Textbook Treatment of the Constant Growth Valuation Model: An Assessment of Congruence with Reality

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Abstract

It would be difficult for any informed financial market observer to overlook the fact that market prices often exhibit substantial, and sometimes extreme, deviation from perceived ‘fundamental values.’ During some periods, this deviation appears to be more extreme than in others. Anecdotally, it seems that even staunch believers in investing according to fundamental information have strayed from that strategy in preference for riding the market's momentum. In this paper, we revisit models to approximate fundamental value, and compare these fundamental values to market values. We test for differences using CRSP and Compustat data from 1962 to 2002 for different industry classes of stocks. Of particular interest to the study is the magnitude of deviation and behavioral differences by industry classification.

Textbook Presentation of the Intrinsic Value Model

Finance textbooks promote the idea that common stock valuation is the result of a process of discounting future expected dividends from the investment using a risk-appropriate rate of discount. Assumptions are required concerning the future pattern of dividend levels. This fundamental information is presumed, over a long-term equilibrium, to result in an intrinsic value calculation that serves as the basis for the amount an investor is willing to pay for an investment.

Most undergraduate finance textbooks present the constant growth model as an acceptable way to model the market price of the stock. Block and Hirt 11e (2005, p. 281) equate the intrinsic value to the "Price of stock today". They begin the common stock valuation section by stating that the stock value "may be interpreted by the shareholder as the present value of an expected stream of future dividends", without indicating exactly what "value" means (Block and Hirt, p.281). Brealey et. al. describe the valuation formula's determination of "value", but in margin notes, the statement is made that "today's stock price equals the present value of all expected future dividends." Ross, Westerfield, and Jordon begin by describing P_o as a present value but then say "More generally, let P_o be the current price of the stock..." (p. 195). Brigham and Houston 10e (2004) identify P_o as the "actual market price of the stock today." Most introductory textbooks mirror this initial contention that the intrinsic value is, in fact, the market price.

At more advanced levels, the problem continues. Brigham and Daves, for example, identify P_o as the "actual market price of the stock today" (p. 160). While they do call it an intrinsic value later (p. 163), the "actual market price" statement is not reversed.

Most of the textbook authors will recognize certain shortcomings of the model, such as the need for the required return to exceed the growth rate for the model to work properly or the contention that markets have to be in equilibrium for the model to work. Brigham and Daves address the conditions under which the constant growth model can be used:

> "The constant growth model is often appropriate for mature companies with a stable history of growth..."(see also Brigham and Houston 10e [2004]) where "The dividend is expected to grow forever at a constant rate...The stock price is expected to grow at this same rate...The expected

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dividend yield is constant...The expected capital gains yield is also constant, and it is equal to *g*...The expected total rate of return, *rs*, = dividend yield +*g*."

These conditions under which the model should be appropriate suggest that some conditions would not yield correct valuations. This serves as the basis for some of our omissions of observations, e.g. stocks that do not pay dividends, valuations where the growth rate exceeds the required return, etc. (r_s is the same as our k_s). If the last condition holds, of course, the intrinsic value equation holds, since it is simply an algebraic manipulation of that contention:

$$r_s = \frac{D_1}{P_0} + g, \qquad \text{then} \quad P_0 = \frac{D_1}{r_s - g}$$

It is perhaps obvious that the intrinsic value calculation would seldom hit the exact market price. We might expect, though, that the intrinsic value formula would sometimes yield overestimations of market price, and sometimes yield underestimations of market price. On average then, (if expectations are averaged out over time) the intrinsic value formula should be right on the money *if the stock market is efficient*.

It is also interesting to note that the seminal article in the development of the constant growth model does *not* claim to indicate the "actual market price of the stock today." Rather, the price, growth rate, and current dividend together are used to imply a rate of profit the firm should require on capital budgeting decisions. In this role, price is determined outside the equation as in the real world (Gordon-Shapiro 1956, p.106). The required rate of return is implicit in the known market price, not the other way around (Gordon-Shapiro 1956, p. 105).

Related Literature

Several studies address the predictability of stock prices and explore other valuation models. Stock returns appear to be predictable *over the long term* (Campbell 1991, Bekaert, and Hodrick 1992). Market prices for these assets should closely reflect the intrinsic value, since investors' bids are supposedly based on that value. A paper by Campbell (2000) traces the development of asset pricing models for the past few decades and presents summaries of the volumes of research involving theoretical models and empirical studies.

Several other studies (Shiller 1981, Leroy and Porter 1981, others) have documented the volatility of stock prices compared to prices implied by dividend discounting. Evans (1998) relates discounted value of 'expected' future dividends to swings in stock prices, and concludes that dividend growth forecasts predict dividend-price ratios well. Various other studies have inferred significant variations in discount rates from market price fluctuations (Abel 1993, Campbell and Cochrane 1994).

Intuitively, though, we can understand that the real world often does not fit well into our rational theory. While variation in returns is observable ex-post, uncertainty about the future cannot be foretold. Expectations about future cashflows can be formed but those expectations can be erroneous. Coming up with a valuation model that a rational man would accept as a basis for his bid on a financial asset may not pan out in a market driven by emotions of elation (a bull market) or fear (a bear market).

During certain periods, investors may become concerned that actual market values are very high (or very low) in comparison to what an intrinsic value indicates. Purchasing an "overvalued" asset, while irrational from a valuation standpoint, may in fact result in exceptionally high returns if the purchase occurs in a market condition of positive momentum. Purchasing an "undervalued" asset, on the other hand, would seem rational from a valuation standpoint, but may in fact result in highly negative returns if the purchase occurs in a market condition of negative momentum.

Problems with Valuation Input Variables

The common valuation equation for equity investments involves three variables that determine an intrinsic value: cashflow, required return, and an assumed growth pattern for the cashflow. In a steady economic environment, valuation could result in equity values that closely reflect current stock prices. The assumptions common to most financial models assert that, even in absence of stability, the model, on average and over the long term, should reflect averages of stock prices over time. The fact is, though, that significant variation in all three variables occurs. Compound that variation with behavioral specifics not captured by an assumption of a representative 'rational investor', and the result is a questionable valuation model.

In financial models, required returns are estimated using a variety of processes. One of the most common is the Capital Asset Pricing Model (CAPM). Alternative models have been proposed, as well. While they perform well at aggregate levels (such as describing returns in general or on widely diversified portfolios) their estimates of required returns become less dependable applied at the industry, firm, and project levels (Fama and French, 1997).

Companies (or industries) exist that pay virtually no dividends, and yet have prices reflecting a high and growing dividend (or is it just an extremely low required return?). Fama and French (1999) indicate that these firms represent a large portion of the stock market.

Evans (1998, p. 720) presents some indication that lagged values of dividends alone cannot totally account for the growth expectations of investors. While an expectation of dividends can be based on the current level and a growth expectation, though, in reality nobody can tell the future. Expectations for dividend growth in multiple firms may be more attainable based on historical growth, since positive and negative current signals from firm to firm will tend to offset one another. We can *count on* our ability to calculate a dividend growth forecast based on dividends from the past. The problem of unpredictable future dividends, however, often is *not* alleviated by the statistical notion of risk used in valuation models.

Other complicating factors exist concerning dividends as well. Companies carry out stock splits and repurchases, affecting per share calculations and market prices. We therefore use adjusted figures for both dividends and prices for our input variables.

The Market Value - Intrinsic Value Gap

Regardless of the cause, we can observe when prices fly at great heights above perceived intrinsic values. We will term this the Market Value - Intrinsic Value Gap (MV-IV) gap. In this paper we will present an intrinsic value model. Market and Beta inputs provide a required return estimate based on the Capital Asset Pricing Model (CAPM), and the constant growth dividend discount model provides for calculation of the intrinsic value. We avoid using values implied directly by market prices (e.g. via P/E multiples) in an effort to estimate purely intrinsic values based on basic and widely accepted valuation and asset pricing models. Equationally, the intrinsic value is

$$V_{CS} = \frac{D_1}{k_{CS} - g} \qquad \text{Equation 1}$$

where D_1 is the last dividend paid times $1+g$, g is the compound growth rate expected for the dividends, and k_{CS} is the required rate of return as determined by the CAPM:

$$k_{CS} = k_j = k_{RF} + \beta_j (k_M - k_{RF}) \qquad \text{Equation 2}$$

In equation 2, k_{RF} is a risk-free rate of return[F], β_j is the systematic risk measure for firm j, k_M is the rate of return on a market index, and k_M - k_{RF} is the average risk premium for the market index return. *kcs* is based on the variability of the individual stock's return relative to average market variability. The market variability serves as a benchmark whereby the market risk of the individual stock can be scaled.

The MV-IV gap is calculated as

$$P_{CS} - V_{CS} \qquad \text{Equation 3}$$

where P_{CS} is the price of a stock and V_{CS} is the calculated intrinsic value of the same stock. Obviously, this could be positive or negative, depending on the magnitude of the values relative to one another.

If the intrinsic value model is reasonably good at identifying the average price of a stock over time, we might reasonably expect to see market prices deviating above and below the intrinsic value over time, depending on whether the market has overvalued or undervalued the security.

Input Variables for Intrinsic Value Calculations

It is, of course, impossible to know the general market's expectation of dividends, growth rates, and required returns. The best we can do is to estimate, based on some current or past observation. The expected dividend can be calculated as the last paid dividend times $1+g$. Unfortunately, dividends are often extremely low or zero, even if earnings are normal, resulting in an intrinsic value of zero for the stock. In observing our CRSP data, we conclude that this occurrence alone is frequent enough to rule out a large dataset for individual stocks' intrinsic values. In order to provide for fewer instances of zero valuations, we parsed the data into industry groups (Appendix 1) identified in an earlier study (Fama and French, 1997), and used industry averages for quarterly dividend payments. While this practice rules out conclusions on individual securities, it will allow for a psuedo industry dividend measure, equally weighted. We checked whether a zero average dividend ever occurs industry-wide for any of these industry classifications. Although zero valuations did occur, we believe that the occurrence is infrequent enough that our conclusions are not compromised. Only three of the industry groups are affected, plus the 'miscellaneous' category. 85% of the zero dividend observations occurred between 1967 and 1972. Of our 6,400 observations, less than 1/2 of 1% had zero average industry dividends.

The dividend growth rate was calculated based on the industry average dividends. We use a 3-year (12 quarter) moving compound growth rate calculation for each industry. This is used as a proxy for investors' expected dividend growth rate for each industry group. We did not adjust for 'news' or 'rumors', for several reasons. First, collection of these inputs is not practical, with the possible exception of compiled information bits collected for only a few companies. Second, these signals often may be false indicators of expectations. Third, sophisticated investors who make decisions based on this type of information may not be so willing to share it with the general public, especially if it is perceived to be valuable. Fourth, since end-of quarter observations were used for our study, most of these 'news' effects (which occur and are reacted on minute by minute) would not reflect in the quarterly stock prices. Finally, dividend growth from the past is readily available to most investors who desire to know it, with little effort involved to collect the data. It is somewhat plausible, then, that future growth expectations may be based on past growth.

The Capital Asset Pricing Model was used to estimate a required return for each industry. A twelve-quarter moving average on the ten-year treasury bond rate[2], lagged one quarter to capture beginning-of-quarter knowledge, was used as a proxy for a risk-free rate (k_{RF}). A forty-quarter moving average S&P 500 return for the prior four quarters was used for the index return measure (k_M). Beta was estimated using an arithmetic average of current Scholes-Williams betas for firms in each industry for each quarter. The Beta was lagged one quarter to capture beginning-of-quarter knowledge.

Finally, intrinsic values were calculated using equation 1. Graphs of the resulting values revealed infrequent and very large upward and downward spikes. Examination of a few of these revealed that most were occurring because the denominator of equation 1 was approaching zero, or was negative because of unusually large growth calculations (g was greater than k_{cs}).To avoid these anomalies, spiked values were replaced according to a simple conceptual algorithm (rather than using a statistical remedy); if the intrinsic value was calculated to be less than zero, the value was replaced with a zero value. Extreme positive spikes were identified as intrinsic values that were more than double the market price. These extreme positive intrinsic values were replaced with the market price.[3] The MV-IV gap was calculated by subtracting the intrinsic value from the market value.

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[2] *We use the treasury bond rate because it is more consistent with the long term horizon of common stock investment, and the return is less volatile than the t-bill rate. It is also used by a majority of business firms(see Bruner, et al, "Best Practices in Estimating Cost of Capital: Survey and Synthesis." Financial Practice and Education, Spring/Summer 1998, pp. 13-28.*

[3] *As in the Gordon-Shapiro paper, it is a requirement that the growth rate g be less than the required return k_{cs}. The negative spikes occurred when the growth rate exceeded the required return, so they were changed to a zero value, the lowest a stock's price can go in the real world. The large positive spikes occurred because the denominator (k_{cs}-g) was approaching zero. The choice to cut off the positive values at 2(MV) was arbitrary. A statistical outlier elimination would have only identified extreme positive and negative values for omission. We preferred the conceptual algorithm because the adjustments were more intuitive than a non-intuitive statistical manipulation.*

Empirical Approach and Results

We utilize a paired t-test to test the null hypothesis that the industry average price minus the industry average intrinsic value = 0. To identify any exceptions, this test was repeated for each of the industry groups, as well. For both the total *and* for all of the industry subgroups, we reject the null hypothesis in favor of the alternate hypothesis, that the difference in the means is greater than zero. Results for the alternate hypothesis are presented in Table 1.

Use of the t-test assumed that the data were normally distributed. Analysis of the data indicates that this may not be a realistic assumption. The non-parametric sign test is used to test the same null hypothesis. According to the test, if the industry average price and the industry average intrinsic value are truly equal, then it should be equally likely to get an observed difference that is positive as it is to get a negative difference. The sign test calculates the binomial probability of getting a number greater than or equal to the number of observed positive differences given the assumption that the probability of success is 0.5. The results are reported in Table 2. For both the total and for all of the industry subgroups the null hypothesis is rejected.

In order to determine if there exists a significant correlation between the market's momentum and the magnitude of the MV-IV gap, we ran partial correlations of the MV-IV gap versus changes in the S&P 500 level. The change in the S&P 500 involved six different lagged changes, to capture recent (within one and a half years prior) lagged effects[4]. Results of correlations are presented in Table 3.

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[4] *The limit of no more than six lagged quarters was imposed for pragmatic rather than theoretic reasons; greater lags would have caused greater erosion of data points, reducing our dataset substantially. Therefore, only lags of one through six quarters were used.*

Table 1. One-tail Test Results of t-Test

Ha: mean(diff) > 0		
All Industries	t = 54.1523	P > t = 0.0000
Aircraft Industry	t = 17.9311	P > t = 0.0000
Agriculture Industry	t = 16.8297	P > t = 0.0000
Automobiles and Trucks Industry	t = 17.8581	P > t = 0.0000
Banking Industry	t = 19.0438	P > t = 0.0000
Alcoholic Beverages Industry	t = 18.1343	P > t = 0.0000
industry = blank	t = 18.4619	P > t = 0.0000
Construction Materials Industry	t = 19.0806	P > t = 0.0000
Printing and Publishing Industry	t = 17.5903	P > t = 0.0000
Shipping Containers Industry	t = 16.6699	P > t = 0.0000
Business Services Industry	t = 18.8427	P > t = 0.0000
Chemical Industry	t = 18.2197	P > t = 0.0000
Electronic Equipment Industry	t = 17.3675	P > t = 0.0000
Apparel Industry	t = 17.2180	P > t = 0.0000
Construction Industry	t = 17.7345	P > t = 0.0000
Coal Industry	t = 16.6176	P > t = 0.0000
Computer Industry	t = 16.3323	P > t = 0.0000
Pharmaceutical Products Industry	t = 16.9681	P > t = 0.0000
Electrical Equipment Industry	t = 19.5077	P > t = 0.0000
Petroleum Industry	t = 16.5905	P > t = 0.0000
Fabricated Products Industry	t = 19.5161	P > t = 0.0000
Financial Trading Industry	t = 18.5205	P > t = 0.0000
Food Industry	t = 19.7304	P > t = 0.0000
Entertainment Industry	t = 17.6535	P > t = 0.0000
Precious Metals Industry	t = 11.9699	P > t = 0.0000
Defense Industry	t = 17.3789	P > t = 0.0000
Health Care Industry	t = 15.8913	P > t = 0.0000
Consumer Goods Industry	t = 18.2121	P > t = 0.0000
Insurance Industry	t = 8.5304	P > t = 0.0000
Lab Equipment Industry	t = 17.9159	P > t = 0.0000
Machinery Industry	t = 20.0498	P > t = 0.0000
Restaurants Hotel Motel Industry	t = 18.2601	P > t = 0.0000
Medical Equipment Industry	t = 18.6652	P > t = 0.0000
Nonmetallic Mining Industry	t = 17.0252	P > t = 0.0000
Miscellaneous Industry	t = 17.1455	P > t = 0.0000
Business Supplies Industry	t = 19.5268	P > t = 0.0000
Personal Services Industry	t = 18.3850	P > t = 0.0000
Real Estate Industry	t = 17.6236	P > t = 0.0000
Retail Industry	t = 18.6660	P > t = 0.0000
Rubber and Plastics Industry	t = 18.9410	P > t = 0.0000
Shipbuilding Railroad Equipment Industry	t = 19.3966	P > t = 0.0000
Tobacco Industry	t = 17.7686	P > t = 0.0000
Candy and Soda Industry	t = 18.4547	P > t = 0.0000
Steel Works Etc. Industry	t = 19.2234	P > t = 0.0000
Telecommunications Industry	t = 17.5567	P > t = 0.0000
Recreational Products Industry	t = 17.6652	P > t = 0.0000
Transportation Industry	t = 18.8769	P > t = 0.0000
Textile Industry	t = 17.0216	P > t = 0.0000
Utilities Industry	t = 19.6466	P > t = 0.0000
Wholesale Industry	t = 19.5785	P > t = 0.0000

Table 2. One-tail Test Results of Sign Test

Ha: mean(diff) > 0	*n+ observed*	*n+ expected*	*Binomial P(n+>=n+ observed)*
All Industries	5814	2926.5	0.0
Aircraft Industry	119	59.5	0.0
Agriculture Industry	117	58.5	0.0
Automobiles and Trucks Industry	118	59.5	0.0
Banking Industry	121	60.5	0.0
Alcoholic Beverages Industry	119	59.5	0.0
industry = blank	120	60.0	0.0
Construction Materials Industry	119	60.0	0.0
Printing and Publishing Industry	120	60.5	0.0
Shipping Containers Industry	115	59.0	0.0
Business Services Industry	121	60.5	0.0
Chemical Industry	115	58.5	0.0
Electronic Equipment Industry	120	60.0	0.0
Apparel Industry	119	60.0	0.0
Construction Industry	116	59.5	0.0
Coal Industry	113	58.0	0.0
Computer Industry	121	60.5	0.0
Pharmaceutical Products Industry	121	60.5	0.0
Electrical Equipment Industry	121	60.5	0.0
Petroleum Industry	120	60.5	0.0
Fabricated Products Industry	121	60.5	0.0
Financial Trading Industry	118	60.0	0.0
Food Industry	121	60.5	0.0
Entertainment Industry	120	60.0	0.0
Precious Metals Industry	116	60.0	0.0
Defense Industry	121	60.5	0.0
Health Care Industry	101	50.5	0.0
Consumer Goods Industry	117	60.0	0.0
Insurance Industry	121	60.5	0.0
Lab Equipment Industry	120	60.0	0.0
Machinery Industry	120	60.5	0.0
Restaurants Hotel Motel Industry	118	59.5	0.0
Medical Equipment Industry	121	60.5	0.0
Nonmetallic Mining Industry	118	60.0	0.0
Miscellaneous Industry	113	56.5	0.0
Business Supplies Industry	120	60.0	0.0
Personal Services Industry	118	59.5	0.0
Real Estate Industry	119	60.0	0.0
Retail Industry	119	60.0	0.0
Rubber and Plastics Industry	120	60.5	0.0
Shipbuilding Railroad Equipment Industry	120	60.0	0.0
Tobacco Industry	121	60.5	0.0
Candy and Soda Industry	120	60.5	0.0
Steel Works Etc. Industry	119	59.5	0.0
Telecommunications Industry	118	60.0	0.0
Recreational Products Industry	120	60.0	0.0
Transportation Industry	117	60.0	0.0
Textile Industry	120	60.0	0.0
Utilities Industry	121	60.5	0.0
Wholesale Industry	121	60.5	0.0

Conclusions

The null hypothesis that the industry average price minus the industry average intrinsic value = 0 was rejected in favor of the alternate hypothesis that the gap is greater than zero. This gives us substantive reason to believe that the traditional valuation model has some serious deficiencies in terms of reflecting actual stock prices. To see if this held true for the industry subgroups, the test was repeated for each subgroup. For *all* of the industry subgroups, we reject the null hypothesis in favor of the alternate hypothesis, that the difference in the means is greater than zero.

For the correlation between the market's momentum and the magnitude of the MV-IV gap, the six-quarter lag seems to dominate the significant results. For agric, banks, eleceq, energy, fabpr, food, mach, medeq, and whlsl, the six quarter lag is the only change in the S&P 500 that significantly impacted the MV-IV gap. A few other significant results appear as well: a one-quarter lag for steel and mines, a three quarter lag for aero, hshold, and steel, a four-quarter lag for guns and bldmt, and a five-quarter lag for paper. For 32 industry groups, though, no significant results are present. This could mean that factors other than momentum are affecting the MV-IV gap. It could also indicate that the long-accepted (and taught) model of intrinsic stock valuation simply misses the mark where indication of market price is concerned. Even if stocks are consistently undervalued by the valuation model, it should still indicate a greater gap during momentum cycles in the general market.

The repetition of the six-quarter lag, though only present in nine of the industry groups, suggests some eighteen-month effect. Perhaps as the stock market experiences greater changes over one and a half years, some industries exhibit sensitivity in terms of price relative to what conceptual models tell us *should be* the price according to fundamentals.

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