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Portfolio Strategy

Price/Earnings Ratios, Risk Premiums and the g* Adjustment

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This paper addresses a fundamental market paradox about the role of growth in equity return projections.

This theoretical analysis is critically based on the assumption of a stable P/E ratio over time. In practice, this assumption is certainly questionable, especially when developing short or long term return projections for a given point in time. However, the stable PE assumption allows this theoretical analysis to focus narrowly on several important structural issues involved in the estimation of equity risk premiums.

The starting point for any equity return projection is the sum of its dividend yield and its price appreciation. With an assumed stable Price/Earnings ratio (P/E), price appreciation is equivalent to earnings growth, so the projected equity return is dividend yield (DY) plus earnings growth (g). However, this basic two-term formulation immediately runs into challenges because long-term earnings growth is hard to estimate.

As an alternative, a common practice is to bypass this theoretically correct two-term formulation and instead adopt the more readily observable Earnings Yield (EY) as a one-term equity return estimate. However, while EY incorporates some portion of earnings growth, it doesn't properly account for the impact of higher growth levels. Consequently, the EY alone tends to understate projected return, especially when higher levels of earnings growth are anticipated.

To "true up" the EY and make it consistent with the two-term, DY–based expression, an incremental adjusted-growth term "g*" should be added to EY. This g* term turns out to play a number of important roles in equity analysis.

For example, the EY, less some relevant interest rate, is commonly used as an estimate of the equity risk premium. In some situations, g* might represent a sizable fraction of the EY or the interest rate. The risk premium might then be significantly underestimated if EY alone were used without this g* true-up.

Positive g* values generally represent the firm's potential for value-additive investments derived from competitive advantages in terms of patents, licenses, branding, market penetration, pricing power, etc. The total present value of these opportunities — the Franchise Value — is the ultimate source of P/E premiums and positive values of g*.

In addition to contributing to more consistent estimates of going-forward returns and risk premiums, the g* framework turns out to shed considerable light on many other facets of the equity growth process that leads to P/E premiums.

Summary

We thank Dr. Stanley Kogelman (who is a not a member of Morgan Stanley's Research Department) for his important contributions to the development of the mathematics and the research in this report. Unless otherwise indicated, his views are his own and may differ from the views of the Morgan Stanley Research Department and from the views of others within Morgan Stanley.

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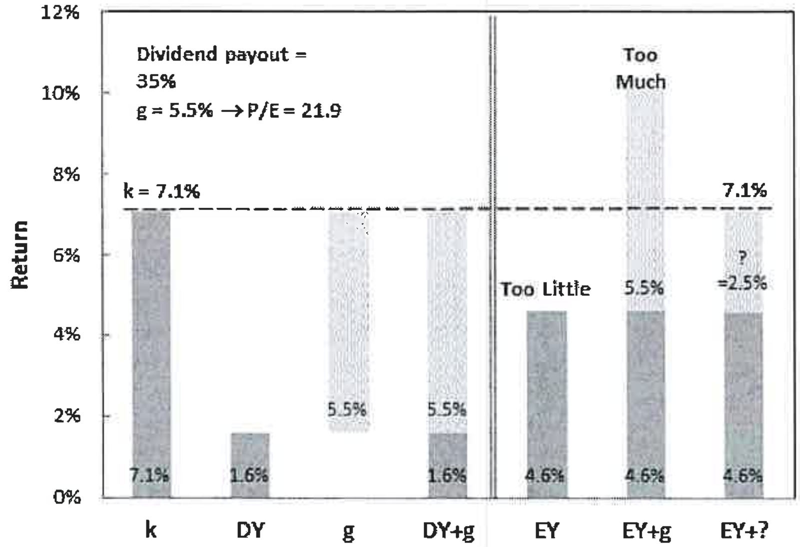
The starting point for any equity return projection is the sum of its dividend yield and its price appreciation. With an assumed stable Price/Earnings ratio (P/E), price appreciation is equivalent to earnings growth, so the projected equity return is dividend yield (DY) plus earnings growth (g). However, this basic two-term formulation immediately runs into challenges because long-term earnings growth is hard to estimate.

As an alternative, a common practice is to bypass this theoretically correct two-term formulation and instead adopt the more readily observable Earnings Yield (EY) as a one-term equity return estimate. However, while EY incorporates some portion of earnings growth, it doesn't properly account for the impact of higher growth levels. Consequently, the EY alone tends to understate projected return, especially when higher levels of earnings growth are anticipated.

To "true up" the EY and make it consistent with the two-term, DY–based expression, an incremental adjusted-growth term "g*" should be added to EY.. This g* term turns out to play a number of important roles in equity analysis.

Exhibit 1 illustrates the return components for a hypothetical firm with a P/E of 21.9, corresponding EY of 4.6% and a market capitalization rate k of 7.1%. The 1.6% DY and 5.5% growth add to 7.1%. But, if that same growth rate is added to EY, the result is a return that is far greater than k. However, the 2.5% gap between EY and k implies the need for the addition of a 2.5% adjusted-growth term in order to "true-up" these two return estimates.

Exhibit 1: Return as Dividend Yield + Growth or Earnings Yield + "Growth-Adjustment"



Source: Morgan Stanley Research

The missing growth adjustment in Exhibit 1 is symbolized by g* which is just the difference between k and EY. In this paper, it is shown that this g* term plays a number of important roles in equity analysis and can be computed in a number of other ways.

As another example, a g* of zero is shown to imply that the P/E is just the reciprocal of the discount rate (k). Positive g* values lead to higher P/E premiums. Moreover, these P/E premiums, expressed as a percentage of the total P/E, turn out to be linearly related to the value of g*.

Positive g* values generally represent the firm's potential for value-additive investments derived from competitive advantages in terms of patents, licenses, branding, market penetration, pricing power, etc. The total present value of these opportunities — the Franchise Value — is the ultimate source of P/E premiums and positive values of g*.

In addition to contributing to more consistent estimates of going-forward returns and risk premiums, the g* framework turns out to shed considerable light on many other facets of the equity growth process that leads to P/E premiums.

Finally, and perhaps most importantly, the EY is commonly used in the estimation of the equity risk premium. However, the EY understates the total return in certain situations, and this lower return estimate naturally maps onto the risk premium estimate. Moreover, any such underestimation at the total return level becomes more significant in percentage terms at the lower level of the risk premium. Thus, g* can serve as a particularly helpful premium adjustment to obtain more theoretically consistent estimates of the offered equity risk premium.

The Dividend Discount Model: Retention-Driven Growth

In the classic Dividend Discount Model (DDM), a firm retains a fixed percentage b of its current earnings E and pays out the balance (1 – b)E to investors in the form of dividends. All retained earnings are assumed to be targeted for new investments that offer a return equal to the firms' current return on equity, r.

These assumptions lead to a growth rate g that applies to both earnings and dividends. The price of the firm's equity is the present value of the projected dividend stream, discounted at the market capitalization rate k.

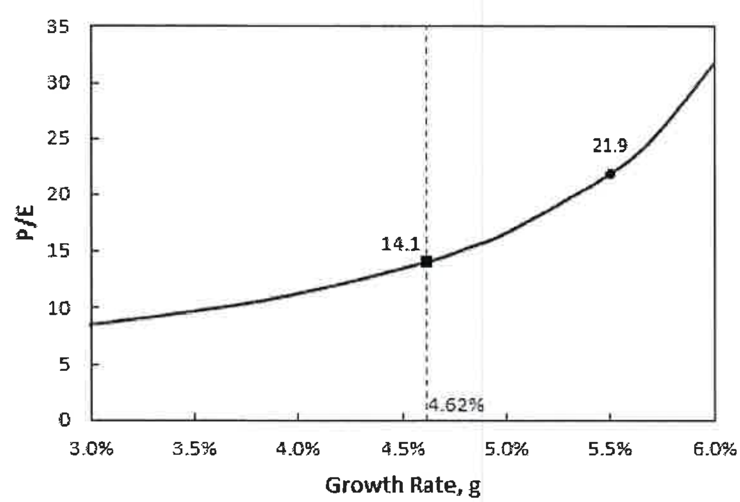
$$P = \frac{D}{k-g} = \frac{(1-b)E}{k-g}$$

And,

$$P/E = \frac{1-b}{k-g}.$$

In Exhibit 2, the DDM-based P/E is plotted for firms that pay out 35% of earnings as dividends and retain 65% for new investments. Growth rates of 4.6% and 5.5%, are highlighted, with corresponding P/E's of 14.1 and 21.9.

Exhibit 2: P/E vs Growth with the DDM (b = 65%, k = 7.1%)



Source: Morgan Stanley Research

The retention-driven growth model leads to g-values that depend on both a firm's dividend payout policy (and corresponding retention rate) and its return on equity r. If two firms have the same retention, the one with the higher r will have higher earnings growth. Specifically, if bE dollars of earnings are retained at the end of the first year and reinvested at r, then at the end of the second year, the incremental earnings (above and beyond E) will be r(bE). The annual growth rate is then

$g = rbE/E = br.$

Thus, in Exhibit 2, for a fixed retention rate of 0.65, higher g values reflect the higher r values which naturally lead to higher P/Es.

In the special case in which r equals the market rate k, g = bk, the P/E formula takes on a simpler form. In the P/E formula, replacing g by bk and doing some algebra reveals that P/E is just 1/k.

$$P/E = \frac{1-b}{k-bk} = \frac{1-b}{(1-b)k} = \frac{1}{k}.$$

The above formula shows that the P/E is independent of retention when r = k. This result is intuitively reasonable because investors presumably can obtain the market rate themselves by simply investing in a market portfolio or index fund. There is no reason for investors to pay a "P/E premium" relative to 1/k, for a firm that just earns k on its retained earnings.

We refer to 1/k as the "base P/E." For example, if k = 7.1%, the base P/E is 14.08 and the corresponding EY = E/P = k. This observation is important because it says that when r = k the earnings yield equals the equity return. If r > k, the P/E > 1/k, EY will be less than k and EY alone will underestimate the equity return.

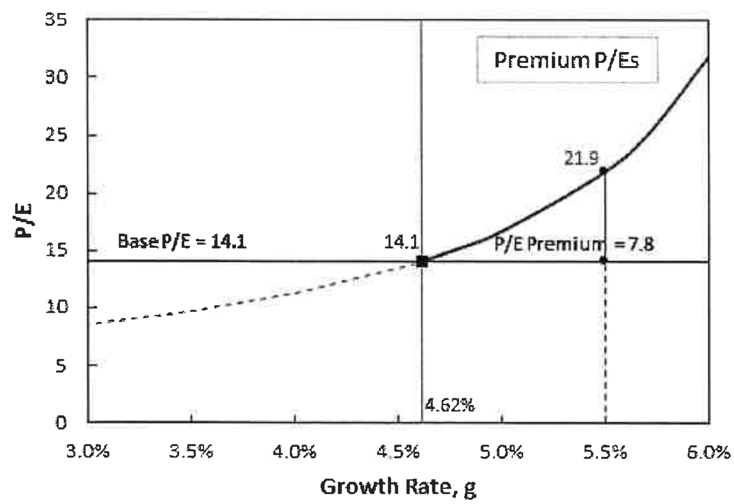
Exhibit 3 starts with the P/E graph in Exhibit 2 and adds a horizontal line at 14.08%. This line highlights the fact that the same base P/E applies to all growth rates.

The P/E curve intersects the base P/E line at g = bk = 4.62%. The P/E for firms with r > k and g > 4.62 will be greater than 14.1%, and such firms will be valued at a P/E Premium (relative to the base P/E of 1/k). This Premium is the difference between the total P/E and the base P/E:

P/E = Base P/E + P/E Premium

P/E Premium = P/E – 1/k.

Exhibit 3: The Base P/E and P/E (b = 0.65, k = 7.1%)



Source: Morgan Stanley Research

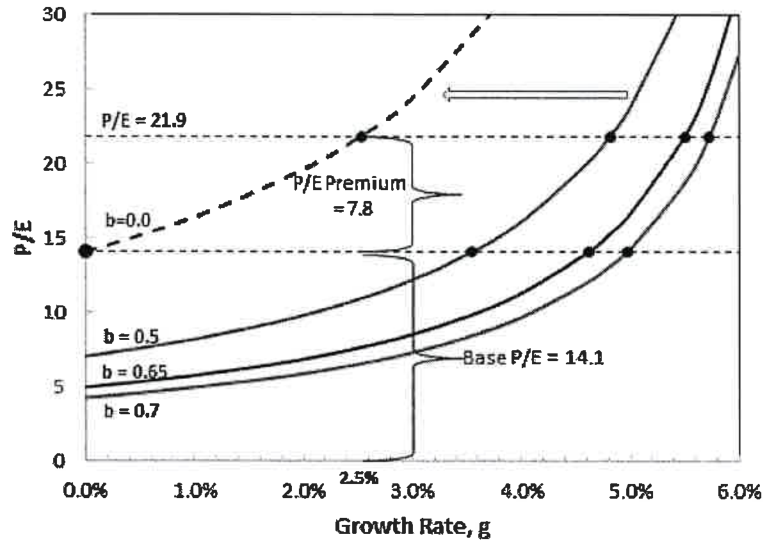
For example, a firm with g = 5.5%, will have a P/E of 21.88 and its P/E premium is 7.79 (21.88 – 14.08). For such a firm, EY is only 4.57% (= 1/21.88) and EY understates the 7.1% market rate k by 2.53%. For higher P/E premiums, the extent of the EY underestimation increases because the k – EY gap increases.

Exhibit 4 shows P/E vs g curves corresponding to retention rates of 0.70 and 0.50 in addition to the 0.65 retention curve of Exhibit 3. As we move from high to low retentions, the curves appear to shift to the left, implying lower growth is needed to achieve the same P/E premium. This effect of higher P/E's with lower retentions follow from the g = br relationship, implying that for a given growth g, a lower retention b implies a higher return r and hence more value adding reinvestment. For example, a firm with 50% retention needs a g of only 4.8% (and, an implicitly higher r) to be valued at a P/E premium of 21.9 (vs 5.5% growth for a firm with b = 0.65).

More generally, Exhibit 4 shows that, as b decreases toward a hypothetical 0%, the growth required to achieve a P/E of 21.9 steadily declines toward 2.5%.

In the next section, we show that this "limiting" g value represents the "growth" associated with a firm that pays out all earnings yet still has growth opportunities. For example, if additional demand may be satisfied with minimal cost, the resulting earnings growth would not require any retained earnings for funding. Such growth may be viewed as intrinsic or "organic." Other possibilities for growth without retention might involve situations where financing is obtained externally so all net returns can be paid out.

Exhibit 4: P/E vs Growth with Different Retentions



Source: Morgan Stanley Research

Spread-Driven Earnings Growth and g*

In this section, we go "back to basics," revisit the DDM and present a simple formula for g*. The first step is to represent r in terms of a spread s over k, so r = k + s and

g = br = b(k +s).

Replacing g in the DDM formula by this spread-based expression leads to a simplified P/E formula (see Appendix for details).

$$P/E = \frac{(1-b)E}{k-g}$$

$$P/E = \frac{1}{k-bs/(1-b)}.$$

The above P/E formula can be converted to a representation of EY by inverting both sides of the equation.

EY=k-bs/(1-b).

In the original g* calculation associated with Exhibit 1,

EY=k-g*.

A comparison of the two equations implies that

$$g^* = \frac{bs}{1-b}.$$

So, g* may be calculated based solely on the return spread and retention, without direct reference to either EY or k.

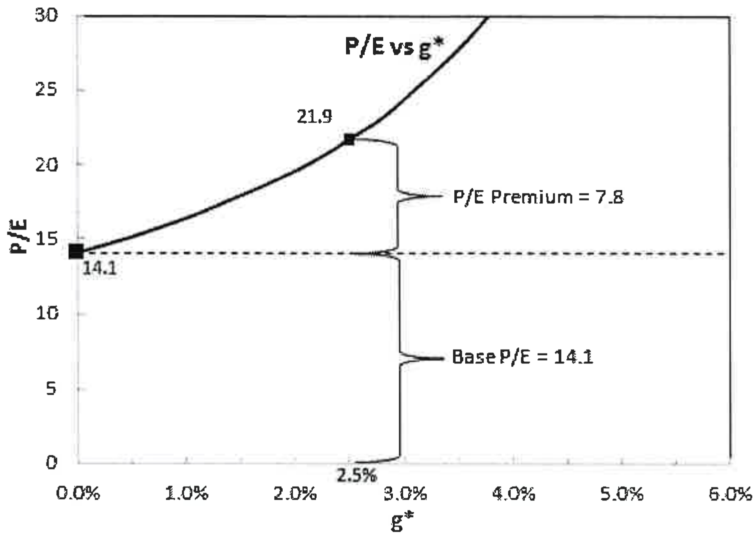
Substituting g* in the P/E formula above, leads to formulas that depend only on g* and k.

$$P/E = \frac{1}{k-g^*}, \text{ or}$$

$$P = \frac{E}{k-g^*}$$

The formulation P =E/(k-g*) of the DDM suggests that, for any given price (based on a specific b and g), there is a price-equivalent firm for which earnings grow retention-free rate g*. The growing stream of earnings is fully available for distribution. To emphasize this point, Exhibit 5 plots P/E vs. g*.

Exhibit 5: P/E vs g*



Source: Morgan Stanley Research

Another interpretation of g* results from writing,

k = DY + g = EY + g*:

g*=g-(EY-DY).

The difference between EY and DY (that is, bEY) represents the return investors forgo in favor of the growth gained through retention and investment. Thus, this difference may be viewed as a growth cost to investors. In the context of the DDM, as b decreases, so does this difference. At zero retention, DY = EY and g* = g.

Thus, the intrinsic growth g* may be interpreted as a"net growth."

Several additional insights flow from the g* formula and Exhibits 4 – 5:

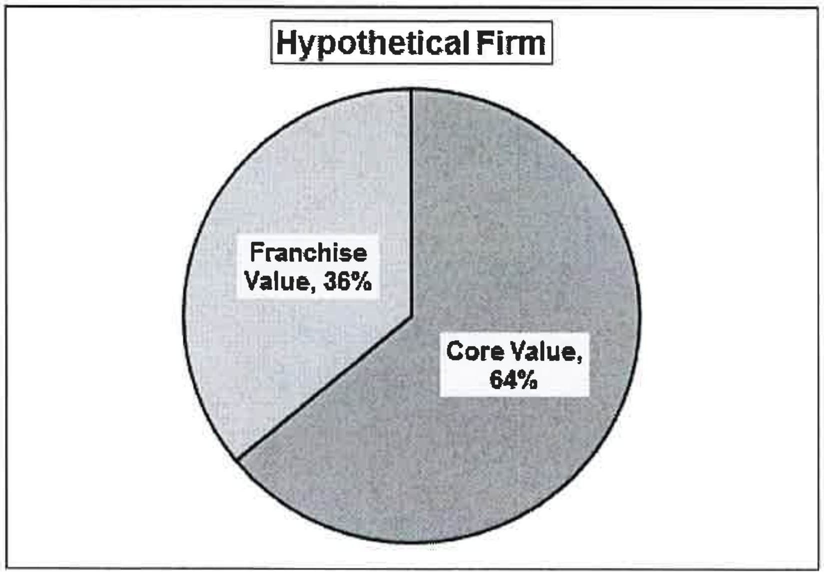
- For any given P/E, Exhibit 4 shows that g* incorporates (and is P/E equivalent to) all combinations of growth and retention associated with that P/E. For example, a firm with 5.5% growth and b = 0.65 is P/E-equivalent to a full-payout firm with g*=2.5%.
- If a firm's return on equity is equal to the market return, its return-spread s = 0, g*=0, and the P/E equals the base P/E.
- Any P/E may be expressed as the sum of the base P/E and P/E Premium and the premium increases as g* increases.

The underlying relationship between g* and the P/E premium implied in the last bullet will be explored in more detail in the next section.

P/E Premiums, Franchise Value and g*

In this section, the starting point is a separation of firm value into two components: Core Value and Franchise Value. Exhibit 6 illustrates the 64%/36% distribution of these two components for the firm with a P/E of 21.9 and a P/E Premium of 7.8.

Exhibit 6: Two Components of Firm Value: P = Core Value + Franchise Value



Source: Morgan Stanley Research

The Core Value is related to earnings generated by a firm's current businesses and is calculated by computing the present value of a constant earnings stream E.

Core Value = E/k

More generally, when predicted earnings vary from year-to-year, E would be "perpetual-equivalent" earnings.

The Franchise Value relates to future business opportunities whose size and value derives from the firm's patents, licenses, branding, market penetration, etc. These firm-specific characteristics enable a company to make new investments that earn a positive return relative to the cost of capital.

The total firm value P and P/E are as follows:

P= E/k + Franchise Value

P/E = 1/k + (Franchise Value)/E

The above equation is similar to the P/E Premium equation

P/E = 1/k + P/E Premium.

Thus, the P/E Premium is just the Franchise Value divided by E

P/E Premium = Franchise Value/E.

The Premium Fraction or f-Ratio

By utilizing the price equation in the last section, we obtain a simple general relationship between k, EY and P/E by multiplying both left and right sides by k and then dividing by P.

kP = E + k×{Franchise Value}

k = E/P + k×{Franchise Value}/P.

The percentage of total value accounted for by the Franchise Value is represented by a ratio f

f={Franchise Value}/P, and

k=EY+kf.

This formula for k can be compared to the earlier representation of k as:

k = EY + g*.

This comparison leads to another g* formula:

g*=kf, or

f=g*/k.

The above formula implies that the growth g* may be viewed as the proportion of the market return accounted for by the Franchise Value.

The f-ratio may also be viewed as the percentage of total P/E accounted for by the P/E Premium:

$$f = \frac{[(Franchise\ Value)/E]}{P/E} = \frac{P/E\ Premium}{P/E}.$$

This formulation of f enables g* to be computed without reference to the DDM. Referring back to the example given in Exhibit 6,

$$f = \frac{P/E\ Premium}{P/E} = 7.8/21.9 = 36\%$$

and again, we get

g* = kf

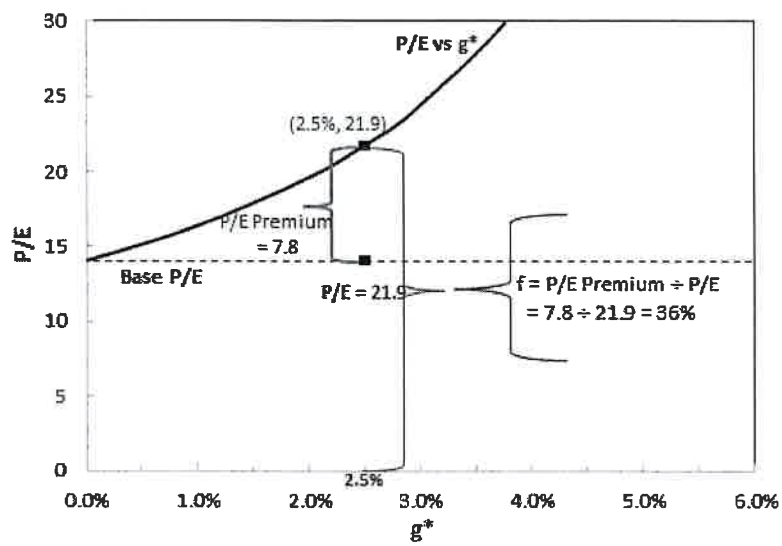
= 7.1 x .36

= 2.5%.

Thus, 36% of firm value is accounted for by the Franchise Value, and the remaining 64% is accounted for by Core Value or, equivalently, by the base P/E.

In Exhibit 7, the P/E vs g* curve of Exhibit 5 is reproduced and the f-ratio at a P/E of 21.9 is highlighted.

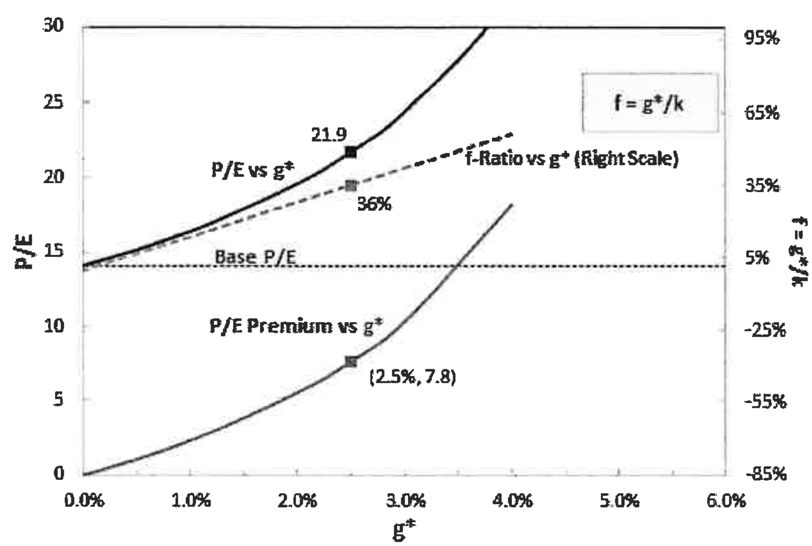
Exhibit 7: Illustration of the f-ratio



Source: Morgan Stanley Research

In Exhibit 8, the top curve plots total P/E vs. g* while the bottom curve focuses only on the P/E premium. As g* increases, both the total P/E and the P/E Premium follow increasingly curved paths, but the corresponding f-value (the straight dashed line) simply increases linearly.

Exhibit 8: Premium Fraction f vs g*



Source: Morgan Stanley Research

Generalized Franchise Value and g*

In the last section, it was shown that, in general, g* = kf, with no reference to the DDM.

This generality is important because, while the DDM offers a straightforward way of calculating both price and P/E, its simplifying assumptions may be viewed as restrictive. For example, future investment opportunities may be funded by borrowing and/or stock issuance in addition to (or instead of) retained earnings. And, investment opportunities themselves will vary in terms of size, timing and return.

To obtain a more general representation of the Franchise Value, suppose there are a range of potential investments having various levels of return. Let A (r) be the magnitude of the investment that provides a specific return r.

The corresponding annual net return is A(r) multiplied by the spread (r – k), and the increment of present value associated with this specific return r is:

Franchise Value (r) = (r-k)A(r)/k

The generalized Franchise Value formula accumulates these value increments across all r values greater than k,

$$\text{Franchise Value} = \int_{r>k} \left\{\frac{r-k}{k}\right\} \times A(r) \times dr.$$

The corresponding generalized g* is:

$$g^* = kf = k\frac{\int_{r>k}\left\{\frac{r-k}{k}\right\} \times A(r) \times dr}{P}.$$

The DDM-g* is based on the special case in which all future investments are financed through retention and have the same return r. Then, it can be shown that (see Appendix)

$$\text{P/E Premium} = \frac{1-b}{k-g} - \frac{1}{k} = \frac{sb}{k(k-g)}.$$

Since,

$$\text{P/E} = \frac{1-b}{k-g} \text{ and } f = \frac{P/E\ Premium}{P/E}$$

$$f = \frac{sb}{k(k-g)} \div \frac{1-b}{k-g}$$

$$g^* = kf = \frac{bs}{1-b}.$$

This is precisely the formula for g* that was derived earlier based solely on the DDM-P/E.

The Risk Premium Adjustment

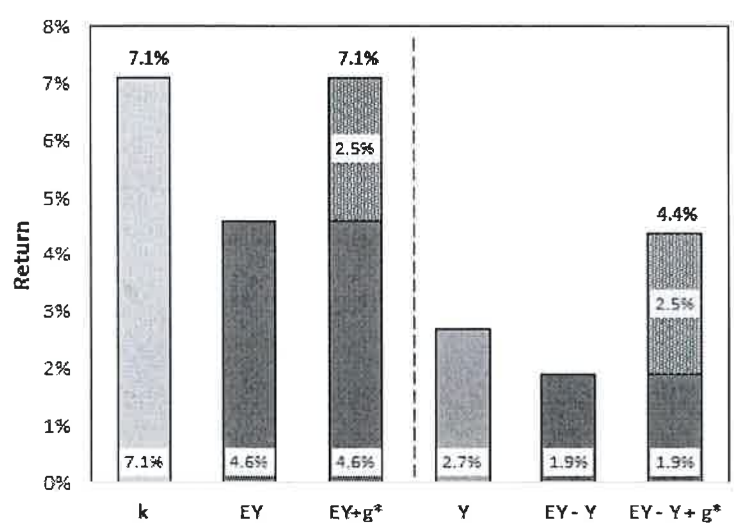
In the first section of this paper, Exhibit 1 showed there was a 2.5% gap between EY (= 4.6%) and the market return for a firm with a P/E of 21.9, 1.6% DY and 5.5% growth. We later showed that g* = 2.5% was precisely the adjusted growth term to true-up EY to obtain the market return (see the left panel of Exhibit 9).

The right panel in Exhibit 9 shows that the same g* value is needed when EY is the starting point for estimating the equity risk premium. If the interest rate Y is 2.7%, the baseline for calculating the risk premium relative to Y is EY – Y = 1.9% (4.6% - 2.7%).

But EY – Y alone cannot be the risk premium because (EY-Y) + Y falls 2.5% short of the assumed 7.1% equity return. If g* = 2.5% is added to 1.9%, the risk premium rises to 4.4%. Then, risk premium + Y = 4.4% + 2.7% results in the correct 7.1% return.

While 2.5% may appear to be a relatively modest correction in an absolute sense, that same 2.5% represents a very significant relative enhancement of the equity risk premium. And, in situations when EY is particularly low or the interest rate is relatively high, the g* addition may significantly impact the risk-premium estimate.

Exhibit 9: Earnings Yield and Risk Premium are "Trued-Up" by Adding g*



Source: Morgan Stanley Research

Conclusions

As noted at the outset, this theoretical analysis is critically based on the assumption of a stable P/E ratio over time. In practice, this assumption is certainly questionable, especially when developing short or long term return projections for a given point in time. However, the stable PE assumption allows this theoretical analysis to focus narrowly on several important structural issues involved in the estimation of equity risk premiums.

The main result of this paper is that using the earnings yield alone as a return estimate can fail to fully account for higher levels of earnings growth. High-growth firms typically have the ability to make new investments at above-market returns. However, the resulting higher P/Es can lead to lower EY's that tend to understate the expected total return. To provide theoretically consistent long-term return projections, an **adjustment term** must be added to the EY. We refer to this adjustment term as g*. This g* term is subject to a number of interpretations, some of which provide helpful insights into the nature of the earnings growth process.

Within the context of the Dividend Discount Model, g* may be viewed as a **"net yield,"** the difference between earnings growth and the retention-based cost of growth.

The DDM's fixed retention rate can be viewed as generating a growing pool of investment opportunities over time. The g* term can then be interpreted as an equivalent return derived from applying a **net spread** to this investable pool.

The g* also acts as a **"sufficient parameter"** in consolidating the growth impact from different combinations of retentions, reinvestment returns, and earnings growth. Although different combinations of these variables can lead to the same P/E ratio, there is only one growth rate g* associated with a given P/E. Because of its unique relation to the firm's value, g* may be viewed as representing its **fundamental growth** capability.

The g* term can also be used to obtain a **simplification** of the standard DDM formula,

$P=(1-b)E/(k-g) = E/(k-g^*)$.

This formulation suggests that the price is equivalent to that of a firm that has no retention but still manages to grow its earnings at a rate g*, and with all the earnings being fully available for distribution. In this sense, g* corresponds to a kind of **organic** growth — without retention or reinvestment— such as might be derived from a relatively costless expansion in sales.

At a more general level beyond the DDM context, g* is related to a firm's Franchise Value — the present value of all future opportunities to invest at returns exceeding the cost of capital (COC). These opportunity sets could be quite complex and could depend on variety of returns, time periods, funding limits, etc. In theory, these multiple opportunity sets can be accumulated by integration into a generalized Franchise Value.

Apart from this complexity, at a basic conceptual level, the firm's total value could then be decomposed into two components: 1) the Core Value based just on a continuation of the current level of earnings, and 2) the Franchise Value derived from earnings generated by new investments. When divided by the current earnings, the Core would simply have (1/COC) as its "P/E". The remainder of the total P/E in excess of (1/COC) could then be defined as the P/E premium associated with the Franchise Value.

This P/E decomposition allows for g* to be expressed as the **product of** the COC and the ratio of the firm's P/E premium to its total P/E. This general relationship provides a simple approach to finding g* values from just the market P/E and the COC.

Finally, and perhaps most importantly, the EY is commonly used in the estimation of the equity risk premium. However, the EY has been seen to understate the total return in certain situations, and this lower return estimate naturally maps onto the risk premium estimate. Moreover, any such underestimation at the total return level becomes more significant in percentage terms at the lower level of the risk premium. Thus, g* can serve as a particularly helpful **premium adjustment** to obtain more theoretically consistent estimates of the offered equity risk premium.

Appendix

In the body of this paper, there were many different (but equivalent) representations of the net growth, g^*. This Appendix provides the mathematical details underlying the various g^* formulas.

The main variables used in the Appendix are summarized below:

P	=	Current stock price
b	=	Earnings retention rate
$1-b$	=	Dividend payout ratio
r	=	Return on Equity (ROE)
g	=	Earnings growth
	=	Price growth if the P/E is stable
k	=	Market capitalization rate (= stock return)
g^*	=	Net growth
E	=	Annual earnings
DY	=	Dividend yield
	=	$(1-b)E/P$
EY	=	E/P

The Net Growth g^*

In this paper, the P/E is assumed stable so that price growth equal earnings growth g. The return of any stock is therefore just its Dividend Yield plus earnings growth.

$$DY + g = k \qquad (1)$$

Since EY generally is not equal to the return, an additional growth term g^* must be added to "true-up" the EY estimate by filling in the gap between the market return and earnings yield.

$$EY + g^* = k \qquad (2)$$

$$g^* = k - EY \qquad (3)$$

Another representation of g^* can be derived by equating the left sides of Equations (1) and (2).

$$EY + g^* = DY + g$$

$$g^* = DY + g - EY$$

$$= (1-b)EY + g - EY$$

$$g^* = g - bEY$$

The right side of the above equation may be interpreted as "net growth" after the cost of retention is taken into account.

A Spread-Based g^* Formula

In this section, a computational formula for g^* is derived from the Dividend Discount Model (DDM). This formula is dependent only on the retention b and the return spread s relative to k.

$$r = k+s$$

According to the DDM,

$$P/E = \frac{1-b}{k-g}$$

$$g = br$$

Thus,

$$g = b(k+s)$$

$$P/E = \frac{1-b}{k-b(k+s)}$$

$$= \frac{1-b}{(1-b)k-bs}$$

$$= \frac{1}{k-bs/(1-b)}$$

$$g^* = bs/(1-b) \qquad (4)$$

g^* **and the Premium P/E Ratio**

In the body of this paper, g^* was shown to be the product of the market rate k and the P/E Premium ratio (f) for all firms, independent of the DDM.

$$P/E\ Premium = P/E - 1/k$$

$$f = \frac{P/E\ Premium}{P/E}$$

$$g^* = kf$$

In the special case of the DDM, as shown below, this general expression is equivalent to Equation (4).

$$P/E\ Premium = \frac{1-b}{k-g} - 1/k$$

$$= \frac{k(1-b)-(k-g)}{k(k-g)}$$

$$= \frac{g-bk}{k(k-g)}$$

$$P/E\ Premium = \frac{b(r-k)}{k(k-g)}$$

$$f = \frac{b(r-k)}{k(k-g)} \div \frac{(1-b)}{(k-g)}$$

$$g^* = kf = \frac{bs}{(1-b)}$$

References

1) Leibowitz, Martin L. "Franchise Value," John Wiley & Sons, 2004

2) Leibowitz, Martin L. and Anthony Bova. "Franchise Volatility and the Cost of Capital ." Morgan Stanley Research, February 4, 2016

3) Leibowitz, Martin L. and Anthony Bova. "Net Growth and the Price/Earnings Ratio ." Morgan Stanley Research, November 27, 2017

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(as of March 31, 2018)

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	COVERAGE UNIVERSE		INVESTMENT BANKING CLIENTS (IBC)			OTHER MATERIAL INVESTMENT SERVICES CLIENTS (MISC)	
STOCK RATING CATEGORY	COUNT	% OF TOTAL	COUNT	% OF TOTAL IBC	% OF RATING CATEGORY	COUNT	% OF TOTAL OTHER MISC
Overweight/Buy	**1189**	**38%**	**315**	**41%**	**26%**	**555**	**39%**
Equal-weight/Hold	**1355**	**43%**	**364**	**47%**	**27%**	**644**	**45%**
Not-Rated/Hold	**53**	**2%**	**4**	**1%**	**8%**	**7**	**0%**
Underweight/Sell	**545**	**17%**	**84**	**11%**	**15%**	**214**	**15%**
TOTAL	**3,142**		**767**			**1420**	

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