
Measuring the Present Value of Growth Opportunities

Richard A. Wall, Ph.D.
CFA
M&T Bank
Distinguished Professor
Department of Economics
and Finance
Canisius College
Buffalo, NY 14208
USA
716-888-2666
wall@canisius.edu

The concept of the present value of growth opportunities (PVGO) is generally accepted in valuation literature, but does not yet seem to have gained much popularity among investment professionals. This paper focuses on the development of a model form that lends itself more directly to practical measurement of PVGO than prior academic models using simplifying assumptions. It is demonstrated that a significant bias in PVGO measurement occurs if analysts are not careful in the application of real versus nominal cost of equity. After identifying additional measurement issues, primarily alternative earnings constructs, betas, and equity risk premiums, median PVGO is estimated for all industry sectors using stocks in the Russell 3000 index in the USA. With proper measurement, PVGO can be a useful relative valuation tool in investment decision making, and in academic research that seeks to evaluate the fundamentals that underlie it.

The present value of growth opportunities (PVGO) is a concept that originated as far back as Miller and Modigliani (1961). The value of the firm is separated into the value of assets in place plus the net present value of future growth projects. Thus, growth in of itself is only value creating if future projects generate positive net present value (NPV). As a consequence, when future growth projects are nonexistent or result in NPV of zero, the value of a firm's stock is the ratio of its normalized earnings divided by the cost of equity.

A practical aspect of the PVGO concept is that it can serve as an improvement over price-earnings (PE) multiples in investment decision making because it adds the risk and franchise factor dimensions to price and earnings when making comparisons across peer companies and even industries. A company's stock price can be broken into its status quo versus growth potential components to judge whether the investor's assessment of growth prospects is consistent with the market consensus. The critical determinant of the differential between the PE of a "growth" firm versus that of a zero NPV firm is what Liebowitz and Kogelman (1990 and 1992) refer to as the "franchise factor." This is represented by the difference between return on stockholders' equity and the cost of equity, the source of potentially positive expected NPV.

In academic research, proper measurement of PVGO can be used to evaluate the validity of alternative valuation models, and to estimate the contribution to value of fundamental factors like risk, growth, decay rates, and profitability. For example, empirical analysis by Chung and Charoenwong (1991) finds a positive relationship between PVGO and stock risk. PVGO measurement is critical to estimation of the key parameters of multistage and finite growth valuation models, and models that incorporate decay of profit to a competitive norm, such as those of O'Brien (2003), Danielson (1998) and Liebowitz (1998).

The translation of many academic models to measurement form is hindered by simplifying assumptions such as a constant investment stream, constant earnings stream (the no-growth case), accounting return on the book value of equity, or lack of clear distinction between the nominal and real cost of equity. As a result, practical measures of PVGO may be biased or misspecified. The measurement issue is examined in depth by Danbolt *et al.* (2002) using British firms in the FTSE 350. Their study analyzes the impact of alternative measures of earnings and equity risk premium (ERP), and the conversion from a nominal to real risk-free rate, on the percentage of stock price attributed to PVGO. Further, they test for PVGO model validity and consistency with call option theories of growth opportunities.

The conclusions of Danbolt *et al.* do not directly support the PVGO methodology, based on a high incidence of negative PVGO's in inflation adjusted circumstances, and lack of correlation between contemporaneous abnormal returns of assets in place and growth opportunities. However, as the authors indicate, their tests cannot disentangle the joint hypothesis of the PVGO methodology and call option theory of growth opportunities, making it difficult to accept or reject one or the other. Further, a material number of negative PVGO estimates can just as easily be explained by measurement error in earnings and the required rate of return,

especially given the likelihood the sample contains mature or even declining firms and industries that may have true PVGO's near zero.

The present paper has two primary purposes. First, it is demonstrated theoretically that explicit separation of real growth in output from inflationary growth in product prices yields a sound discounted cash flow (DCF) model that is consistent with the concept of separating the value of assets in place from the value of growth opportunities. In fact, the primary problem with earlier academic models of PVGO in textbooks and the academic literature is a lack of direct specification of real versus inflationary growth in earnings and capital investment. The intuitive appeal of the model result is that a comparison of stock price to the value of assets in place (the latter being the ratio of earnings to the real cost of equity) is nothing more than a risk adjusted PE multiple. Thus, assuming one can overcome measurement error issues, PVGO has an obvious benefit as a potential improvement over PE multiples for relative valuation in stock selection when risk characteristics differ within and between industries. It is also demonstrated in the same DCF model that PVGO can be derived from, and is thus consistent with, a risk adjusted market to book value of equity ratio.

The second purpose of this paper is to generate estimates of industry median PVGO for a reasonable range of earnings constructs and ERP's, and to examine the impact of the more theoretically sound real required rate of return on equity. It is not surprising that in a large database a wide range of individual firm estimates of PVGO's, including negative values, will occur. Equity analysts go to painstaking lengths to make adjustments to financial statements and statistically estimated betas on a company by company basis. This is obviously not possible with a large database of observations. The use of industry median PVGO estimates controls for noise across firms within each industry, permitting assessment of the efficacy of alternative measurement constructs across industries.

The paper first derives a basic model of PVGO that assumes a growth process of real output in an inflationary environment. Next, measurement issues in the estimation of earnings and the cost of equity are reviewed along with potential biases in resulting estimates of PVGO. Following this, PVGO is estimated (as of mid 2006) for each GICS industry group represented in the USA based Russell 3000, and for alternative measures of earnings and components of the cost of equity.

The Basic PVGO Model

The traditional approach to the modeling of PVGO is to start with a "no-growth" firm, and then to distinguish the impact of growth on value for firms with zero versus non-zero NPV growth opportunities.¹ That approach is followed here, but with an explicit focus on a real output and investment growth process that is aimed at the facilitation of practical measurement using a real cost of equity. The first step is to recognize that, even in the "no-growth" case, nominal earnings may grow with inflation.

The No-Growth Case

Assume a firm that makes an initial investment per share of B_0 , with annual capital expenditures set equal to economic depreciation to maintain the real productive capability of the asset base. For simplicity, assume that there is inflation in the economy at an annual rate of π , no technological change or obsolescence, and that revenue and expenses are subject to the same rate of inflation. Thus, there is no “real” growth in unit sales.

Earnings per share in year t , while constant in real terms, grows in a nominal sense at the rate of inflation as follows

$$E_t = S_t - C_t = (S_0 - C_0)(1 + \pi)^t = E_0(1 + \pi)^t \quad (1)$$

where S_t and C_t represent revenues and expenses per share in year t , respectively. Next, the relationship between the nominal cost of equity, k , and real cost of equity, k_r , is most correctly given by

$$(1 + k) = (1 + \pi)(1 + k_r), \quad (2a)$$

and this implies the following as the appropriate discount factor for each E_t

$$(1 + k)^t = (1 + \pi)^t(1 + k_r)^t. \quad (2b)$$

Calculating the standard discounted present value of earnings to infinity using equations (1) and (2b), the $(1 + \pi)^t$ terms cancel out, resulting in the value of a perpetuity in terms of real earnings and the real cost of equity, whether one initially approaches the matter using nominal or real measures of earnings and cost of equity,

$$P_0 = E_0 / k_r. \quad (3)$$

Equation (3) demonstrates that, for a “no-growth” firm—i.e. no growth in real output—the value of equity is the ratio of today’s (real) earnings divided by the *real* cost of equity.

Real Growth

The next step in the process is to focus on “real growth,” at an annual rate of g_r , in unit sales and the productive capability of the asset base. Further, nominal investment in any time period t must be measured in relation to the replacement cost of the existing asset base—i.e. accounting book value adjusted for inflation. Constant leverage and turnover ratios are assumed. Thus, real growth rates in sales, assets, and stockholders’ equity are one in the same.

Let’s start with incremental per share stockholders’ investment at the end of time period 1 following an initial investment of B_0 at time 0,

$$I_1 = g_r B_0(1 + \pi) \quad (4)$$

This relation specifies that a real growth objective of g_r requires a nominal investment in year 1 based on the inflation adjusted, or replacement cost, $B_0(1 + \pi)$, of the initial asset base.

The equity portion of the replacement cost of the expanded asset base can be written as of the end of year 1 as the sum of I_1 plus the inflation adjusted initial asset base

$$B_1 = I_1 + B_0(1 + \pi) = B_0(1 + g_r)(1 + \pi) \quad (5)$$

Note that stockholder investment at the end of year 2 is derived from B_1 after adjusting it for one additional year of inflation

$$I_2 = g_r B_0(1 + g_r)(1 + \pi)^2 \quad (6)$$

Continuing this process iteratively, it can be shown that investment and the replacement cost of the asset base, with real growth in production at the rate of g_r , are as follows for any time period t

$$I_t = g_r B_0(1 + g_r)^{t-1}(1 + \pi)^t \quad (7)$$

$$B_t = I_t + B_0(1 + g_r)^{t-1}(1 + \pi)^t = B_0(1 + g_r)^t(1 + \pi)^t \quad (8)$$

Now define R as the constant rate of earnings on the replacement cost of assets, B_t . Earnings is assumed to occur at the end of the period (which includes inflation for that period) but is based on real assets in place at the beginning of the same period. Thus,

$$E_t = R B_{t-1}(1 + \pi) = R B_0(1 + g_r)^{t-1}(1 + \pi)^t \quad (9)$$

R , as a rate of return on the equity portion of the replacement cost of the asset base, replaces ROE (accounting rate of return on book value of equity) in the typical PVGO model. Earnings in equation (9) assume, for simplicity, the same rate of return, R , on the initial real asset base and growth projects. Today's stock price, P_0 , can be derived as the difference between the discounted present value of all future earnings less the present value of future investment outlays (per share)

$$P_0 = \sum E_t / (1 + k_r)^t(1 + \pi)^t - \sum I_t / (1 + k_r)^t(1 + \pi)^t \quad (10)$$

where the summations are carried from 1 to infinity. Note that, also for simplicity, the same risk adjusted discount rate, k_r , is assumed for assets in place and future growth opportunities.

Substituting for E_t and I_t from equations (9) and (7), respectively, and simplifying, we have the familiar looking formula

$$P_0 = B_0 [(R - g_r) / (k_r - g_r)] . \quad (11)$$

However, the more common presentation of this equation as a market to book value of equity ratio is normally expressed with nominal growth rates, a nominal cost of equity, and the accounting return on common equity (ROE). If $ROE > k$, it is concluded that PVGO, or franchise value, is positive. Obviously, the comparison of accounting ROE to a nominal cost of equity is problematic. *Ceteris paribus*, ROE will tend to be lower for firms with newer capital (and vice-versa) because book value is acquired at more recent prices. This introduces a measurement bias when using accounting based market to book values to assess PVGO.

Equation (11) applies a *real* return, R , on the *replacement cost* of assets, in comparison to the real cost of equity, k_r , to measure PVGO. The assessment and measurement of PVGO is now (properly) independent of the acquisition date of assets for book value accounting purposes. However, measuring the real return on replacement cost of assets is easier said than done. Fortunately, the formulation of the model in real and replacement cost terms gives rise to a simple result when the PVGO model is reworked into its more conventional form, as follows.

Substituting expected earnings, E_0 , for RB_0 in equation (11), and reconfiguring, we can derive the conventional breakdown as the value of assets in place plus PVGO in terms of real returns and real growth as

$$P_0 = E_0/k_r + [g_r B_0 (R - k_r)] / [k_r (k_r - g_r)] \quad (12)$$

The second term in equation (12) is, of course, PVGO, and can be indirectly measured as the residual $P_0 - E_0/k_r$. The measurement of PVGO itself, as well as any attempt to ascertain the impact on PVGO of fundamental factors—growth, risk, or return—critically depends on an unbiased estimate of E_0/k_r . However, if one substitutes the nominal cost of equity in place of k_r , as may be the case by an unsuspecting analyst, this would cause a downward bias in the value of assets in place, and thus an upward bias in PVGO estimation.

Nominal Cost of Equity Bias

The upward bias in the measurement of PVGO caused by a nominal cost of equity is more pronounced for low growth firms. Consider a “no-growth” firm with current earnings of \$1 per share and a 7.5% nominal cost of equity, in an inflationary environment averaging 2.5% per year. Thus, the value of the stock, E_0/k_r , is \$20ps (\$1/.05). The assets in place value of the stock, if mismeasured as E_0/k , is \$13.33 (\$1/.075). PVGO estimated as \$6.67 is 33% of stock price when it really should be 0% of the \$20 trade price, a hefty perceived premium to pay for future growth expectations that do not really exist.

Now consider a “growth” firm trading at the same \$20 price and nominal cost of equity at 7.5%, but with current earnings of \$0.50ps.² The correct assets in place value for this stock, E_0/k_r , is \$10ps (\$0.50/.05). The correct PVGO, also at \$10ps, is thus 50% of the \$20 price. But, with a nominal cost of equity, the assets in place price is estimated to be \$6.67 (\$0.50/.075), and PVGO at the residual of \$13.33. The PVGO bias is \$3.33, or 16.7% of the trade price. Thus, arithmetically, the PVGO bias for the “growth” firm is only half (in dollar and percentage terms) that of the “no-growth” firm. The tendency for investors is to perceive low growth firms to be overpriced relative to high growth firms, potentially causing overweighted portfolio allocations for the growth sector.

Measurement Issues

Proper measurement of PVGO requires data on only two constructs— E_0 and k_r . But appearances can be deceiving. With regard to earnings, the analyst must carefully weigh a number of issues ranging from trailing versus expected earnings, normalized earnings, earnings from continuing operations, and non-recurring earnings. Further, the literature is filled with modeling theory (e.g. CAPM and APT) and measurement problems for both the nominal and real cost of equity. The approach taken here is to follow the basic concept of the CAPM—a risk-free rate plus the systematic risk (beta) adjusted market equity risk premium. The nominal cost of equity is converted to a real rate by subtracting the long-run expected inflation rate in the economy from the risk-free rate.³

The academic and professional finance community in the USA appears to be getting comfortable with the idea of a risk-free rate represented by long-term U.S. Treasury bond yields. Further, the inflation environment has been pretty stable for close to 20 years now (CPI inflation averaging 2.5% per year for the past 10 years or more). Systematic risk measured by beta has less general acceptance given the wide variety of regression based estimation procedures (e.g. weekly versus monthly data), margin for error in estimates, historical versus forward looking betas (e.g. raw versus adjusted betas), and the assumptions underlying the CAPM model itself.

The real controversy recently, however, is in the estimation of the equity risk premium (ERP). Mehra and Prescott (1985) are credited with starting the ball rolling on this issue based on their observation that the expected ERP should be much lower than historically calculated return differentials between stocks and risk-free bonds. While a complete review of the literature on the subject is beyond the scope of this paper, a few of the more influential articles on the subject deserve attention.

Arnott and Bernstein (2002) conclude that the forward looking ERP, at the time of the writing of their paper, could actually be zero or negative. They estimate that, over an extended period of time, the expected ERP tends to average 2.4% as compared to the historically earned ERP of 5.7% over bonds derived from the Ibbotson Associates database. Notwithstanding, there are theoretical and empirical arguments for a higher *ex ante* ERP, much closer to the historical average, such as by Jones and Wilson (2005). Taking another step, theoretical challenges have been levied against the ability of consumption based CAPM models to properly measure

risk aversion in the first place. Siegel (2005) provides a good summary of these theoretical and estimation issues, but still concludes with the assertion that the ERP is about 2% to 3% over bonds yields.

Considering all sides of these arguments, and typical default risk premia on corporate bonds, a fair ERP range over long-term U.S. Treasury yields from about 2.5% to 5% is utilized in the empirical analysis to follow. Note, however, that more recent estimates by analytical services at the time of this study, such as by Bloomberg, lean toward a 5% ERP over U.S. Treasury yields.

Empirical Measurement of PVGO

Empirical estimation of PVGO for investment decision making and academic research depends critically on model validity. Similar to arguments made by critics of the CAPM, one cannot easily resolve the joint hypothesis of model validity and best practices for empirical estimation. The indirect measurement of PVGO as the residual $P_0 - E_0/k_r$ has, in addition to the concern for the validity of the CAPM, similar joint discounted cash flow modeling and estimation issues regarding the appropriate earnings construct, equity risk premium, and whether the modeling approach to the earnings and growth process leads to a nominal or real cost of equity. For example, do better estimates of PVGO arise using trailing or forecasted earnings, nominal or real cost of equity, historical or forward modeled equity risk premiums, raw or adjusted betas, etc.

The empirical analysis to follow seeks to guide empiricists, analysts, and investors in the selection of a range of reasonable approaches to earnings, beta, ERP, and cost of equity measures in PVGO estimation. Notwithstanding the concerns raised by Danbolt *et al.* about the validity of the option theories of growth opportunities, the empirical model applied in this paper proceeds on the grounds of the generality and wide acceptance of DCF models. Put another way, absent a rejection of the DCF valuation methodology itself, is there a set of measurement parameters that fairly fits the most appropriate variation of the potential DCF models underlying PVGO?

In the tables to follow, similar to Danbolt *et al.*, PVGO is estimated using trailing earnings and expected earnings, raw and adjusted beta, an ERP range from 2.5% to 5% to be consistent with ex ante and historical views, and nominal and real costs of equity. The purpose is to provide a methodology that generates reasonable estimation parameters for PVGO that can then be applied to individual firms on a case by case basis (after careful fundamental analysis and restatement of earnings and market data by equity analysts).

Data was gathered from Bloomberg for all companies in the Russell 3000 in mid 2006—missing data on certain variables reduced the workable sample to about 2,600 firms. The following variables were obtained: EPS from continuing operations (ttm), next year's expected EPS, adjusted beta, raw beta, and stock price (early June 2006). E_0/k and E_0/k_r were calculated for each firm, as described in Tables 1 and 2, for ERP's of 2.5% and 5%, raw versus adjusted beta, and ttm versus expected EPS. The nominal cost of equity, k , assumes a risk-free rate of 5%, consistent with market

Table 1
Median PVGO Percentage of Stock Price
by GICS Industry Group Equity Risk Premium
of 2.5% with Adjusted Beta

Industry	ttm Earnings			Expected Earnings		
	Firms	k(nom)	k(real)	Firms	k(nom)	k(real)
1. Automobiles/Components	32	35%	4%	29	6%	-34%
2. Banks	269	17%	-23%	251	4%	-44%
3. Capital Goods	195	40%	12%	184	19%	-17%
4. Commercial Serv./Supplies	91	45%	18%	86	25%	-15%
5. Consumer Durables/Apparel	110	21%	17%	102	-4%	-55%
6. Consumer Services	94	49%	24%	94	32%	-4%
7. Diversified Financials	76	24%	-10%	66	8%	-37%
8. Energy	127	32%	1%	124	-3%	-51%
9. Food/Staples Retailing	29	30%	-6%	27	27%	-15%
10. Food/Beverage/Tobacco	57	31%	-6%	52	12%	-38%
11. Health Care Equip/Services	172	50%	27%	170	30%	-4%
12. Household/Personal Prod.	24	25%	-17%	22	13%	-39%
13. Insurance	94	-3%	-56%	84	-26%	-88%
14. Materials	120	38%	11%	109	11%	-29%
15. Media	80	43%	13%	76	25%	-15%
16. Pharmaceuticals/Biotech	167	150%	180%	158	86%	80%
17. Real Estate	142	66%	49%	125	50%	26%
18. Retailing	135	37%	10%	131	19%	-18%
19. Semiconductors and Equip.	102	71%	59%	102	34%	7%
20. Software and Services	194	55%	47%	189	42%	16%
21. Technology Harware/Equip.	164	60%	42%	162	31%	2%
22. Telecommunication Serv.	36	58%	34%	34	33%	-1%
23. Transportation	53	37%	6%	52	14%	-22%
24. Utilities	91	16%	-26%	87	2%	-49%

conditions for U.S. Treasuries in mid-2006. Conversion to a real cost of equity, k_r , subtracts a 2.5% assumed expected inflation rate, reflecting historical inflation in the U.S., and expectations going forward as revealed in yields and prices on U.S. Treasury inflation protected securities. PVGO's, measured as the residual of stock price less E_0/k or E_0/k_r , are converted to a percentage of stock price for each firm in the sample.

Tables 1 and 2 report median PVGO percentage of stock price for each of the 24 GICS industry groups broken out by Bloomberg. The intention here is to ascertain the competitive and growth environment of each industry by first controlling for noise in individual firm PVGO's caused by measurement errors in the EPS and beta measures involved. For example, one would expect mature industries with high levels of competition to exhibit near zero, modest positive or even modest negative median PVGO. By comparison, early studies using small samples, such as by Kester (1984), attribute more than 50% of stock value to PVGO. These estimates are untenable for the economy as a whole based on generally accepted economic principles of competition and life cycle stages of industries. This type of

Table 2
Median PVGO Percentage of Stock Price
by GICS Industry Group
Equity Risk Premium of 5% with Raw Beta

Industry	ttm Earnings			Expected Earnings		
	Firms	k(nom)	k(real)	Firms	k(nom)	k(real)
1. Automobiles/Components	32	57%	47%	29	36%	18%
2. Banks	269	38%	17%	251	29%	5%
3. Capital Goods	195	58%	47%	184	44%	31%
4. Commercial Serv./Supplies	91	61%	50%	86	42%	23%
5. Consumer Durables/Apparel	110	43%	24%	102	24%	0%
6. Consumer Services	94	60%	45%	94	47%	29%
7. Diversified Financials	76	44%	29%	66	32%	9%
8. Energy	127	55%	42%	124	30%	14%
9. Food/Staples Retailing	29	47%	25%	27	39%	13%
10. Food/Beverage/Tobacco	57	44%	20%	52	27%	-5%
11. Health Care Equip/Services	172	64%	52%	170	47%	28%
12. Household/Personal Prod.	24	38%	14%	22	25%	-13%
13. Insurance	94	24%	3%	84	7%	-22%
14. Materials	120	58%	48%	109	41%	25%
15. Media	80	53%	32%	76	38%	13%
16. Pharmaceuticals/Biotech	167	137%	146%	158	98%	89%
17. Real Estate	142	75%	65%	125	62%	49%
18. Retailing	135	56%	45%	131	45%	30%
19. Semiconductors and Equip.	102	82%	78%	102	59%	50%
20. Software and Services	194	75%	69%	189	60%	50%
21. Technology Harware/Equip.	164	74%	67%	162	55%	45%
22. Telecommunication Serv.	36	65%	53%	34	51%	33%
23. Transportation	53	56%	47%	52	39%	21%
24. Utilities	91	35%	10%	87	23%	-6%

result is most likely caused by an upward bias in the nominal required rate of return employed to estimate the value of assets in place.

A perusal of the tables reveals cross-industry PVGO differentials one would expect—higher for growth industries such as biotech and semiconductors, lower or even negative for utilities and insurance. Further, correlations tabulated from data in the tables confirm the arithmetic example of nominal versus real PVGO bias presented earlier, demonstrating that the upward PVGO bias is more pronounced for low growth firms. To confirm this visually, one can see a strong tendency that, in conversion from a nominal to real cost of equity, the percentage point reduction in median PVGO is greater for low growth industries and lower for high growth industries.

Consistent with Danbolt *et al.*, median PVGO estimates are highly sensitive to changes in the earnings per share measure, the magnitude of the ERP, and the inflation adjustment of the risk-free rate. The main hypothesis of this paper, however, that assets in place value should be measured as E_0/k_r , is strongly supported by the data in Tables 1 and 2. Looking at Table 2 with an ERP of 5%, all

industry median PVGO's are positive using a nominal cost of equity, with many at unrealistically high percentages of stock price. Even in Table 1 with lower nominal cost of equity using an ERP of 2.5%, the vast majority of industry median PVGO's are still positive.⁴ This would only be possible in an economic system where most industries have not reached maturity, nor a highly competitive environment. While it is true for certain industry groups, it is not true for all or even nearly all. Thus, the conclusion reached from the data is that appropriate modeling and measurement of PVGO should start with an assets in place value using a real cost of equity.

While the choice among the various measures of earnings and size of the ERP cannot directly be solved owing to the joint modeling and measurement issues discussed above, a recommendation for practical measurement of PVGO can be made from the results herein. Focusing on PVGO's using the real cost of equity (and recognizing that there is a matter of judgment in the selection of appropriate data just as any equity analyst has to do), the last column of Table 2 provides realistic cross-industry distributions of positive (and a few negative) industry median PVGO's. Further, this scenario of parameter choices is most theoretically plausible based on expected earnings, an ERP of about 5%, and real cost of equity.

The preponderance of positive industry median PVGO's ranging from about 20% to 50% in the last column of Table 2 is consistent with a U.S. economic system that is characterized by sustainable moderate real economic growth. Median PVGO percentages near zero—for example, Consumer Durables/Apparel, Food/Beverage/Tobacco, and Utilities—are clearly mature, slow real growth industries and/or industries with high degrees of competitive pressures. The significant negative median PVGO for Insurance is consistent with the effects of a post-terrorism economy on that particular industry. Note that the unusually high PVGO for Pharmaceuticals/Biotech is driven primarily by the Biotech sector's low to negative current earnings, and high future growth potential, by a material number of these firms. Translation of this conclusion—i.e. measurement of PVGO by expected earnings, an ERP in the 5% range, and real cost of equity—to a particular company at a particular point in time, of course, would require careful analysis and potential restatement of accounting earnings and beta estimates, as well as adaptation of the market risk-free rate and ERP environment for changes over time that are bound to occur.

Conclusion

The primary purpose of this paper is to develop a model form for the present value of growth opportunities that leads to measurement of the concept for investors and analysts in the investment decision making process, and academic research that seeks to identify the primary fundamental forces that drive value creation. A model is developed that has its roots in the present value of growth opportunities (PVGO) theoretical literature, but focuses more directly on growth in real output and real investment required to achieve it. The result is an indirect measure of PVGO as the residual between stock price and the ratio of current earnings to the real cost of equity. The latter ratio is the assets in place value of a no-growth firm

in an environment with inflation in revenues and expenses. The residual is positive, reflecting value creation, when there is growth in real output and the rate of return on the replacement cost of assets exceeds the real cost of equity.

Industry median PVGO estimates are presented for alternative combinations of earnings constructs, equity risk premium (ERP) and beta measures. Results indicate that the real cost of equity, as distinct from the nominal cost of equity, generates more realistic patterns of PVGO's that are consistent with the maturity phases and competitive environments across the industries examined. It is shown that a "no-growth" assets in place value with a nominal cost of equity in the denominator causes an upward bias in PVGO estimation that is more pronounced for value firms than growth firms. Empirical results also provide insights into the selection of earnings and equity risk premium measures to generate meaningful PVGO estimates. A realistic distribution of industry median PVGO estimates is generated with expected earnings, an ERP in the 5% range, and real cost of equity.

Footnotes

¹ Some of the most widely used finance textbooks follow this approach. Good examples are found in Bodie and Merton (2000), and the widely accepted text on investments by Reilly and Brown (2006). The latter text forms the basis for investments and portfolio theory required readings for the CFA™ curriculum.

² Risk is held constant for arithmetic simplicity. The author recognizes that other fundamental factors, such as risk, could also affect the magnitude of the potential PVGO bias, especially in light of the positive relation between PVGO and risk found by Chung and Charoenwong (1991).

³ The market risk premium is defined as the difference between the expected market return and risk free rate, each in nominal terms. Thus, no separate inflation adjustment is required for the market risk premium since inflation cancels out.

⁴ The distinction between raw versus adjusted beta, while it may be important for an individual firm, had little or no effect on the main conclusions and measurement recommendations of the paper. As such, additional tables that combined 5% ERP with adjusted beta and 2.5% ERP with raw beta were omitted for brevity.

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