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Estimating the Cost of Equity Capital Using Tobin's q

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ABSTRACT

This paper presents a new technique for estimating a firm's cost of equity capital using Tobin's *q* ratio. Although based on the constant growth rate valuation model, the Tobin's *q* approach obviates the need for estimating the growth rate *g*. Moreover, the data required for implementing this new approach are readily available for large firms.

The finance literature provides two reasonably practical methods for estimating a firm's cost of equity capital. One method requires estimating the beta of the firm's stock.[1] The other method involves estimating the dividend (or earnings) growth rate or, alternatively, investors' expected return on investment.[2] This paper suggests a third approach to estimating the firm's cost of equity capital based on Tobin's *q* ratio. Given the inherent uncertainties of any cost of capital estimate, another estimation procedure is always desirable. Moreover, this particular method is relatively easy to apply for large firms. Since 1976, replacement or current cost data are routinely provided by large firms in their 10 K reports or, as has become more common recently, in their annual statements.[3] More specifically, Statement of Financial Accounting Standards (*SFAS*) No. 33 mandates current cost information for those firms with at least $125 million of inventory, property plant, and equipment and for firms with total assets of at least one billion dollars. Thus, for such firms, it is a relatively simple matter to calculate Tobin's *q* ratio. For the smaller firm, application of this alternative cost of capital estimation procedure would require estimating the replacement cost of its assets a la Fallkenstein and Weil [1977] or Lindenberg and Ross [1981].

The Tobin's q approach to measuring the firm's cost of equity capital is based on the observation that, at least for some valuation models, there is a direct relationship between the firm's cost of equity capital and Tobin's q. In particular, a simple transformation of Tobin's q yields the firm's cost of equity capital in the context of the constant growth rate valuation model. In what follows, Section I derives the relationship between Tobin's q and the firm's cost of equity capital for the constant growth rate valuation model. Seciton II applies Tobin's q approach for measuring the cost of equity capital to a large firm which publishes current cost data in its annual statements. Section III briefly concludes the paper.

I. TOBIN'S q AND THE COST OF EQUITY CAPITAL

According to the constant growth rate valuation model, the value of the firm's stock V can be expressed as:[4]

$$V = (1-b)E/(k-br) \tag{1}$$

where

E = expected value of the firms's accounting earnings in the coming year[5]

b = expected value of the firm's retention rate

r = expected return on investment

k = the firm's cost of equity capital.

This model can be generalized to incorporate stock as well as retention financing. With stock financing, Equation (1) becomes

$$V = (1-c)E/(k-cr) \tag{2}$$

Here, c is the firm's investment rate which is equal to b+s where s is the expected stock financing rate (expressed as a proportion of earnings). Assuming for now that the firm is solely equity financed, V is also the market value of the firm.

Tobin's q is defined to be the market value of the firm dividend by the replacement cost of the firm's assets. As argued by Lindenberg and Ross, the market value of the firm differs from the replacement cost of its assets by the present value of monopoly and firm-specific factor rents. Specifically, the market value of the firm (MV) can be represented as

$$MV = RC + F + M \tag{3}$$

where

RC = the replacement cost of the firm's assets

F = capitalized value of the rents attributable to firm-specific factors

M = capitalized value of the rents attributable to monopoly profits.

Thus, a firm which earns no such rents will be valued at the replacement cost of its assets so that its Tobin's q is one. A firm which earns monopoly or firm-specific factor rents will have a Tobin's q greater than one.

The constant growth rate valuation model incorporates monopoly and firm specific factor rents through the expected rate of return r. Indeed, the relationship $r > k$ means that the firm is able to capture rents from its investments thereby yielding a return on investment greater than the market required return k. The relationship $r = k$ means that the firm is unable to earn monopoly or firm-specific factor rents.

The constant growth rate valuation model can be reformulated to correspond to Equation (3). Specifically, when the firm has no monopoly or firm-specific factor rents ($F+M=0$), its expected rate of return on investment r is equal to its cost of capital k. The firm's market value can then be obtained by substituting k for r in Equation (2) yielding

$$V = RC = (1-c)E/(k-ck) = E/k \tag{4}$$

On the other hand, if the firm enjoys monopoly profits or firm-specific factor rents, the market value of the firm (Equation (2)) can be decomposed into two components

$$V = E/r + (r-k)E/r(k-rc) \tag{5}$$

where the first component is the economic replacement cost value of the firm's assets

$$RC = E/r \tag{6}$$

and the second component is the capitalized value of the firm's monopoly and firm-specific factor rents

$$F + M = (r-k)E/r(k-cr) \tag{7}$$

Equations (2) and (6) can be used to determine Tobin's q which takes on the simple form

$$q = V/RC = (r-cr)/(k-cr) \tag{8}$$

Three aspects of Equation (8) are worth noting. First, as argued by Lindenberg and Ross, $q > 1$ when the firm earns monopoly or firm-specific factor rents, that is, whenever $r > k$.[6] Second, Tobin's q is an increasing function of r. This accords with one's intuition since the greater is r (all other things equal) the greater are the monopoly and firm-specific factor rents to be captured. Third, Tobin's q is, not surprisingly, a decreasing function of k, the yield required by the firm's shareholders.

Rather than employing Equation (8) which is a function of the growth rate (cr), k is best represented for our purposes by the equation:

$$k = [1-c + cq]E/v. \tag{9}$$

Equation (9) is obtained by substituting Equation (6) into Equation (2) and eliminating r. The importance of Equation (9) is that it relates the firm's cost of capital to Tobin's q rather than the usual growth rate.[7] Since all the variables on the right-hand side of Equation (9) are available from annual statements and market data sources, the cost of equity capital can be readily estimated from Equation (9).[8]

If the firm has debt (and/or preferred shares) in its capital structure, the calculation of k is only slightly more complicated. Assuming that monopoly and factor rents accrue only to the firm's common shareholders, Tobin's q becomes

$$q = (V+D)/(E/r+D) \tag{10}$$

where D is the market value of the firm's debt (and/or preferred shares).[9] Substituting Equation (10) into Equation (2) to eliminate r yields

$$k = [1-c + cqV/(V + (1-q)D)]E/V \tag{11}$$

Again, the variables on the right hand side of Equation (11) are readily determinable so that Equation (11) can be used to estimate the firm's cost of equity capital if there is debt and/or preferred shares in the firm's capital structure. Note that if there is no debt (preferred shares) in the firm's capital structure then Equation (11) is identical to Equation (9).

II. AN EXAMPLE

We estimate the 1983 year-end cost of equity capital for Abbott Laboratories, a large supplier of health care products and services, using Tobin's q ratio.[10] With one minor exception, all of the data are obtainable from Abbott Laboratories' annual reports.

(i) Replacement Cost of the Assets

Current assets excepting inventory are valued at book value. Investments are valued at market value. Inventory and property, plant, and equipment are valued at current cost. Deferred Charges and Other Assets are valued at book value.

Balance Sheet Items (12/31/1983)	Annual (000)
Current Assets (excluding Inventory)	$ 863,002
Inventory	426,000
Investment Securities	380,902
Net Property, Plant & Equipment	1,457,000
Deferred Charges & Other Assets	59,717
Replacement Cost of Assets	$3,186,621

(ii) Market Value of the Firm

Shareholders' Equity is valued at the year-end market price of the stock. Short-term Liabilities are valued at book value. Other liabilities excluding deferred taxes are valued at book value.

Long-term debt is broken down into listed securities, industrial development revenue bonds, and other debt, principally term borrowings by foreign subsidiaries guaranteed by the parent. Each listed bond is valued at its market price as of the last trade during 1983. Industrial development revenue bonds are

broken down into three catagories: $42 million 1983 flotation with a 6 1/2% coupon and maturity of 40 years; $20 million flotation with a 6 1/2% coupon and maturity of 25 years; $25.8 million flotations with an average coupon of 8.2% and an average maturity of 30 years. All industrial development revenue bonds are valued at the approximate average year-end interest rate for industrial Aa bonds as computed by Moody's of 12%. Other debt is valued at par. The following is the calculation of the market value of the firm:

Balance Sheet Items (12/31/1983)		Amount (000)
Short-term Liabilities		$ 676,769
Other Liabilities		87,775
Long-term Debt:		
11.8%-13	$147,938	
11.0%-93	96,750	
9.2%-99	57,595	
7 5/8%-96	20,947	
6 1/4%-93	7,501	
Ind. Rev.	52,237	
Other	38,815	421,783
Stockholders' Equity		5,387,650
Market Value of the Firm		$6,573,977

(iii) Cost of Equity Capital

Given the previous calculations, Tobin's q is:

$$q = 6,573,977/3,186,621 = 2.06$$

This is reasonably close to the 2.35 value calculated by Lindenberg and Ross for Abbott Laboratories' average Tobin's q for the years 1960-1977. Except for 1976-77, Lindenberg and Ross' replacement cost calculations are based on their own estimation techniques rather than published accounting data which were unavailable prior to 1976. They also estimated bond values without recourse to market prices.

Abbott Laboratories' cost of equity capital for December 31, 1983 can now be estimated from Equation (11) where

$$q = 2.06$$
$$E = 347,617,000^{11}$$
$$V = 5,387,650,000$$
$$D = 1,186,327,000$$
$$c = b = 0.65^{12}$$

This yields an estimated cost of equity capital of 13.53%. Using Lindenberg and Ross' q value of 2.35 yields an estimate of 16.28%.

It is interesting to compare the previous calculation with the more standard $D_1/P + g$ approach where D_1 is next year's dividend per share, P the current price per share, and g the dividend (earnings) growth rate. Using the formula $g = br$ and the 1983 investors' book rate of return for r, yields an alternative estimate of Abbott's cost of equity capital of 19.20% where

$$r = .255$$
$$D_1 = \$1.16575$$
$$P = \$44.49$$

It is worth emphasizing that although both methods for estimating the firms cost of equity capital are based on the same underlying model, each method utilizes different parameters in the estimation process. Most importantly, the Tobin's q approach obviates the need to estimate the growth rate g which has always been the most contentious issue in using the constant growth rate valuation model.

II. CONCLUSION

This paper analysed the relationship between Tobin's q ratio and the firm's cost of equity capital in the context of the constant growth rate valuation model. This analysis yielded an alternative method for estimating a firm's cost of equity capital using Tobin's q ratio. This method is especially applicable for large firms which are required by SFAS No. 33 to publish current cost data in their annual (or 10 K) statements. The Tobin's q approach was then applied to just such a large firm, Abbott Laboratories, to show how this new technique is implemented.

Perhaps the most important aspect of Tobin's q approach to estimating the cost of equity capital is that it does not depend on estimating g, the growth

rate. Estimating g has always been a contentious issue when applying the constant growth rate valuation model. This is not surprising since estimates of q are based either on a time series of historical cost data (Gordon, 1974) or on subjective, if not arbitrary security analyst estimates (Brigham et al, 1985). On the other hand, except for having to estimate next period's earnings, a comparatively simple problem, the Tobin's q approach is a function of market value data and management's own recent estimate of the current cost of its assets. In addition to the likelihood that the latter exceptional data are likely to yield a more meaningful estimate of the cost of equity capital, they are also more readily available, at least for large firms.

FOOTNOTES

[1]See, for example, Weston [1973].

[2]See Gordon [1962].

[3]In the absence of technological change, current cost and replacement cost are identical. Otherwise, current cost is replacement cost adjusted for the value of any operating advantages or disadvantages of the assets owned. As a practical matter, the techniques for estimating replacement and current costs are virtually identical.

[4]See Gordon [1962,1974] and Gordon and Gould [1978].

[5]Although the literature does not specify whether earnings in this model are historical cost or economic earnings, all empirical studies to date have used historical cost earnings. More substantivally, work by Lintner [1956] and Fama and Babiak [1968] indicate that firms target historical cost earnings in determining their dividend payout ratio (or, equivalently, the retention rate).

[6]To see this, note that $k > cr$, otherwise the model will not converge.

[7]Equation (9) still has the usual interpretation, namely, $(1-c)E/V$ is the dividend yield and cqE/V is the growth rate where growth is now defined in terms of Tobin's q.

[8]There is a literature which argues that k is investors' required yield, not the cost of equity capital. See Elton and Gruber [1976], Gordon and Gould [1978] and Aivazian and Callen [1979]. However, even according to this literature, k has to be estimated in order to compute the firm's cost of equity capital and the approach given here does that.

[9]The assumption that firm-specific factor and monopoly rents accrue only to common shareholders is not completely innocuous. If the firm has risky non-callable debt in its capital structure before new investments are discovered, then bondholders also benefit from the firm's ability to capture rents from these investments since their bankruptcy region is thereby reduced. See Myers [1977] on this point.

[10]We provide relatively detailed calculations to allow the reader to make his own adjustments if so desired.

[11]E should be estimated 1984 earnings. In this example, we assume for simplicity that earnings follow a martingale so that the best estimate of E is current 1983 earnings.

[12]Abbott Laboratories did not use external equity financing for at least four years prior to 1983 so that we set $c=b$. b is the average retention rate over this five year period. In any case, the retention rate is fairly stable over this period.

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