APPENDIX E

THE WEIGHTED AVERAGE COST OF CAPITAL AND LEVERAGE ADJUSTMENTS

Motivation for this Appendix

The after tax weighted average cost of capital (AT*WACC*) and "leverage" adjustments are a cornerstone of modern finance and figures prominently in the testimony of Dr. Villadsen. However, Dr. Villadsen uses them in an inappropriate way to increase "reasonable" direct estimates of the fair rate of return, into recommendations that the Alberta Energy and Utilities Board in 1998 decided it would be ***derelict*** in exercising its statutory responsibilities to accept. In this appendix I will discuss why the application of ATWACC and associated "leverage" adjustments is unnecessary and how they produce such large adjustments as to violate the fair return standard. I note that much of this appendix is similar to one I filed in the 2009 GMI hearing, since although the testimony this time is from Dr. Villadsen of Brattle in substance it is very similar to the evidence filed at that time by Drs. Vilbert and Kolbe also of Brattle and with whom Dr. Villadsen has co-authored a monograph.

Of note is that the Regie at that time stated (D2009-156, page 57)

> D-2009-156, R-3690-2009, 2009 12 07 57
>
> [228] Given the numerous difficulties posed by applying the ATWACC based on market values, the Régie concludes that establishing capital structures based on book values and using the traditional approaches based on hearing expert witnesses as to the optimal debt/equity proportions to retain is a proven route that is compatible with the establishment of a reasonable return on the basis of the distributor's rate structure.
>
> [229] **Consequently, the Régie does not accept the After Tax Weighted Average Cost of Capital (ATWACC) approach based on market values as a reference approach for determining the reasonable return on Gaz Métro's rate base.**

In the subsequent GMI hearing in 2011 GMI used Dr. Morin as its witness who did not use the ATWACC aproach or make leverage adjustments. I was therefore somewhat surprised to see that Dr.

Villadsen continued to use an approach that the Regie explcitly rejected. Further I can see no attempt in Dr. Villadsen's evidence to deal with the Regie's critique and Decision. Consequentrly, I can see no reason to cause the Regie to reconsider its 2009 Decision. Note, although Dr. Villadsen does not call her evidence ATWACC, I will demonstrate that mathematically it folows the same methodology as presented to the Regie in 2009.

The Weighted Average Cost of Capital and ATWACC

To illustrate why the ATWACC and associated leverage adjustments are not acceptable to apply to a regulated firm I will develop a simple model of a firm and use a limited amount of algebra. Note the numbers are designed for simplicity and are not reflective of actual values as I will deal with them at the end of the appendix.

Suppose a regulated firm has \$10mm in assets and is judged to warrant a 15% fair ROE[1] and 50% debt with a cost of 5%. Assuming the book values are equal to market values the weighted average cost of capital or *WACC* is 10%.[2] In this example the firm's required level of capital income, or earnings before interest and taxes (*EBIT*), is 10% or \$1 mm, allocated \$250,000 as interest and \$750,000 (\$1million minus \$250,000) as forecast earnings to the to the shareholders. If we assume a perpetuity model, so the cash flows go on forever, the firm's equity market value is determined as the forecast net income divided by the shareholders equity cost or

$$\$5mm = \frac{\$1mm - \$0.25mm}{0.15} \tag{1}$$

This is because the allowed ROE was assumed to be an accurate estimate of the equity cost of 15%. As a result, the book and market value of the equity are the same and the price to book ratio is equal to 1.0.

It is a very general proposition in finance that if the investor expects to get what they require the market value is equal to the cost or in this case the book value. We see this every single day in the

[1] For simplicity this is the investor's cost of equity capital, so I ignore issue costs.

[2] This is 50% of the ROE of 15% and 50% of the debt 5% since there are no taxes. The value of the debt is \$5 mm.

bond market where if a bond offers an interest rate more than the market required return it will sell at a premium or price to book above 1.0 and the opposite if the required rate of return exceeds the interest on the bond.[3]

If we use some notation rather than numbers, we can define the expected return on investment (*ROI)* as the capital income or *EBIT* divided by the total book value of both equity and debt. The equity market value is then

$$\$5mm = \frac{ROI * A - K_b * B}{K_e} \tag{2}$$

where A is the total book value of assets, B is the amount of debt financing ($5mm) and I have subscripted the two required investor returns as b for debt (bonds) and e for equity.

The total enterprise value (V), or the overall market value of the firm (debt plus equity), is the $5mm equity value plus the $5mm of debt or $10mm. We can value the firm's equity by the above equation which is generally referred to as the flows to equity *(FTE*) method of valuation, where the flows to the equity holder are discounted at the cost of equity capital. However, to do this calculation we need the value of the debt financing and most corporate investment decisions separate the investment decision from the financing decisions. Consequently, it is conventional to rearrange this equation to get the *WACC*. First multiply through by the cost of equity,

$$E * K_e = ROI * A - K_b * B \tag{3}$$

where I have substituted E for the equity market value (previously determined to be $5mm). Second, group the equity and debt values to get the total enterprise value and factor for the overall market value to get,

$$V(K_e \frac{E}{V} + K_b \frac{B}{V}) = ROI * A \tag{4}$$

[3] See Laurence Booth, 1997, The importance of market to book ratios in regulation", *Quarterly Bulletin*, National Regulatory Research Institute, Winter.

dividing through we get

$$V = \frac{ROI * A}{K_e \frac{E}{V} + K_b \frac{B}{V}} \tag{5}$$

where the total enterprise or market value is equal to the forecast *EBIT* (capital income) discounted at the weighted average cost of capital (*WACC*). In our example the $1mm in *EBIT* discounted at the *WACC* of 10% gives the total market value of $10mm. The equity value is then this $10mm value minus the $5mm in debt or the same $5mm calculated directly using the flows to equity approach.

Note in (5) the WACC and *ROI* are the same at 10% so the market value of the firm equals its book value, int eh same way the price (market) to book ratio for equity is 1.0. Now suppose for whatever reason the *ROI* increases to 11% since the *WACC* stays at 10%, since it is determined in the capital market, the total enterprise value increases to $11mmm. The equity value is then $11mm minus the $5mm in debt, so the equity value increases to $6mm and the price (market) to book ratio increases to 1.2X.

Adding corporate income taxes does not materially change any of the basic results. All that happens is that the *EBIT* becomes taxable, while the interest expense is tax deductible. In this case it is this after- tax net income that is discounted by the equity cost, that is,

$$Equity = \frac{(ROI * A - K_b * B)(1 - T)}{K_e} \tag{6}$$

where *T* is the corporate tax rate. Rearranging, as before, means that the *after- tax ROI* must exceed the *after tax WACC* or

$$V = \frac{ROI(1 - T) * A}{K_e \frac{E}{V} + K_b (1 - T) \frac{B}{V}} \tag{7}$$

The only difference is that since interest is tax deductible, whereas equity costs are not, the after-tax *ROI* must exceed an after tax *WACC or ATWACC*.

It is fundamental to corporate finance that the *ATWACC* uses market values. This means for example, that the debt and equity ratios use market for debt and equity divided by the total enterprise value and *not* book values. The *ATWACC* then gives the current yardstick that the firm must beat to create shareholder value, that is, to increase the firm's market value. Only by calculating the *ATWACC* in this way can the firm be sure that it is accepting projects that *enhance* shareholder value, rather than destroying it.

ATWACC, WACC and the Regulation of Utilities

It is important to recognize that the *ATWACC* is critical for the concept of *shareholder value maximization:* if the firm is not expected to earn its *ATWACC* then its market value will fall. The *ATWACC* is thus a critical concept to understand how a firm can make decisions that enhance shareholder value. In contrast, regulators are not concerned with maximising or enhancing shareholder value; their mandate is to set "fair and reasonable" rates. This frequently puts them at odds with maximising shareholder value since regulation should *never* be designed to enhance or even maintain market values. What this means is that the regulator sets rates and through them the firm's *EBIT* and *ROI*, whereas for non-regulated firms the *ROI* is determined in the marketplace.

To continue with the previous example (no tax purely for simplicity), where the *WACC* is 10% and the equity cost 15%, suppose the regulator institutes some risk reduction techniques such as the use of a forward, instead of an historic, test year,[4] or the use of deferral accounts. As a result, the equity cost drops to 11% due to the reduction in risk. Now, with everything else held constant, the debt is still valued at \$5mm and the rate base (total assets) at \$10mm; the only thing that has changed is the equity cost. In this case, the equity value can be determined from the flows to equity formula as

$$\$6.818mm = \frac{\$1mm - \$0.25mm}{0.11} \tag{8}$$

Note that the equity holders ***recognise*** the reduction in risk, so they bid up the stock market value from \$5mm to \$6.818mm due to the lower risk and equity cost. In this case, the existing

[4] Forward test years remove any inflationary bias involved in the use of an historic test year adjusted for specific identifiable changes. With the decline in inflation most of the need for forward test years is removed.

shareholders get an additional capital gain of 36.4% return over and above their fair return.[5] If the firm is now in a rate hearing to adjust its *ROE*, a tip off to the regulator is that the market to book ratio has gone from 1.0 to 1.364X (6.818/5), so intuitively by lowering the firm's risk and seeing the market value increase the regulator knows that the allowed *ROE* has to be cut. The obvious thing for the regulator to do is simply get expert opinion to estimate the equity cost, and if this is unbiased, notice and cut the allowed *ROE* to 11%. The equity value will then return to \$5mm and the shareholders will continue to earn a fair return on their \$5mm investment.

The question is what does estimating the *WACC* add to this process? Assuming there is no bias to estimating the equity cost at 11.0% the new *WACC* is

$$WACC = 0.11 * \frac{6.818}{11.818} + .05 * \frac{5}{11.818} \tag{9}$$

or 8.46%. The most important thing to note is that the *WACC* uses market value weights and since the equity market value has gone up to \$6.818mm, the *WACC* uses an equity ratio of 57.7% and a debt ratio of 42.3%, rather than the assumed regulated weights of 50% for both. ***These market value weights are the direct result of the decline in the equity cost and do not indicate any need for leverage adjustments as I will show later.***

The reason for the use of market value weights in the *WACC* is that it is the minimum rate of return the firm has to earn to *maintain* its market value, which has increased from \$10mm to \$11.818mm. Theoretically, it makes no difference whether this \$11.818mm market value is the result of actually raising \$11.818mm in new financing, or whether it is simply the current market value of the original \$10mm investment, as in this case. The point is simply that using *WACC* as a cut off rate reflects what the firm must earn to sustain this current market value, that is, "*keeping what it has got*." In particular, the new *WACC* of 8.46% is applied to the market value of \$11.818mm to get the required capital income of \$1mm.

In contrast, the regulator should not be interested in letting the investors "keep what they have got" instead, they must ensure that rates are fair and reasonable. In the example, the allowed ROE must

[5] They get their fair return as the earnings are paid out as a dividend.

be cut and implicitly that the equity market value must fall, and with it the market value weights, back to their 50% book value weights! Moreover, the regulator must determine a fair return on the book value of the investment, that is, the rate base, not the firm's market value. In this sense, there is a fundamental contradiction to applying the conventional *WACC* or *ATWACC* to rate of return regulated firms. This is because the underlying assumptions behind the *WACC* and rate of return regulation are different.

However, suppose a Board tries to apply a *WACC*. First, note that this exercise is much more prone to error, and as a result more subjective than just estimating the fair rate of return directly. This is because as well as estimating the equity cost, a board must estimate the market, not the embedded, cost of debt, the financing weights, and the appropriate tax rate. All these components are subject to error since many issues of debt are not traded and as a result it is difficult to estimate either their cost or their market value. However, assuming all these additional estimation problems away, suppose the correct 8.46% WACC is estimated and awarded to the regulated firm, what happens next?

If the regulator accepts this *WACC* and applies it to the book value rate base, the equity value drops to $5.42mm or

$$V = \frac{.0846 * \$10 - .25}{.11} \tag{10}$$

Although the *ROI* is reduced from 10% to 8.46%, it is not reduced to the correct *ROI* which I will show is 8.0%, so the equity market value is still $0.42mm *higher* than it should be. The reason for this is that by using market value weights the *WACC* puts greater emphasis on the higher equity cost than the debt cost. For non-regulated firms this is correct since the objective of calculating the *WACC* is to maintain these higher market values! However, it is totally incorrect for a regulator who is tasked with awarding a fair return regardless of what happens to the stock price. ***By estimating and applying a market based WACC to a book value rate base the effect of the higher allowed ROE is perpetuated through its impact on the higher equity market value.***

Over time, if nothing else changes, the excess value will gradually be removed. For example, as the equity market value falls to $5.42mm the new *WACC* becomes

$$WACC = 0.11 * \frac{5.42}{10.42} + .05 * \frac{5}{10.42} \quad (11)$$

or 8.12%. Again, if everything remains constant, in the next rate hearing the regulator would cut the allowed *WACC* to this new WACC of 8.12% and with it the shares would again fall in value, all else constant, to $5.1 mm causing a further decline in the WACC until eventually it equals 8% and the shares are back to book value.

Note that the regulated firm, as well as others with a vested interest in the firm as an investment, may complain about the regulator being "tough" by repeatedly cutting the allowed *ROE* through a lower *WACC*, but it is not being tough at all. The *ROE* is still above the fair *ROE* of 11% until the *WACC* drops to 8.0%. However, by using market value weights in the *WACC* and by shifting the focus from the *ROE* to the *WACC*, this adjustment process is drawn out to the stockholders' benefit. Further it gives the regulated firm an opportunity to bring up other arguments that may delay even this adjustment. Consequently, the adoption of *WACC* based regulation delays the adjustment process to the stockholder's benefit.

The basic insight from this discussion is that by using market values in *WACC*, the resulting cost of capital is higher than a fair return since the higher equity cost is given a greater weight. Further if the firm is a pure *ROE* regulated utility it tends to "support" the use of market values and is contrary to "fair and reasonable" regulation. This is because the market to book ratio is the basic signal as to whether equity investors are being treated fairly. When we add in flotation costs and a desire to allow the regulated firm to maintain market access at most times a market to book ratio marginally above 1.0, say 1.10 is appropriate.[6] However, apart from this minor deviation from book values, the essential point is that the correct financing weights for a regulated firm should be the regulated capital structure weights, not the market value weights. To incorporate into the regulatory process a regulated firm's market value is to support investor expectations, however unrealistic, and delay the adjustment to a fair and reasonable value for the allowed *ROE*.

The Alberta EUB correctly stated (Generic Cost of Capital Decision U-200452, page 24)

[6] The justification for this is that after the issue costs the new equity added to the rate base is the book value.

"The Board considers that the application of a market required return (i.e. required earnings on market value) to a book value rate base is appropriate in the context of regulated utilities."

In explicitly considering the usefulness of applying an *ATWACC* to the book value, the EUB stated (Decision U-99099, page 300)

"The Board observes that the intrinsic long-run value of a pure play regulated entity is best represented by book value. In other words, the present worth of future regulated earnings, discounted at the allowed return, is by definition equal to book value assuming achieved regulated earnings on average equal allowed regulated earnings. Accordingly, the Board considers that book capitalization represents the best indicator of the long-run market capitalization for a pure play regulated firm."

In this way the Board is correctly saying that if the allowed ROE drops from 15% to 11%, it should ignore the increased market value and instead focus on the fact that earning 11%, the new equity cost, and then discounting at 11% gives the book value. It is difficult to see how a regulator could say anything other than what the EUB stated above, since to accept a market to book ratio much above 1.0 is in effect to support unrealistic investor expectations. The EUB further recognised this when it went on to say (U99099, page 303)

"The Board would be derelict in its statutory responsibilities to recognize market capitalization ratios that are derived from a market value capitalization that deviates from the intrinsic long-run value of the regulated firm."

This is the clearest possible statement by a regulator of the fundamental grounds for rejecting *ATWACC* and its emphasis on market values. This applies to the use of the *ATWACC* as a base for fair ROE testimony.

Further the EUB went on to say

"In essence, a regulated company's earnings are driven by the portion of the original cost rate base deemed to be financed by common equity. This fact results in a fundamental disconnect to the theory that market capitalization ratios, which have deviated significantly from book capitalization ratios, reflect the appropriate financial risk necessary to determine a fair composite return to be applied to the original cost rate base of a pure play regulated utility. This is because the earnings of a pure play regulated utility are governed by and driven by the regulated return allowed on book equity. In other words, it is the book equity that reflects the appropriate financial risk necessary to determine a fair composite return for a pure play regulated utility."

This means that the correct financial risk measure for regulated utilities is the book debt equity ratio and *not* that determined using market values.

The EUB went on to calculate an *ATWACC* using regulated book value capital structure weights and the embedded debt costs. In this case (Decision U-99099, page 303)

> *An ATWACCBV would be suitable for a regulated utility whose profit, by legislation, is limited to a fair return on the book value (i.e. original cost) of its assets. The Board notes that an ATWACCBV is consistent with the logic of the traditional method of determining fair return***.**

In our example, the *ATWACCBV* is the 5% debt and 11% equity cost weighted with the 50% regulated capital structure weights. In this case the *ATWACCBV* is 8.0% and awarding this 8% cost of capital means that the value of the equity is

$$V = \frac{.08 * \$10 - .25}{.11} \tag{13}$$

or $5mm. This is the exact same result that would arise if the regulator simply awarded the 11% *ROE* directly and ignored the ATWACC completely.

The EUB *ATWACCBV* correctly recognises that apart from any estimation error attached to the equity cost, the *ATWACC* approach with market values is *inconsistent* with allowing a fair return to a regulated firm. The only approach consistent with allowing "fair and reasonable" rates is to estimate a sample of comparable firm's *ATWACC using book* value weights and embedded debt costs. In this case the exercise comes down to the normal problem of whether the estimated equity cost is accurate or not. However, this adds extra layers of estimation, and the easiest route is the traditional route of estimating the equity cost directly.

The Need for Leverage Adjustments

The above discussion is a critique of the use of the *ATWACC* for a regulated utility. However, the *ATWACC* has also been used in a more roundabout way to achieve the same result without applying the *ATWACC* directly to the book value rate base. This is by using it to generate a financial leverage risk premium that does not in reality exist.

Suppose we go back to our example where the fair rate of return has dropped from 15% to 11% and as a result the *WACC* (again ignore taxes for now) is not 8.46%. This is higher than the *ATWACCBV* since the 11% equity return is weighted at 57.7% due to the higher equity market value. Ingeniously Dr. Kolbe in 2009 and now Dr. Villadsen argue that the debt ratio using market values, that is, 42.3% in the example (100%-the 57.7% equity ratio) is lower than the 50% regulated weights. As a result, they argue that the "higher" leverage (financial) risk using book value weights requires a higher financial leverage risk premium and an increase in the equity cost from that directly estimated. This is even though in the example it is the lower equity cost that is driving the higher equity market values! For example, with our assumed correct 11% equity cost, the 50% equity and book weights, 5% debt cost and the 8.46% WACC, the fair ROE using their methodology is to solve the following equation.[7]

$$8.46=0.5*ROE+0.5*.05$$

This gives an ROE of 11.92% or almost 1% higher than what the investor's actual equity cost is, as well as an equity market value only slightly less than if the WACC were applied directly to the book value.

To emphasise the assumed correct equity cost is 11% and because this has dropped the equity value has gone up, but Dr. Villadsen argues that when applied to the book equity, as is normally done, this needs an added "leverage" adjustment. In this example the WACC with book value weights is set equal to the correct WACC with market weights. The result is that the stockholder gets an allowed ROE of 11.92% when they only required 11.0% in the first place by construction!

We can see this methodology in the testimony of Drs Vilbert and Kolbe in 2009 and Dr. Villadsen's current evidence. For example, in 2009 Dr. Vilbert estimated the *ATWACC* of the Canadian sample at 7.1% when he used a multi-stage DCF model and an estimated average equity cost of 9.6% (Dr. Vilbert testimony Schedule MJV-7). Dr. Kolbe then added in U.S. and other estimates and made some adjustments to use an *ATWACC* of 7.75%. Then on page 56 of his evidence Dr. Kolbe explicitly shows how with the same equation that I used above the implied ROE from a 7.75% ATWACC and book value weights means a 12.39% fair ROE. In other words, starting with a

[7] This is Dr. Kolbe's equation on page 56 of his evidence, whereas Dr. Villadsen uses three leverage equations.

directly estimated equity cost of 9.6%, he ends up with a 12.39% ROE using the *ATWACC* and differential leverage assumption. In the same vein, and for comparison purposes with Dr. Vilbert only, at a directly estimated equity cost of 8.7% for her multi-stage DCF Canadian sample Dr. Villadsen calculates an *ATWACC* of 5.6%. (BV 4-7) which with similar leverage adjustments to the regulated book weights becomes 10.5% (BV-4.8).[8]

In my constructed example this ATWACC/leverage methodology generates a fair ROE of 11.92% when the true answer by construction is 11.0%. In 2009 Dr. Vilbert's direct estimates from the multi-stage DCF of 9.6% ended up as an ROE after Dr. Kolbe's use of the ATWACC/leverage methodology at 12.39%. In the current situation Dr. Villadsen's multi-stage DCF estimate from the Canadian sample is 8.7% (BV 4.7) which ends up as an ROE of 10.5%. In all cases, the addition of this financial leverage premium of 0.92% in my example, up to 2.72% in Dr. Kolbe's case in 2009 and 1.8% in Dr. Villadsen's case is not only unnecessary, but incorrect.[9]

The leverage adjustments are not needed for several reasons.

First, the leverage adjustments came about in my example when the assumed correct number for the equity cost to start with was 11.0% but ended up almost 1% higher. This illustrates the fallacy of the underlying methodology.

Second, Dr. Villadsen, following Dr. Kolbe, argues that the shares are less risky when the equity value is higher and the financial leverage lower. However, regulated utility shares are less risky when they trade close to book value since there is less chance of the ROE being cut. In the example with a market to book of 1.36 and an increasing share price a diligent regulator is likely to cut the *ROE* making the shares more not less risky. If anything, the regulator should look at the equity cost of firms with high price (market) to book ratios as more risky than the regulated operations.

Third In this example the ***firm*** did not substitute equity for debt and reduce its financial risk so there was no basic change in its risk. Moreover, without any change in interest payments there is no change in financial risk. The fact is the leverage is at the firm not the individual level and there has been no change in financial leverage for the firm. As a reference point in Dr. Villadsen's leverage example that motivates these leverage premia

[8] Her CAPM estimated equity cost is 7.6% with a 4.8% ATWACC, which becomes a fair ROE of 8.5% (BV 4.12). Dr. Villadsen also uses other releveraging models.

[9] Note these are simply from one set of estimates. Both Dr. Vilbert and Dr. Villadsen produce many estimates which hides the fact they are all based on significant leverage adjustments and the same basic approach that was rejected by the Alberta EUB (1999) and the Regie (2009).

(pages 19-25) a change in the market value of the shares has absolutely no impact on the variability in the firm's earnings because the corporate use of debt has not changed

Fourth As the Alberta EUB pointed out, the correct approach for the regulator is to apply the book value weights as in the *ATWACCBV*. This ignores the market value weights which is what the regulator should do in estimating the fair ROE, particularly when the change in the market (price) to book ratio indicates the allowed ROE should be cut not increased.

To emphasize bond rating reports which measure the financial risk are based on corporate credit metrics and the firm's financial statements. They are not based on market value capital structures.

Following the AEUB's decision that to accept market value weights would be a "dereliction" of duty, the obvious implication is that the weights in the *sample WACC* estimated by Dr. Villadsen should also be book value weights. In my example this means that the regulated book value of 50%, rather than the market value debt ratio of 42.3% is what matters. Hence in comparing this 50% regulated debt ratio with the firm in hand that also has 50% debt ratio means that no adjustment is necessary. Making an adjustment based on market values is then inappropriate for a regulated firm. As the AEUB again noted (Decision U99099, page 301)

> *"the Board considers that beta and the cost of equity do not change to the extent necessary for an ATWACC, determined from market capitalization weights, to remain constant when applied to the book capitalization for a pure play regulated utility. The increase required to the cost of equity to achieve a constant ATWACC would be excessive and violate the fair return standard."*

It is my judgment that the only time a leverage adjustment is needed is when its business risk changes, and the Board wants to offset this change so it can continue to award a generic allowed *ROE*. In this case, the Board is advised to base its decision on business risk and financial market access as is normally done in Canada not through leverage adjustments to the ROE that have no theoretical basis and are not needed.

The Size of Leverage Adjustments

It is well accepted that financial risk magnifies business risk. The basic financial leverage equation indicates that the ***accounting*** return to the stockholder is determined as follows

$$ROE = ROI + (ROI - R_d)\,{}^{D}\!/\!_{S} \qquad (14)$$

where these are all ***book*** values, that is, D and S are the book values of debt and equity, and R_d is the embedded cost of debt. The equation simply comes from manipulating the firm's financial statements. It means, for example, that with a fixed stock of assets, as revenues and the *ROI* change, the greater the amount of debt the greater is the variation in the accounting return to the shareholders. This is the basis of Dr. Villadsen's discussion on pages 19-25 of her report. However, the above equation says absolutely ***nothing*** about how the stock market reacts to this financial risk, that is, how market values change, or how the cost of equity changes as the firm uses debt.[10]

To understand how the investor's required rate of return or equity cost varies with the use of debt we need a valuation model. The first valuation attempt was by Franco Modigliani and Merton Miller (M&M) who in 1958 developed an arbitrage model to show that the total enterprise value was independent of the use of debt. This was their famous "no magic in debt argument." If individuals can borrow on the same terms as the firm, then investors will not pay a premium for firms to use debt when they can do it themselves. ***In this case personal leverage is identical to corporate leverage and the firm adds no value by using debt.*** Consequently, they derived the following formula

$$K_e = K_0 + (K_0 - K_b)\,{}^{B}\!/_{E} \qquad (15)$$

where the *Ks* indicate the cost of equity and debt, that is, fair or required returns and ***not*** accounting returns, and B and E then represent the market values of debt and equity respectively. The subscript 0 then indicates what the equity cost would be if the firm had no debt outstanding, this is often referred to as the unlevered equity or the asset cost.

Note two things about this equation. First, apart from redefining returns and debt ratios, in form it is the same as the financial leverage equation. This is because in the accounting model total assets are fixed, whereas in this valuation model M&M ***proved*** that the value of the firm was fixed and independent of leverage *under their assumptions*. As a result, changes in the book and market debt ratios have the same impact. Second M&M *proved* that as the market value was constant the weighted average cost of capital was also constant, which in this case means that it is equal to the

[10] I use this equation, for example, in my business risk appendix.

unlevered equity cost. However, note that I italicised proved and assumptions, since this was a mathematical proof that followed from their assumptions, not a description of reality. With different assumptions we get different results.

In the M&M equation changes in the market valued debt equity ratio (*B/E*) are multiplied by the spread between the constant *WACC* and the cost of debt. It is this coefficient that determines how much changes in the debt equity ratio affect the equity cost since it is this coefficient that determines the risk. ***This is the important point: people who believe that changes in the debt equity ratio have a big impact on the equity cost believe that the coefficient on the market valued debt equity ratio is high and vice versa.*** This is what gives rise to leverage adjustments if the regulator wants to change the equity ratio in response to changes in business risk.

However, the overall market value in the M&M model is only fixed by their assumptions. Remember from equation (7) the market value is determined by the expected capital income (*EBIT*) discounted at the WACC. Given that M&M were discussing capital structure not operating changes, they assumed that the after-tax operating income was constant. What M&M then "proved" was that with firm value constant the *WACC* must also be constant. In this case, given that the *WACC* is a weighted average of the debt and equity costs, the equity cost must increase with more debt to offset the impact of more "cheaper" debt. In contrast, if the market value increases with the use of more debt, the cost of capital must decrease and vice versa. Whether the equity cost increases or possibly even decreases with the use of debt depends on the valuation model and the assumptions. The critical question is how the use of debt affects the overall firm value; the impact on the *WACC* and the equity cost then follow directly.

M&M's "no magic in debt" result was controversial in 1958 and remains so today. This is because of the assumptions they needed to "prove" their result. The most important are that:

- there are no taxes of any kind,
- there are no transactions costs,
- the firm is traded in the capital market,
- there are no information asymmetries between borrowers and lenders,
- everyone borrows on the same terms, if the company issues 50-year bonds so can others,
- all firms are perpetuities that pay out 100% dividends,
- there are no bankruptcy or financial distress costs of any kind.,

- there are two or more identical firms with different levels of debt that can be arbitraged,
- the managers operate the firm to maximize enterprise value and not their own personal goals.

A result of all these assumptions is that personal and corporate leverage are identical so there is no magic in debt financing. All these assumptions have been disputed to a greater or lesser extent and if *any* of them are incorrect then the total value of the firm is affected using debt and so too will be its after tax cost of capital (*ATWACC*).

M&M's result is a classic in corporate finance, and they won the Noble prize in economics for it. However, its great strength lies not in its result, which few accepted then or now, but the fact they focused corporate finance on the implications of their assumptions. For example, in 1963 they recognised that they made a mistake in their treatment of corporate income taxes and corrected their original paper. They then showed that, all else constant, the value of the firm increases due to the tax shield generated by the tax deductibility of interest payments.[11] The result is that the ATWACC continuously decreases with the use of debt. The reason is simply that what we term value is the *private* value and by reducing corporate income taxes the private value of the firm increases at the expense of the government. Hence if the private market value increases due to the interest tax shield the *ATWACC* of necessity falls.

In the M&M (1963) model the *ATWACC* declines continuously, and the equity cost changes as follows,

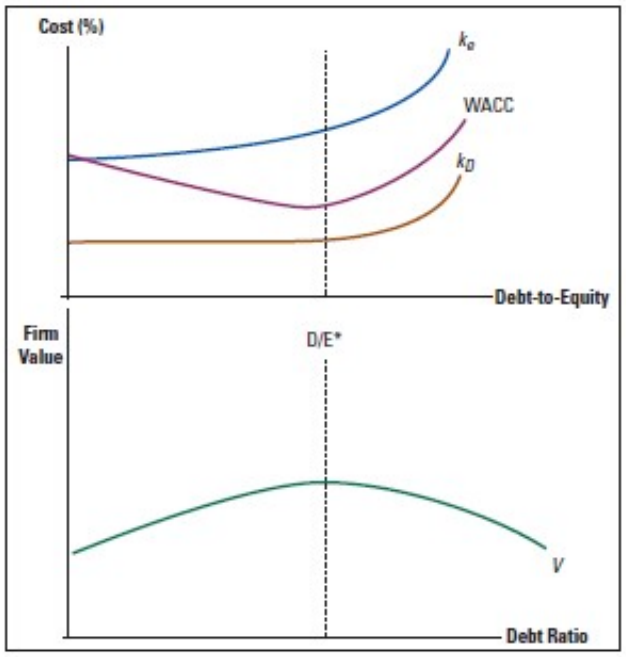
$$K_e = K_0 + (1-T)(K_0 - K_b)\,{}^{B}\!/\!_{E} \qquad (16)$$

There is still a financial leverage risk premium, but it is now much smaller, since the use of debt also generates a valuable tax shield. Note that in equation (16) the debt equity ratio is now multiplied by (1-T), since part of the interest payments are paid for by the government through lower tax payments. Assuming a 40% corporate tax rate, people who believe in M&M (1963) would estimate a leverage impact only 60% the size of those who believe in M&M (1958). A different model produces a different leverage adjustment!

[11] This is the basis for the Hamada tax adjusted beta models referenced by Dr. Villadsen.

Since 1963 all the other assumptions of M&M have been relaxed and every time an assumption has been relaxed there is another leverage equation and another estimate of the leverage adjustment to the equity cost similar to that in equation (16). However, two main theories of capital structure have emerged: since M&M (1958): the static trade off (STO) model and the pecking order hypothesis (POH). The STO is a static model that assumes that firms trade off the tax advantages of using debt against the loss of financial flexibility that arises due to excessive leverage. It is this model that develops the familiar "U" shaped *WACC* function below as the firm increases its debt ratio.[12]

FIGURE 21.9 The Static Trade-Off Model



Initially the *ATWACC* declines due to the tax advantages of debt. In the M&M (1963) model, for example each dollar of debt increases the firm's market value by the value of the corporate tax rate; the *ATWACC* then starts to increase as the loss of financial flexibility sets in. Obviously there has to be some offset to the tax deductibility of interest, otherwise all firms would try to finance with 100% debt. The offset comes as the debt becomes riskier for fear of financial distress or bankruptcy and

[12] From chapter-page 21-28 of my textbook L. Booth, S Cleary, and I Rakita, Introduction to corporate finance (5th edition), John Wiley and Sons, 2020.

must be sold on higher and higher yields and the firm loses its financial flexibility. As the firm uses too much debt its market value falls and its *AT*WACC increases.

In contrast, the pecking order hypothesis (POH), developed in 1963 by Gordon Donaldson at Harvard, is a dynamic model of financing based on the fact that firms are controlled by managers. In this case, firms raise capital by issuing securities that impose the least restrictions on management. Consequently, firms primarily rely on internal funds and only after these are exhausted do, they go externally for capital, raising capital where the costs are lowest. Initially they will use bank debt, then bonds, and as a last resort new equity.

I have reviewed these basic ideas on capital structure since the flat *ATWACC* approach of Drs, Kolbe and Vilbert and now used in part by Dr. Villadsen is essentially the 1958 M&M model extended to include corporate taxes in 1963. Hamada's beta adjustments are simply an extension to include the beta as the risk determinant of the firm without debt. These are very important models and for the last 43 years I have invariably taught corporate financing to second year MBAs with the first five weeks devoted almost exclusively to these ideas, as well as to the implication that if this model holds there is no value to the activities of investment bankers so they should all study marketing! I then spend the balance of my course explaining how companies add value by adopting different financing decisions. The fact is that financial theory has come a long way since 1958 and is now better harmonised with practise: no one believes the flat *AT*WACC model fits reality; it is simply a good starting point to discuss how investment bankers can create value for firms.[13]

However, a flat *ATWACC* does have the advantage that it gives just about the largest possible leverage effect, that is, the coefficient on the market valued debt equity ratio in the equity cost equation 8 is as large as possible. I showed earlier that the M&M 1958 flat *WACC* model gives a bigger equity cost adjustment (equation 15) than if the *WACC* declines with leverage in the conventional way (equation 16). However, by assuming a flat ATWACC in the presence of corporate taxes, there is an even bigger coefficient on the market valued debt equity ratio since there

[13] It would be interesting to ask why investment bankers are so well paid if corporate financing decisions as represented by a flat ATWACC have no value. Moreover, consistently firms report that they have a target capital structure, which obviously does not exist if the ATWACC is flat or constant.

are no non-tax offsets to the use of debt such as financial distress, bankruptcy or simply a loss on credit rating and inability to follow through on corporate strategy.

To illustrate, assume a constant *ATWACC* such that K_A is constant:[14]

$$K_e \frac{E}{V} + K_b(1-T)\frac{B}{V} = WACC = K_A \tag{17}$$

Rearranging this *ATWACC* equation to solve for the equity cost (K_e) at any leverage ratio,

$$K_e = K_A + (K_A - (1-T)K_b)\,{}^{B}\!/_{E} \tag{18}$$

Since the *ATWACC* is assumed constant, it should equal K_0, its starting point without any debt, so the main difference is that it is this cost minus the after-tax cost of debt that determines the coefficient on the debt–equity ratio. With a constant *ATWACC* this coefficient on the debt equity ratio, which is called the leverage coefficient, is larger than either the M&M (1958) (equation 15) no tax case or the M&M (1963) (equation 16) tax case as a simple comparison indicates. These seem to be three cases considered by Dr. Villadsen with two dubbed "Hamada" adjustments, but they simply flow from M&M who developed them several decades ago.[15]

The reason for the very large leverage adjustment in equation (18) is that the model is internally inconsistent. The flat *ATWACC* assumes the tax deductibility of interest, which should cause the cause the *ATWACC* to fall, but there is no explicit account of the offsetting costs that negate this to keep the *ATWACC* constant. Moreover, it is obvious from equation (18) that if the debt cost, K_b, increases with the debt equity ratio then the equity cost does not increase as quickly and may even fall, which is what Solomon showed in the Journal of Finance in 1963.[16] The intuition is simply that "debt" in highly debt financed firms has some of the same characteristics as equity.

[14] As explained earlier the use of market values is not appropriate for regulated firms, either directly or indirectly through WACC estimates from samples of regulated firms.

[15] Unlike Dr. Kolbe (GMI 2009) it is not clear how Dr. Villadsen derived her estimates.

[16] The only reason for the cost of debt to increase is the risk of financial distress or bankruptcy, which M&M ignored in their 1958 paper. Therefore, Solomon's result is inconsistent with the M&M assumptions. However, it

To show these principles return to the previous example, where the equity cost was assumed to decrease from 15% to 11% due to a reduction in risk. As a result, the equity market value increases from $5mm to $6.818mm and the market valued debt ratio decreases from 50% to 42.3%. Dr. Villadsen then seems to say that any direct equity cost estimate at this lower market debt ratio must be increased when applied to the higher book debt equity ratio. So, the question is: what is the coefficient that we multiply the increased debt equity ratio by to get the higher fair return? Although there is *NO* need for a leverage adjustment, since the equity cost is accurately estimated at 11.0%, how could one be made?

One way is to estimate an unlevered equity cost from equation (15) by inserting the debt cost of 5%, the debt equity ratio of .423/.577 or 0.7333, and the equity cost of 11%. In this case, the unlevered equity cost is 8.46% which was the WACC that I estimated earlier. The use of debt financing has increased the equity cost from the debt free 8.46% to the observed 11.0%, so there is a 2.54% financial leverage risk premium due to the corporate use of debt. The coefficient on the market valued debt equity ratio in this example is 3.46% (8.46-5.0). The releveraged equity cost at the 50:50 book debt equity ratio would then be 11.92%. So, someone believing in M&M (1958) would calculate the increased debt-equity ratio of 0.266 (1.0-0.733) and multiply by this leverage coefficient of 3.46%. Further if they believed that the equity cost estimated from a sample of firms with lower market valued debt ratios underestimated the financial risk at the regulated firm's debt ratio, they would increase the 11.0% by 92 basis points.

If instead the M&M (1963) with taxes equation (16) is used with a 50% tax rate, the unlevered equity cost is higher at 9.39% and the financial leverage risk premium is only 1.61% since part of the interest costs are paid by a reduction in taxes. As a result, the financial leverage risk premium is only half what it is with the flat *WACC* M&M 1958 model. In this case the coefficient on the market valued debt equity ratio is 2.20 ((9.39-5.0)*.5). Releveraging to the 50% debt ratio increases the equity cost to 11.59 or 33 basis points less than by using the flat WACC M&M 1958 model. Believing in M&M (1963) gives a smaller bump to the ROE estimate by making leverage adjustments since the interest is tax deductible.

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is consistent with a model of bankruptcy and financial distress. Intuitively why the equity cost decreases is difficult to understand given that its risk is still increasing.

Believing in a constant *ATWACC* with a 50% tax rate gives an *ATWACC* and unlevered equity cost of a constant 7.4%.[17] Hence the market valued debt equity ratio is multiplied by (7.4-2.5) or approximately 5.0%. This is higher than either M&M (1958) no tax or M&M (1963) with tax and seemingly gives the highest possible leverage adjustment. This is because the debt cost is after tax and there are no explicit offsetting costs in the model, yet the *ATWACC* is somehow held constant. Using this model, the leverage adjustment would not be 59 or 92 basis points but 131 basis points to move the equity cost at the regulated debt ratio to 12.3%.

Let me make the importance of these examples clear. The chain of events is that the risk of the utility has declined causing its equity cost to drop from 15% to 11%. The obvious thing that the regulator should do is simply cut the allowed *ROE* from 15% to 11%. This is also what would happen if the regulator used the AEUB's *ATWACCBV* approach and recognised that it would be "derelict" in exercising its statutory responsibilities in using market values. However, using the "*ATWACC* approach" avoids this full *ROE* drop in two ways. The first is to go directly to the *ATWACC* with market values, which seals in the higher equity ratio and delays the drop in the allowed *ROE*. However, if this fails the second step is to argue for a leverage adjustment. Then the assumption of a flat *ATWACC* with taxes generates just about the biggest coefficient on the debt equity ratio and the largest financial leverage risk premium. This provides the biggest "bump" when a sample estimate is applied to the regulated common equity ratio. In my example, it would give an equity cost of 12.31%, 131 basis points higher than the true equity cost and higher than using any other equity cost model that I am aware of. *Moreover, the higher the market value and the bigger the need to cut the allowed ROE, with this approach the higher the unnecessary financial leverage adjustment.*

Q. DO YOU THINK THE LEVERAGE MODELS ARE ACCURATE ENOUGH TO SET RATES?

A. No.To illustrate when the NEB established its automatic ROE adjustment mechanism in RH-2-94 several experts attempted testimony on the impact of capital structure changes along the lines of the current testimony of Dr. Villadsen. For example, Dr. Sherwin and Ms. McShane of Foster Associates, who at the time provided testimony on behalf of the utilities, concluded before the NEB (page 24 of the RH-2-94 decision)

[17] 7.4%= 11%*0.577 + 5%*(1-0.5)*0.423

"The finance models, even when adapted to the real world of Canadian utility regulation, cannot provide the basis for determining a pipeline's optimal capital structure."

If they can't determine the optimal capital structure, then they can't determine the leverage adjustment. In that hearing Dr. Berkowitz and I also used models similar to those used by Dr. Villadsen in this hearing but expressed little support for them. As the Board noted in its Reasons for Decision (page 24 of the RH-2-94 Decision)

"Dr. Booth and Berkowitz concluded that these estimates are approximately the increases in ROE required by investors. However, they noted the estimates are subject to error since they are based on valuation formulas, which are as yet unproven. Moreover, they noted that these formulas ignored the non-tax advantages of debt financing and the effects of financial distress."

Finally, the NEB also noted Dr. Waters' testimony (a frequent witness before the NEB at that time) where he indicated that

"*To date empirical testing to more clearly describe the relationship (between capital structure and the investors required return) has not been done successfully."*

The NEB's summary from almost thirty years ago is an accurate assessment of my views today and it is still my judgment that the misgivings expressed by expert witnesses continue.[18] Despite the seeming precision of the estimates provided by Dr Villadsen, the estimates are based on assumptions and models that have not been verified in the real world.

Consequently, and even though there is no need for such adjustments in the first place, there is also serious doubt as to their validity even when they are needed.

[18] Notably the only expert witnesses that rely on the *ATWACC* methodology as far as I am aware are from the Brattle group. Neither Dr. Chretian in 2007 nor Dr. Morin in 2011 used it.