4868	4716	4596	
% margin	*39.3%*	*35.5%*	*35.8%*	*37.1%*	*38.0%*	*36.7%*	*35.4%*	*34.1%*	*32.8%*	*31.5%*	
Non-Oper. Income (Exp)	119	309	309	352	276	221	166	110	55	0	*0*
Interest Expense	99	129	328	316	578	401	427	466	431	441	
LT Debt	3957	7134	9177	9176	10601	9651	9809	10021	9827	9886	*Average*
% cost of debt	*2.5%*	*1.8%*	*3.6%*	*3.4%*	*5.5%*	*4.2%*	*4.4%*	*4.7%*	*4.4%*	*4.5%*	*Average*
Unusual Expense (Inc)	96	1280	1366	426	133	106	80	53	27	0	*0*
Pre-tax Income	4810	3959	3910	5178	5132	5002	4717	4459	4313	4155	
Income taxes	1194	1070	795	1054	599	873	778	678	707	666	
Implied tax rate	*24.8%*	*27.0%*	*20.3%*	*20.4%*	*11.7%*	*17.5%*	*16.5%*	*15.2%*	*16.4%*	*16.0%*	*Average*
MI Expense	58	61	51	72	72	52	62	57	57	54	*Random*
Net Income	3674	2950	3166	4196	4605	4077	3877	3724	3550	3435	
% profit margin	*29.6%*	*20.7%*	*21.4%*	*28.0%*	*31.5%*	*28.3%*	*27.1%*	*26.1%*	*24.7%*	*23.5%*	

Appendix 3: Optimal Biotechnology Valuation, Amgen Inc (continued)

	Historical					Projections					TV
	2005A	2006A	2007A	2008A	2009A	2010E	2011E	2012E	2013E	2014E	
Capex and OWC Projections											
Capex	$ 867	$ 1,218	$ 1,267	$ 672	$ 530	$ 604	$ 682	$ 763	$ 852	$ 948	
% revenue	*7.0%*	*8.5%*	*8.6%*	*4.5%*	*3.6%*	*4.2%*	*4.8%*	*5.3%*	*5.9%*	*6.5%*	*6.5%*
OWC											
Total Assets	29297	33788	34639	36443	39629	42797	45898	48880	51690	54274	
% growth	*NA*	*15.3%*	*2.5%*	*5.2%*	*8.7%*	*8.0%*	*7.2%*	*6.5%*	*5.7%*	*5.0%*	*5.0%*
Total Liabilities	8846	14824	16770	16057	16962	18506	20049	21566	23033	24423	
% assets	*30.2%*	*43.9%*	*48.4%*	*44.1%*	*42.8%*	*43.2%*	*43.7%*	*44.1%*	*44.6%*	*45.0%*	*45.0%*
Cash	5255	6277	7151	9552	13442	11523	13319	14642	14800	15849	
% total assets	*17.9%*	*18.6%*	*20.6%*	*26.2%*	*33.9%*	26.9%	29.0%	30.0%	28.6%	29.2%	*Average*
Current Assets	9235	11712	13041	15221	18932	18144	20185	21857	22587	23951	
% total assets	*31.5%*	*34.7%*	*37.6%*	*41.8%*	*47.8%*	42.4%	44.0%	44.7%	43.7%	44.1%	*Average*
Curr. Portion of LT Debt	0	1878	2000	1000	0	1120	821	729	1038	976	
% total liabilities	*0.0%*	*12.7%*	*11.9%*	*6.2%*	*0.0%*	6.1%	4.1%	3.4%	4.5%	4.0%	*Average*
Current Liabilities	3595	7022	6179	4886	3873	5558	5567	5797	6502	6747	
% total liabilities	*40.6%*	*47.4%*	*36.8%*	*30.4%*	*22.8%*	30.0%	27.8%	26.9%	28.2%	27.6%	*Average*
OWC	385	291	1711	1783	1617	2183	2120	2148	2324	2331	
Δ in OWC	**NA**	**94**	**1420**	**72**	**166**	**566**	**62**	**28**	**176**	**8**	

Appendix 3: Optimal Biotechnology Valuation, Amgen Inc (continued)

Discounted Cash Flow Analysis										
EBIT*(1-t)	$ 3,673	$ 3,692	$ 4,218	$ 4,435	$ 4,917	$ 4,366	$ 4,224	$ 4,128	$ 3,943	$ 3,860
Plus: D&A	841	914	1199	1073	1049	970	900	837	781	730
Less: Capex	867	1218	1267	672	530	604	682	763	852	948
Less: Δ in OWC	NA	-94	1420	72	-166	566	-62	28	176	8
Unlevered FCF	3647	3482	2730	4764	5602	4165	4504	4174	3697	3633

						40.0%			60.0%			
						TV Gordon Growth Model Selected Growth Rates			**TV EBITDA Exit Multiple** Selected Multiples			**Enterprise Value** Selected Growth Rates		
WACC		**NPV of Future Cash Flows**				*1.0%*	*1.5%*	*2.0%*	*8.1x*	*8.6x*	*9.1x*		*1.0%*	*1.5%*	*2.0%*
6.8%		$16,749				$45,935	$50,550	$56,135	$30,972	$32,892	$34,812		$53,706	$56,705	$60,091
7.0%		16641				43512	47696	52714	$30,612	$32,510	$34,407		$52,413	$55,225	$58,371
7.3%		*16533*		+		41290	*45096*	49626	$30,257	*32133*	$34,008	=	$51,203	*53851*	$56,789
7.5%		16427				39245	42720	46826	$29,907	$31,761	$33,615		$50,069	$52,572	$55,327
7.8%		16322				37357	40540	44277	$29,561	$31,394	$33,227		$49,002	$51,375	$53,969

			Equity Value Selected Growth Rates				**Diluted Shares Outstanding**			**Intrinsic Value per share** Selected Growth Rates		
	Plus: Cash											
WACC	$ 13,442		*1.0%*	*1.5%*	*2.0%*		1021.0			*1.0%*	*1.5%*	*2.0%*
6.8%	**Less: Debt**		$56,547	$59,546	$62,932					$55.38	$58.32	$61.64
7.0%	$ 10,601		55254	58066	61212					$54.12	$56.87	$59.95
7.3%			54044	*56692*	59630	÷		=		$52.93	*$55.53*	$58.40
7.5%			52910	55413	58168					$51.82	$54.27	$56.97
7.8%			51843	54216	56810		40			$50.78	$53.10	$55.64

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