WRITTEN EVIDENCE OF
Michael J. Vilbert

**Appendix B**

**IMPACT OF CAPITAL STRUCTURE ON THE COST OF CAPITAL**

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**Q1. What is the purpose of this appendix?**

A1. This appendix provides additional detail on the after-tax weighted-average cost of capital ("ATWACC") and how it might be used to improve traditional regulatory processes. It first describes the determinants of the overall cost of capital. This is followed by sections on the cost of equity and of debt. The section on the overall cost of capital has important implications for the capital structures that might be used in rate making. Next comes a discussion of ATWACC issues raised by Alberta Energy and Utilities Board ("AEUB") *Decision U99099*. Finally, the appendix describes how these principles relate to traditional regulatory procedures and how they might be put to use in ratemaking.

## I. OVERALL COST OF CAPITAL AS THE CORRECT STARTING POINT

**Q2. Please define formally the Cost of Capital?**

A2. The *cost of capital* can be defined as *the expected rate of return in capital markets on alternative investments of equivalent risk*. In other words, it is the rate of return investors require based on the risk-return alternatives available in competitive capital markets. The cost of capital is a type of opportunity cost: it represents the rate of return that investors could expect to earn elsewhere without bearing more risk. "Expected" is used in the statistical sense: the mean

of the distribution of possible outcomes. The terms "expect" and "expected" in this written evidence, as in the definition of the cost of capital itself, refer to the probability-weighted average over all possible outcomes.

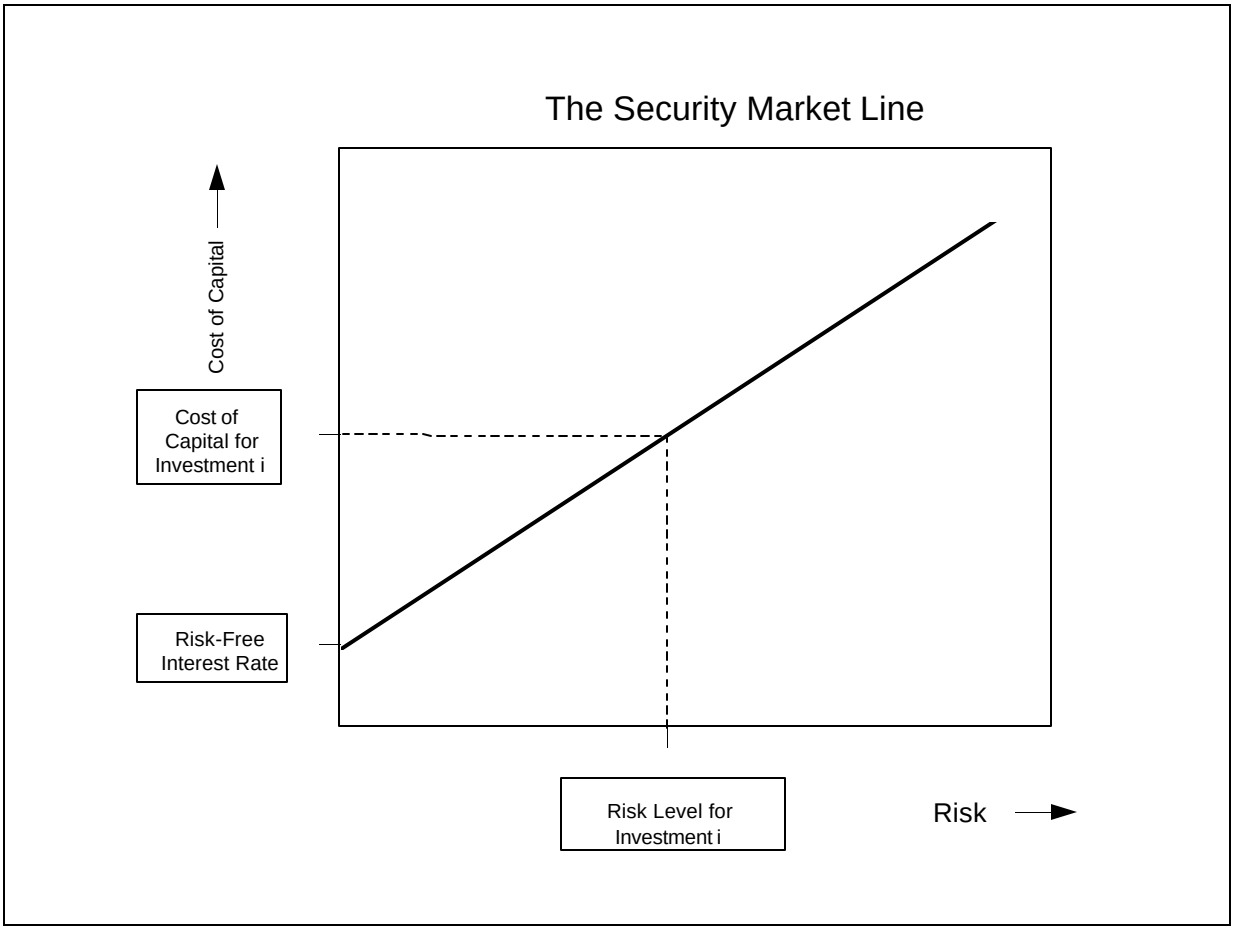


**Figure 1**

The definition of the cost of capital recognizes a tradeoff between risk and return that is known as the "security market risk-return line," or "security market line" for short. This line is depicted in Figure 1. The higher the risk, the higher the cost of capital. A version of Figure 1

applies for all investments. However, for different types of securities, the location of the line may depend on corporate and personal tax rates.

**Q3. Why is the overall after-tax cost of capital conceptually the correct starting point?**

A3. It is common to think of the weighted-average cost of capital as the final result of an analysis of its components, the costs of debt and of preferred and common equity, since that is how it is normally calculated. From a *causation* standpoint, however, the overall cost of capital is the most basic quantity, not the components. In fact, were it not for taxes and the costs associated with excessive debt, the overall costs of capital of corporations would be constants, completely independent of the capital structure (i.e., the debt-equity ratio) the firm happened to choose.

**Q4. Before addressing the importance of the overall cost of capital, please clarify whether you intend preferred stock to be thought of as part of debt or equity in this discussion.**

A4. Preferred sometimes is closer to common for purposes of this Appendix (e.g., preferred dividends may not be deductible for corporate income tax purposes), and sometimes closer to debt (e.g., a fixed preferred dividend has exactly the same risk-magnifying effect on the variability of rates of return on common equity as a fixed interest payment). To avoid the ambiguity that might arise as a result, this discussion focuses on debt and common equity. Additionally, the tradeoff between debt and equity is the basic focus of the economics literature that underlies this discussion. Hydro has no preferred stock in its capital structure.

**Q5. Please return to your discussion of the overall cost of capital.**

A5. Putting taxes, the costs of excessive debt and financing sources other than debt and common equity (e.g., liabilities for future employee benefits) aside for the moment, the right formula to relate the overall cost of capital to the component costs of debt and equity is

$$r_E \times (E/V) + r_D \times (D/V) = r_O \qquad \text{(B-1)}$$

with the overall cost of capital $r_O$, on the *right* side, as the *independent* variable, and the costs of equity ($r_E$) and debt ($r_D$) on the left side, as *dependent* variables determined by the overall cost of capital and by the capital structure (i.e., the shares of equity (E) and debt (D) in overall firm value (V=E+D)) that the firm happens to choose.

Thus, the right starting point for the cost of capital for a company (or a part of a company) is the overall cost of capital for that line of business. That is the quantity used to decide whether to make an investment in a particular business, for example. The overall cost of capital of a line of business depends primarily on the line's capital market "business risk." Business risk in the corporate finance sense is the risk that investors would bear if they owned shares in an all-common-equity-financed company in this line of business.

**Q6. How are the above measures used to determine the capital charges?.**

A6. For an investor owned utility, the capital charges are computed as:

$$r_E \times E/RB + r_D \times D/RB + T = CC \quad \text{(B-2a)}$$

where RB is the ratebase, E is the amount of equity in the ratebase, D is the amount of debt in the ratebase, T is the income tax owed, and CC is the total capital charge. Taxes are paid on equity income only so, $T = (t_C /(1 - t_C) \times r_E \times E$ with $t_C$ being the corporate income tax rate. Using this and the ATWACC equation:

$$r_E \times (E/RB) + r_D \times (1 - t_C) \text{ x } (D/RB) = ATWACC \quad \text{(B-2b)}$$

$$r_E \times (E/RB)/(1 - t_C) + r_D \text{ x } (D/RB) = BTWACC \quad \text{(B-2c)}$$

The capital charges are equal to the BTWACC multiplied times the ratebase as shown below. Mathematically,

$$\begin{aligned} BTWACC \times RB &= r_E \times E/(1 - t_C) + r_D \text{ x } D \quad \text{(B-2d)} \\ &= r_E \times E + r_E \text{ x } E \text{ x } t_C/(1 - t_C) + r_D \text{ x } D \\ &= \text{return on equity + taxes + interest expense} \\ &= CC. \end{aligned}$$

Note that the after-tax return on equity divided by (1 - minus the tax rate) gives enough return to pay the after-tax return on equity plus income taxes.

**Q7. Please describe the determinants of business risk.**

A7. Business risk depends on the variability characteristics of the company's operating cash flows, which are the cash flows to all investors including bondholders. Operating cash flows are the net result of uncertain revenues minus uncertain operating costs. All else equal, business risk grows as revenues grow *more* uncertain and as costs grow *less* uncertain, since costs enter the equation with a negative sign. Roughly speaking, certain costs are *fixed* costs and uncertain costs are *variable* costs. All else equal, companies would rather have variable costs that could be avoided in bad times than fixed costs that have to be paid regardless of how well the business is doing. A company with a high proportion of fixed costs has high "operating leverage," and higher operating leverage means more capital market business risk.

**Q8. Can you give an example of how the relative certainty of costs affects capital market business risk?**

A8. Yes. Suppose two companies' revenues are both $100 plus or minus $20. One company, call it "A," has fixed costs of $80, while the other, "B," has variable costs that are always 80 percent of revenues. This implies that the investor cash flows of A (the fixed-cost company) will range between $80-$80 = $0 and $120-$80 = $40, with an expected value of $100-$80 = $20. The investor cash flows of B (the variable-cost company) will range between $80-(0.8*x*$80) = $16 and $120-(0.8*x*$120) = $24, with the same expected value of $20. The variable-cost company is less risky, with investor cash flows that range between $16 and $24 versus the fixed-cost company's $0 to $40 range.

Thus, the overall cost of capital depends on capital market business risk, which in turn depends on the risk of operating cash flows.

## A. DEBT AND THE OVERALL COST OF CAPITAL

**Q9. How does the use of debt affect the overall cost of capital?**

A9. Most financial economists believe that use of modest amounts of debt reduces the overall cost of capital to a degree, because interest is tax deductible to the corporation. *All else equal*, use of debt increases the total pool of money available for distribution to investors. However, the amount of the cost of capital reduction due to interest tax shields and even whether it happens at all are the subject of academic research, in part because other things do not stay equal as debt is added.

As a Crown Corporation, Hydro does not pay income taxes and, therefore, receives no tax shield from interest payments. The implications of this fact are discussed further below.

Economists are agreed on the outcomes under some sets of assumptions, but none of these assumption sets is fully realistic. The easiest case to analyze is when there are no taxes and there are no additional costs or risks associated with excessive debt. This case is completely unrealistic, however. The important determinants of the actual effect of debt on the overall cost of capital include:

- Interest is tax deductible at the corporate level (unlike dividend payments), which is an advantage: some of the operating income that would otherwise go to taxes is distributed to investors if the company issues debt.

- However, interest income is taxed at the investor's full personal income tax rate (unlike dividends and capital gains on stock sales). An important unresolved issue is the extent to which the tax advantage on debt relative to equity for corporate taxes is offset by this disadvantage for personal taxes.

- In actuality, increasing the debt ratio adds costs for the firm, such as a growing risk of financial distress or a reduction in the flexibility to take advantage of business opportunities, that eventually offset any net tax benefits.

## B. THE BASE CASE: NO TAXES, NO RISK TO HIGH DEBT RATIOS

**Q10. Please start by explaining the simplest case of the effect of debt on the cost of capital.**

A10. The "base case," no taxes and no costs to excessive debt, was worked out in a classic 1958 paper by Franco Modigliani and Merton Miller, two economists who eventually won Nobel Prizes in part for their body of work on the effects of debt.[1] Their 1958 paper made what is in retrospect a very simple point: if there are no taxes and no risk to the use of excessive debt, use of debt will have no effect on a company's operating cash flows (i.e., the cash flows to investors as a group, debt plus equity combined). If the operating cash flows are the same regardless of whether the company finances mostly with debt or mostly with equity, the risk of those cash flows cannot be affected at all by the debt ratio. Since the cost of capital depends on relative risk, the company's overall cost of capital must be unaffected by debt, too.

[1] Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, 48: 261-297 (June 1958).

In this case, issuing debt merely divides the same set of cash flows into two pools, one for bondholders and one for shareholders. If the divided pools have different priorities in claims on the cash flows, the risks (and costs of capital) will differ for each pool (which is the topic of later sections). But the risk and cost of capital of the entire firm, the sum of the two pools, is constant regardless of the debt ratio. The result is that Equation (B-1) above corresponds perfectly to this base case.

## C. CORPORATE TAX DEDUCTION FOR INTEREST EXPENSE

**Q11. What is the effect of adding corporate taxes to the discussion?**

A11. If corporate taxes exist (and if only taxes at the corporate level matter, not taxes at the level of the investor's personal tax return), this conclusion changes. Debt at the corporate level reduces the company's tax liability by an amount equal to the marginal tax rate times interest expense. All else equal, this will add value to the company because more of the operating cash flows will end up in the hands of investors as a group. Thus, if a company starts out with $1,000 in pre-tax operating income and pays taxes at a 35 percent rate, it will have ($1,000×0.35) = $350 in taxes and ($1,000 ! $350) = $650 available for investors. If it now issues debt that has $200 in interest expense, its taxes fall to [($1,000-$200)×0.35] = $280, and it has ($1,000 ! $280) = $720 available for investors as a group. The tax advantage to the use of debt is ($720 ! $650) = $70, or 35 percent of the $200 in interest. This is summarized in Table B-1.

**Table B-1**
**Effect of Corporate Tax Deduction for Interest Expense**

| | Without Debt | With Debt |
|---|---|---|
| **Pre-Tax Operating Income** | $1,000 | $1,000 |
| **! Interest Expense** | 0 | 200 |
| **= Pre-Tax Equity Income** | $1,000 | $800 |
| **! Taxes @ 35%** | 350 | 280 |
| **= After-Tax Equity Income** | $650 | $520 |
| **+ Interest to Bondholders** | 0 | 200 |
| **= Income to All Investors** | $650 | $720 |

Thus, if only corporate taxes mattered, interest would add cash to the firm equal to the corporate tax rate times the interest expense. This increase in cash would increase the value of the firm and reduce the overall cost of capital.

*How much* the value of the firm would rise and *how far* the overall cost of capital would fall would depend in part on how often the company adjusts its capital structure, but this is a second-order effect in practice. (The biggest effect would be if companies could issue riskless perpetual debt, an assumption Profs. Modigliani and Miller explored in a 1963 paper;[2] this assumption could *not* be true for a real company.) Prof. Robert A. Taggart provides a unified treatment of the main papers in this literature and shows how various cases relate to one another.[3] Perhaps the most useful set of benchmark equations for the case where only corporate taxes matter are:

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[2] Franco Modigliani and Merton H. Miller, "Corporate Income Taxes and the Cost of Capital: A Correction," *American Economic Review*, 53: 433-443 (June 1963).

[3] Robert A. Taggart, Jr., "Consistent Valuation and Cost of Capital Expressions with Corporate and Personal Taxes," *Financial Management* 20: 8-20 (Autumn 1991)

$$r^*_1 = r_{A1} - r_D \times t_C \times (D/V) \quad \text{(B-3a)}$$

$$r_{E1} \times (E/V) + r_D \times (D/V) \times (1 - t_C) = r^*_1 \quad \text{(B-3b)}$$

which imply

$$r_{E1} = r_{A1} + (r_{A1} - r_D) \times (D/E) \quad \text{(B-3c)}$$

where $r^*_1$ is the overall after-tax cost of capital, $r_{A1}$ is the all-equity cost of capital for the firm, $r_D$ is the cost of debt, and $r_{E1}$ is the cost of equity.[4] (The "1" subscripts distinguish these quantities in the case where only corporate taxes matter from the subsequent equations that consider both corporate and personal taxes.) Note that Equation (B-3a) implies that when only corporate taxes matter, the overall after-tax cost of capital declines steadily as more debt is added, until it reaches a minimum at 100 percent debt (i.e., when D/V = 1.0).

However, whether any value is added and whether the cost of capital changes at all also depends on the effect of taxes at the personal level.

## D. PERSONAL TAX BURDEN ON INTEREST EXPENSE

**Q12. How do personal taxes affect the results?**

A12. Ultimately, the purpose of investment is to provide income for consumption, so personal taxes affect investment returns. For example, in the U.S. municipal bonds have lower interest rates than

[4] As before, E is the value of equity, $r_D$ is the cost of debt, D the value of debt, and V = E+D the value of the firm.

corporate bonds because their income is taxed less heavily at the personal level. In general, capital appreciation on common stocks is taxed less heavily than interest on corporate bonds because (1) taxes on unrealized capital gains are deferred until the gains are realized, and (2) the capital gains tax rate is lower. The effects of personal taxes on the cost of common equity are hard to measure, however, because common equity is so risky.

Professor Miller, in his Presidential Address to the American Finance Association,[5] explored the issue of how personal taxes affect the overall cost of capital. The paper pointed out that personal tax effects could offset the effect of corporate taxes entirely. To see how this might work, consider the after-corporate-tax, after-personal-tax investor returns of a firm with and without debt. Suppose the corporate tax rate were 35 percent, the effective personal tax rate on the marginal investors holding corporate debt were 40 percent, and the effective personal tax rate on the marginal investors holding common equity were only 7.7 percent, representing a blend of a 33-1/3 percent rate on dividends and much less than that (in present value) on future capital gains when finally realized. Then corporate taxes for an all-equity firm with pre-tax operating income of $1,000 would be ($1,000×0.35) = $350, as above, leaving ($1,000 ! $350) = $650 in after-corporate-tax earnings to be distributed as dividends or retained to support future capital gains. Personal taxes on that amount at the effective marginal personal tax rate on equity would be ($650×0.077) = $50. The after-all-tax cash flow to the marginal investors in an all-equity firm would be ($1,000 ! $350 ! $50) = $600.

[5] Merton H. Miller, "Debt and Taxes," *The Journal of Finance*, 32: 261-276 (May 1977).

Now suppose the firm issues debt with $200 in interest expense, as before. Corporate taxes again fall to [($1,000-$200)×0.35] = $280, and the firm has ($1,000 ! $280) = $720 to distribute to investors. The personal tax burden on all investors equals the sum of that on debt and on equity, or {($200×0.40) + [($720-$200)×0.077)]} = ($80 + $40) = $120. The after-all-tax cash flow to the investors in the levered-equity firm would be ($1,000 ! $280 ! $120) = $600, the same as for the all-equity firm. The tax advantage to use of debt at the corporate level would vanish entirely at the personal level under these conditions. Table B-2 lays out these results.

**Table B-2**
**Combined Effect of Corporate and Personal Taxes**

| | **Without Debt** | **With Debt** |
|---|---|---|
| **Pre-Tax Operating Income** | $1,000 | $1,000 |
| **! Interest Expense** | 0 | 200 |
| **= Pre-Tax Equity Income** | $1,000 | $800 |
| **! Taxes @ 35%** | 350 | 280 |
| **= After-Tax Equity Income** | $650 | $520 |
| ! **Personal Taxes @ 7.7%** | 50 | 40 |
| **= After-all-tax Equity Income** | $600 | $480 |
| **+ Interest to Bondholders** | 0 | 200 |
| ! **Personal Taxes @ 40%** | 0 | 80 |
| **= Total After-all-tax Income** | $600 | $600 |

**Q13. Is it likely that the effect of personal taxes will completely neutralize the effect of corporate taxes?**

A13. No. These conditions seem pretty unlikely, if they require only a 7.7 percent effective personal tax rate on equity. However, personal taxes are important even if they do not make the corporate tax advantage on interest vanish entirely. Capital gains and dividend tax advantages definitely convey some personal tax advantage to equity, and even a partial personal advantage to equity reduces the corporate advantage to debt. For example, suppose the effective marginal personal tax rate on equity returns is 30 percent, versus the 40 percent for debt. In the no-debt case, the personal taxes on equity in Table B-2 climb from $50 to $195, and the after-all-tax cash flow drops from $600 to $455. With debt, personal taxes on equity rise from $40 to $156. The after-all-tax cash flow drops from $600 to $484. The net tax advantage at the corporate level is not 35 percent of interest expense ($70/$200), but 22.4 percent ([($484 ! $455)/(1.0 ! 0.4)]/$200).[6]

The Taggart paper explores this case, also. With personal taxes, the risk-free rate on the security market line in Figure 1 above is the after-personal-tax rate, which must be equal for risk-free debt and risk-free equity.[7] Therefore, the pre-personal-tax risk-free rate for equity will generally not be equal to the pre-personal-tax risk-free rate for debt. In particular, $r_{fE} = r_{fD} \times [(1 ! t_D)/(1 ! t_E)]$, where $r_{fE}$ and $r_{fD}$ are the risk-free costs of equity and debt and $t_E$ and $t_D$ are

[6] The after-all-tax savings ($484-$455) need to be "grossed up" to the corporate level by dividing by 1.0 minus the personal tax rate on debt (0.4).

[7] As Prof. Taggart notes (his footnote 9), it is not necessary that a specific, risk-free equity security exist as long as one can be created synthetically, through a combination of long and short sales of traded assets. Such constructs are a common analytical tool in financial economics.

the personal tax rates for equity and debt, respectively. In terms of the cost of debt, the Taggart paper's results imply that a formal statement of these effects can be written as:[8]

$$r^*_2 = r_{A2} - r_D \times t_N \times (D/V) \quad \text{(B-4a)}$$

$$r_{E2} \times (E/V) + r_D \times (D/V) \times (1 - t_C) = r^*_2 \quad \text{(B-4b)}$$

which imply

$$r_{E2} = r_{A2} + \{r_{A2} - r_D \times [(1 - t_D)/(1 - t_E)]\} \times (D/E) \quad \text{(B-4c)}$$

Note that the first case above, $t_E$ = 7.7 percent and $t_D$ = 40 percent, implies $[(1 - t_D)/(1 - t_E)]$ = 0.65 = $(1 - t_C)$. That corresponds to Miller's 1977 paper, in which the net personal tax advantage of equity fully offsets the net corporate tax advantage of debt. Note also that in that case, $t_N$ = 0.[9] Therefore, if the personal tax advantage on equity fully offsets the corporate tax advantage on debt, Equation (B-4a) confirms that the overall after-tax cost of capital is a constant.

However, it is unlikely that the personal tax advantage of equity fully offsets the corporate tax advantage of debt. If not, and if taxes were all that mattered (i.e., if there were no other costs to debt), the overall after-corporate-tax cost of capital would still fall as debt was added, just not as fast. How fast it falls depends chiefly on the net corporate-over-personal tax advantage of debt (and secondarily on how often the company readjusts its capital structure to the "normal"

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[8] The net all-tax effect of debt on the overall cost of capital, $t_N$, equals $\{[t_C + t_E - t_D - (t_C \times t_E)] / (1 - t_D)\}$, where $t_D$ is the personal tax rate on debt, as before.

[9] In the above example, $t_N = \{[0.35 + 0.077 - 0.4 - (0.35 \times 0.077)] / (1.0 - 0.40)\} = 0.0/0.60 = 0$.

or "target" level). Even absent a complete offset, personal tax effects still serve to reduce the corporate tax advantage of debt.

Finally, note that the overall after-tax cost of capital, Equation (B-4b), still uses the corporate tax rate even when personal taxes matter. Personal taxes affect the way the cost of equity changes with capital structure -- Equation (B-4c) -- but not the formula for the overall after-tax cost of capital given that cost of equity.

## E. HYDRO'S TAX EXEMPT STATUS

**Q14. Is the relevant benchmark ATWACC affected by Hydro's tax exempt status?**

A14. No. As discussed in my evidence, Hydro's ATWACC is not affected by its tax exempt status, but Hydro's revenue requirement is affected. Hydro does not pay income taxes on its equity income and receives no tax shield for its interest payments. Relative to an investor owned utility ("IOU"), Hydro has lower capital charges than an equally risky IOU, because the return on equity does not need to be increased to recover income taxes. The capital charges in Hydro's revenue requirement increase as debt is added to the capital structure, because Hydro would be substituting debt financing, in which it has a tax disadvantage for equity financing, in which it has a tax advantage relative to an IOU.

Another way to understand this result is to consider the relationship between the ATWACC and the before-tax weighted-average cost of capital ("BTWACC"). When multiplied times the rate base, the BTWACC gives the total capital charges for the company, that are the

sum of the after-tax return on equity, income taxes and the interest expense. For an IOU, the BTWACC equals the ATWACC divided by (1 minus the tax rate). This calculation does not hold for Crown Corporations that pay no income tax. The BTWACC for Hydro is the weighted-average of the after-tax return on equity and the before-tax return on debt. Relative to the ATWACC, the BTWACC for Hydro increases as debt is added to the capital structure. Exhibit No. MJV-4 illustrates this effect. Note that as the equity in the capital structure increases, the BTWACC for Hydro decreases.

## F. OTHER COSTS OF DEBT

**Q15. The above discussion refers repeatedly to the "other" costs of debt. Please describe these other costs of debt.**

A15. Here the results cannot be reduced to equations, but they are no less real for that fact. As companies add too much debt, the costs come to outweigh the benefits. Too much debt reduces or eliminates financial flexibility, which cuts the firm's ability to take advantage of unexpected opportunities or weather unexpected difficulty. Use of debt rather than internal financing may be taken as a negative signal by the market.

Also, even if the company is generally healthy, more debt increases the risk that a bad year will imply the company cannot use all of the interest tax shields when anticipated. As debt continues to grow, this problem grows worse and others crop up. Managers begin to worry about meeting debt payments instead of making good operating decisions. Suppliers are less

willing to extend trade credit, and a liquidity shortage can translate into lower operating profits. Ultimately, the firm might have to go through the costs of bankruptcy and reorganization. Collectively, such factors are known as the costs of "financial distress."[10]

The net tax advantage to debt, if positive, is affected by costs such as a growing risk that the firm might have to bear the costs of financial distress. First, the expected present value of these costs offsets the value added by the interest tax shield. Second, since the likelihood of financial distress is greater in bad times when other investments also do poorly, the possibility of financial distress will increase the risks investors bear. These effects increase the variability of the value of the firm. Thus, firms that use too much debt can end up with a higher overall cost of capital than those that use none.[11]

## G. IMPLICATIONS FOR RATEMAKING CAPITAL STRUCTURE

**Q16. Is there one optimal capital structure that minimizes the cost of capital?**

A16. No. The above discussion of the overall cost of capital should make a fundamental point clear: *There is no magic in financial leverage.* Even the best argument for the use of debt, the tax

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[10] See, for example, Richard A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, 6th Ed., New York: Irwin McGraw-Hill (2000) at 510-521.

[11] As discussed further below, some of these costs may not show up in measures of the non-diversifiable risks that affect the cost of capital, but also do not show up anywhere else in either the capital budgeting or ratemaking context. (For anyone not familiar with the term, "capital budgeting" refers to the process by which firms value possible investments and select among them.) All else equal, this suggests that simply averaging the measured after-tax weighted average costs of capital of the sample may understate somewhat the appropriate measure of overall rate of return.

shields on interest, are subject to a personal tax offset to some degree. Moreover, there are non-interest costs associated with debt (e.g., the risk of financial distress and the loss of flexibility).

Actual corporate behavior confirms that debt carries no magic. For example, firms in the same industry often have a wide range of capital structures. Moreover, the most profitable firms often have the least debt. If debt were as valuable as the pure tax-based theories suggest, there's a lot of stupid behavior by what other evidence suggests are the industry's best managers.[12] A recent study that analyzed over 2000 firms for 28 years (1965-1992 inclusive) concluded, "Our tests thus produce no indication that debt has net tax benefits."[13]

These conclusions are borne out in the academic literature. For example, Stewart C. Myers, a leading expert on capital structure, made it the topic of his Presidential Address to the American Finance Association.[14] The poor performance of tax-based explanations for capital structure led him to propose an entirely different mechanism.[15] Research by Professor Myers and

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[12] See, for example, Carl Kester, "Capital and Ownership Structure: A Comparison of United States and Japanese Manufacturing Concerns," *Financial Management*, 15:5-16, (Spring, 1986), which finds that in both countries low debt ratios are associated with high profitability.

[13] Eugene F. Fama and Kenneth R. French, "Taxes, Financing Decisions and Firm Value," *The Journal of Finance*, 53:819-843 (June 1998) at page 841.

[14] Stewart C. Myers, "The Capital Structure Puzzle," *The Journal of Finance*, 39: 575-592 (1984). I believe it is fair to say that Professor Myers is one of the leading experts on the effects of capital structure. In addition to his American Finance Association address, for example, he was tapped to write the review article when Professor Merton Miller won the Nobel Prize in economics in 1990 in large part for his lifetime work on capital structure (Stewart C. Myers, "Merton H. Miller's Contributions to Financial Economics," *Scandinavian Journal of Economics*, 1991).

[15] Stewart C. Myers, "The Capital Structure Puzzle," *op. cit.* and Stewart C. Myers, "Still Searching for Optimal Capital Structure," *Are the Distinctions Between Debt and Equity Disappearing?*, R.W. Kopke and E. S. Rosengren, eds., Federal Reserve Bank of Boston. (1989).

others confirms that competitive firms do not behave as if there is a material net advantage to debt.[16]

Thus, firms consistently behave as if the non-tax costs of debt matter more than the net tax advantage of debt. If anything, the logic of such behavior is *stronger* in Canada than in Japan or the U.S., since equity is at a bigger corporate tax disadvantage in those countries than in Canada (i.e., Japan and the U.S., unlike Canada, have no form of dividend tax credit at the personal level to offset corporate taxes on equity). To accord with these facts, the Board should recognize the implications of that behavior, by measuring the ATWACC from the best sample available and treating that number as independent of capital structure.

**Q17. Do all of the costs of excessive debt show up in the *measured* ATWACC?**

A17. As noted above, they probably do not. The ATWACC measured at higher debt ratios probably understates the ATWACC that would be ideal to use in capital budgeting and in rate regulation.

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[16] The research rejects the notion that a static tradeoff between net tax benefits and costs of financial distress leads to a well-defined or narrow range of optimum capital structures. See, for example, Stewart C. Myers, "The Capital Structure Puzzle," *op. cit.*; Carl Kester, *op. cit.*; Edwin O. Fischer, Robert Heinkel, and, Josef Zechner, "Dynamic Capital Structure Choice: Theory and Tests," *The Journal of Finance*, 44:19-40 (March 1989); Stewart C. Myers, "Still Searching for Optimal Capital Structure," *op. cit.*; and Lakshmi Shyam-Sunder and Stewart C. Myers, "Testing static tradeoff against pecking order models of capital structure," *Journal of Financial Economics* 51:219-244 (February 1999). See also the Winter 1995 issue of the *Journal of Applied Corporate Finance* 7, No. 4, which has a series of articles on what might explain capital structure, given that the static tradeoff approach does not. A very recent paper, John R. Graham, "How Big Are the Tax Benefits of Debt," *The Journal of Finance*, 55:1901-1942 (October 2000) confirms that firms that ought to benefit substantially from use of additional debt, including highly profitable, dividend-paying firms, appear not to use it "enough." The Graham paper leaves us with only three options: either these apparently well managed firms are making major mistakes, the benefits of the tax deduction are less than they appear, or the non-tax costs to use of debt offset the potential tax benefits.

The reason is that some of the non-tax effects of excessive debt discussed above may be hard to detect and may not show up in cost of capital measurement.

**Q18. How should this effect be accommodated?**

A18. This effect is handled in capital budgeting by strict prohibitions against artificially inflating the debt ratio when evaluating a project. For example, Brealey and Myers, *op. cit.* at 551 caution against such adjustments under the subtitle, "Mistakes People Make in Using the Weighted-Average Formula." This implies that the non-tax costs of excessive debt are valued by not reducing the ATWACC for tax effects beyond those embodied in the ATWACC value estimated from the market. Rate regulation using ATWACC needs to adopt similar standards.[17]

**Q19. What are the implications of the "no magic in leverage" principle for establishing the ratemaking capital structure?**

A19. If there is no magic in leverage, there is no magic formula to get a minimum-cost capital structure -- in fact, there is no single minimum cost capital structure. Instead, the evidence is that there is a broad middle range of capital structures where the benefits of greater corporate tax deductions as the debt ratio increases are offset by personal tax effects, a greater risk of financial distress and other costs of debt.

[17] The alternative would be to add in extra, hard-to-quantify cost items at higher debt levels, something done neither in capital budgeting nor ratemaking.

Where the middle range lies depends primarily on the capital market business risk of the firm or activity in question. Firms with more capital market business risk can support less debt at a given cost. Capital market business risk depends on factors such as uncertainty in demand and the capital intensity of the production process (which affects operating leverage). Other firms in the same industry are the best single guide to the level of capital market business risk these factors produce for the line of business in question. Therefore:

- *The best evidence on the location of the minimum cost range of capital structures for a line of business will come from the observed range of a (non-distressed) sample of firms in that line of business;* and

- *Within that minimum cost range, the after tax weighted average cost of capital is effectively constant.*

**Q20. How can the after-tax weighted-average cost of capital be a constant if equity is more expensive than debt?**

A20. It is a mistake to think of the cost of equity as constant as capital structure changes. Even the cost of debt grows as the debt ratio increases. Yet debt has first claim on the firm's operating earnings, so uncertainty in operating earnings is borne by equity in most circumstances. The cost of debt unquestionably rises as debt is added *despite* the protection that equity provides to debt. Intuitively, the cost of equity therefore must rise at a much greater rate.

This intuition is borne out. The more debt, the less equity to bear the total variability. The variability per dollar of equity, and hence the cost of equity, goes up as debt is added, and

at an increasingly rapid rate. The subsequent section on the cost of equity explores this topic in more detail.

**Q21. What is the implication of a constant overall after-tax weighted average cost of capital?**

A21. The important point is that if the after-tax weighted-average cost of capital is constant as capital structure changes within the middle range, so too is the revenue requirement for an IOU. The revenue requirement is based on the after-tax income to equity, taxes, and the pre-tax interest on debt. That sum just equals the overall after-tax cost of capital (times the rate base) divided by one minus the tax rate.[18] A constant overall after-tax cost of capital therefore implies the amount customers should pay is independent of capital structure, too. Recognition of this principle means that regulators and intervenors can avoid the costly and unnecessary controversy over an IOU's capital structure.

Of course, this refers to current market costs of capital, calculated at current market capital structures. Rate making does typically focus on embedded rather than current interest rates, although there is no reason in principle that regulated shareholders (rather than regulated ratepayers) should not bear the risk of changes in interest rates just as competitive companies' shareholders do.[19] However, if the use of embedded interest rates is to be continued, as in this

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[18] $(V)r^*/(1-t_C) = (V)[r_E(E/V) + (1!t_C)r_D(D/V)]/(1!t_C) = r_E E + [t_C r_E E/(1!t_C)] + r_D D$ = after-tax income + taxes + interest. Since V and $t_C$ are constant, a constant value for $r^*$, the after-tax weighted-average cost of capital, means the pre-tax return to all investors is constant, also.

[19] Note that an economically fair transition to such a system would have to hold investors or ratepayers harmless for the excess or deficit of embedded rates over or below market rates on existing securities (continued...)

proceeding, this detail is readily accommodated: simply adjust the revenue requirement by an amount equal to the difference between the company's embedded interest expense and what that interest expense would be at current market interest rates.

As noted above, capital structure does affect the revenue requirement for a Crown Corporation because of the effects of the tax exempt status of a Crown Corporation. However, the effect of capital structure on the revenue requirement of Hydro can easily be accommodated within the ATWACC framework. Recall that the BTWACC multiplied times the rate base gives the capital charges for an IOU. For Hydro the BTWACC is equal to the ATWACC plus a quantity to recover the difference in the before-tax embedded cost of debt relative to the after-tax market cost of debt. This procedure is discussed in more detail in Section V of this appendix.

**Q22. Please summarize the findings about the effect of debt on the cost of capital.**

A22. The after-tax overall cost of capital for a given line of business is a constant over a broad middle range of capital structures. This offers a natural way to regulate a part of a business, for which a stand-alone capital structure cannot be observed: simply base the part's after-tax weighted-average cost of capital on the average after-tax weighted-average cost of capital of a sample of publicly traded companies that are entirely or largely engaged in the line of business in question

[19] (...continued)
at the time of the switch.

(i.e., "pure plays" in that business). Details such as the difference between embedded and current interest rates can be addressed in ways discussed below.

## II. DEBT'S EFFECT ON THE COST OF EQUITY

**Q23. What determines the cost of equity capital?**

A23. The modern models of capital market equilibrium express the cost of equity as the sum of a risk-free rate and a risk premium. An example is the longest-standing and most widely used of these theories, the "Capital Asset Pricing Model" ("CAPM").[20]

**Q24. Is the theoretical discussion of the effect of debt on the cost of equity affected if the cost of capital were estimated using the discounted cash flow model instead of the risk premium model?**

A24. No. In the present context, this would be irrelevant. Here I speak not of how one estimates the cost of capital, but rather of the underlying economic forces that determine it. The Discounted Cash Flow, or "DCF," method attempts to estimate the cost of capital directly, effectively by using information on the stock itself to locate its level. The CAPM is one of the theories that predicts the nature of the risk-return tradeoff in capital markets and the relevant definition of "risk." That is, it is a theory of *why* one gets the DCF value in question. This section of my

[20] For a discussion of the CAPM model, see Richard A. Brealey and Stewart C. Myers, *Principles of Corporate Finance*, 6th Ed., New York: Irwin McGraw-Hill (2000) at 195-205.

evidence draws on models of why the cost of equity is what it is, such as CAPM, to make certain general points. It would be entirely consistent to rely on the theoretical points made here and still use a well-specified DCF model (i.e., one that fit the *actual* growth patterns investors expect, if such data were available) to estimate the cost of capital. This portion of the evidence focuses the determinants of the cost of equity capital.

**Q25. Please continue.**

A25. These models rely on the empirical fact that investors price risky securities to offer a higher expected rate of return than safe securities. The kinds of risk that matter in these models represent the sensitivity of the returns on a given security to changes in one or more fundamental risk factors. For example, the CAPM says one risk factor matters, "the market," and a stock's sensitivity to "the market," known as its "beta," is the relevant measure of its risk. The key point for present purposes is that regardless of whether a security's risk premium is determined by one or several factors, all of the models measure the kind of risk that affects the cost of capital as the sensitivity of the security's return to changes in one or more broad risk factors. That is, the kinds of risk that affect the cost of capital are measures of *variability* in rates of return.

**Q26. What does the measurement of risk as variability in rates of return mean for the effect of changes in capital structure on the cost of equity?**

A26. The addition of debt to an all-equity capital structure loads the total variability of the investor cash flows onto the equity component of capital (financial distress aside), thereby magnifying the

uncertainty per dollar of invested equity. It magnifies the part(s) of the security's variability correlated with the underlying market-wide risk factor(s) right along with the part of its variability that is unique to the security. Therefore, use of debt increases the kind(s) of risk that matter to investors and hence the cost of equity capital.

**Q27. Please explain in more detail why the cost of equity goes up with debt.**

A27. Debt adds *financial* leverage, which increases the risk and cost of capital of the firm's equity for the same reason *operating* leverage increases the overall risk and cost of capital of the total firm. As debt is added, the cost of equity rises at an increasing rate.

Both operating and financial leverage arise when investors receive the difference between variable revenues and fixed costs. Operating leverage stems from fixed operating costs, while financial leverage stems from fixed interest payments. In both cases, the fixed outflows magnifies the relative variability of investor cash flows.

**Q28. Can you provide an example of the effect of leverage on the cost of equity?**

A28. Yes. Consider Table B-3, abbreviated as Table 1 in the body of my evidence, which ignores taxes and other costs of debt for simplicity. Panel A of the table shows four alternative balance sheets for the same company. All three balance sheets have $10,000 in assets, one consisting entirely of equity, one with 20 percent debt financing, one with 30 percent debt, and one with 40 percent debt.

Panel B is an abbreviated income statement. The operating earnings are expected to be $1,000. For the purposes of this illustration, I assume that the risk of these operating earnings can be adequately described by specifying possible values $500 higher or lower, as indicated in the table. I assume also that the implied 10 percent rate of return on total assets equals the cost of capital that reflects the capital market business risk of this company. If there is no debt, equityholders bear only this capital market business risk and receive the entire operating earnings of the company.

If one-quarter, one-half or three-quarters of the company's assets are financed by debt at an 8 percent interest rate, however, bondholders have a prior claim on the first $200, $400 or $600 of operating earnings, respectively. The net income to equityholders is reduced by $200, $400 or $600 in each operating earnings case. As can be seen in Panel C, instead of expecting 10 percent plus or minus 5 percent, at one-quarter debt equityholders expect 10.7 percent plus or minus 6.7 percent. At one-half debt, equityholders expect 12 percent plus or minus 10 percent. At sixty percent debt, they expect 16 percent plus or minus 20 percent. That is, equityholders will be better off on average with debt, but only by bearing more risk.

**Table B-3**
**Example of Financial Risk**

| | Capital Structure | | | |
|---|---|---|---|---|
| | *All Equity* | *25 Percent Debt* | *50 Percent Debt* | *75 Percent Debt* |
| **Panel A: Balance Sheet** | | | | |
| Equity | $10,000 | $7,500 | $5,000 | $2,500 |
| Debt | 0 | 2,500 | 5,000 | 7,500 |
| **Panel B: Income Statement** | | | | |
| Operating Earnings | | | | |
| High | $1,500 | $1,500 | $1,500 | $1,500 |
| Expected | 1,000 | 1,000 | 1,000 | 1,000 |
| Low | 500 | 500 | 500 | 500 |
| Interest Expense | 0 | 200 | 400 | 600 |
| Income | | | | |
| High | 1,500 | 1,300 | 1,100 | 900 |
| Expected | 1,000 | 800 | 600 | 400 |
| Low | 500 | 300 | 100 | -100 |
| **Panel C: Rate of Return of Equity (Percent)** | | | | |
| High | 15.0 | 17.3 | 22.0 | 36.0 |
| Expected | 10.0 | 10.7 | 12.0 | 16.0 |
| Low | 5.0 | 4.0 | 2.0 | -4.0 |

**Panel D: Overall Expected Rate of Return (Percent)**

| | **Cost** | **Wt.** | **Prod.** | **Cost** | **Wt.** | **Prod.** | **Cost** | **Wt.** | **Prod.** | **Cost** | **Wt.** | **Prod.** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equity | 10.0 | 1.0 | 10.0 | 10.7 | 0.75 | 8.0 | 12.0 | 0.5 | 6.0 | 16.0 | 0.25 | 4.0 |
| Debt | 0.0 | 0.0 | 0.0 | 8.0 | 0.25 | 2.0 | 8.0 | 0.5 | 4.0 | 8.0 | 0.75 | 6.0 |

Note also that the increment in the cost of equity from zero to one-quarter debt (10.7 percent ! 10 percent = 0.7 percent) is less than the increment from one-quarter to one-half debt (12 percent ! 10.7 percent = 1.3 percent), which in turn is less than the increment from one-half to three-quarters debt (16 percent - 12 percent = 4 percent). This increasing increment in the cost of equity reflects the increases in risk (that is, the risk increment from plus or minus 6.7 percent to plus or minus 10 percent is greater than that from plus or minus 5 percent to plus or minus 6.7 percent, and similarly from plus or minus 20 percent relative to plus or minus 10 percent). The cost of equity goes up at an increasing rate as debt is added. This effect is illustrated in Figure 2 in the body of my evidence.

Throughout this example, the capital market *business* risk of the company as a whole and the overall cost of capital are unchanged, as verified in Panel D. The extra return to equity is compensation for the additional financial risk that equityholders bear when the company is partially debt financed.

**Q29. Please summarize these results.**

A29. The cost of capital for *equity* goes up (and at an increasing rate) as more debt is added, to reflect the additional financial risk that equityholders bear with more financial leverage. *Equity* cash flows grow more volatile as debt is added. However, factors such as taxes and financial distress aside, the overall cash flows of the company are unaffected by how the cash flows are divided among different types of securities (e.g., debt and equity). If the overall cash flows are unaffected by the addition of debt, the *overall* cost of capital will stay constant as debt is added. The total

risks investors bear as a group do not change merely because the claims on the same set of overall cash flows are split up in different ways.

## III. THE COST OF CAPITAL FOR DEBT

**Q30. Do these principles apply to the cost of capital for debt?**

A30. Yes. The cost of capital is defined the same way for debt as for equity: the *expected* rate of return in capital markets on alternative investments of equivalent risk. (See, for example, Brealey and Myers, *op. cit.*, at 548.) For default-risk-free debt – e.g., federal government bonds – that is the whole story, since the expected cash flows and the promised cash flows are identical.

However, corporate debt might default. This complicates matters in two ways:

- The odds the corporation will default or bear the costs of financial distress increase when the economy is weak and decrease when it is strong, all else equal.

- If the corporation does not default, the bondholder gets exactly the promised coupon payments and principal redemption. If the corporation does default, the bondholder gets less. The *yield to maturity* that is commonly thought of as the cost of debt is therefore an upper bound on the actual payoff bondholders *expect*.

The first factor means the *cost of capital* of a corporate bond is higher than for a Treasury bond, because the *expected* costs of financial distress are positively correlated with risks that are hard to diversify.

The second factor means that the statistically *expected* rate of return on the bond – i.e., the bond's cost of capital -- is *less than* the promised yield to maturity. Thus, the yield to maturity of a corporate bond includes a "default premium" *over and above the bond's cost of*

*capital*, as compensation to debtholders for the option equityholders have to default on the debt (instead of having to pay bondholders out of their personal assets) in the event of financial trouble. Since equityholders own the option to default and pay bondholders for it through a higher default premium in the bond's yield, a higher total variability in the value of the firm makes for a higher default premium in the firm's debt.

**Q31. Does the fact that the cost of capital for corporate debt is less than its yield mean regulatory boards are wrong to use the full return on corporate bonds in setting rates?**

A31. No, for that purpose this is a technical issue that is commonly (and, I will now show, rightly) ignored in normal practice.

It is common to use the yield to maturity as the cost of capital for debt, not the somewhat lower *expected* rate of return on the debt, which is its true cost of capital. At the same time, it is common to use the cost of equity from methods such as DCF or CAPM as the cost of equity capital. These methods will tend to understate the true cost of levered equity just a bit, for reasons that vary by method.

Specifically, the price of the stock that underlies the DCF method will equal PV(Dividends) + PV(Option to Default), where PV is the present value of the quantity in parentheses. The price of the stock is slightly higher than justified by the pure expected dividends, because of the option to default. This reduces the estimated dividend yield and hence the DCF cost of capital estimate.

Similarly, the value of the option to default dampens the estimate of non-diversifiable risk that underlies models such as the CAPM. That is, the value of the option to default goes up just a bit when the economy declines, because an economic downturn increases the odds default will be necessary. Conversely, the value of the option to default shrinks in value when the economic outlook is more rosy. Since the rest of the stock's value falls when the economy declines and rises when the economy rebounds, these effects mask part of the variability associated with the business operations themselves. The result is that the estimated "beta(s)" associated with higher levels of debt will be just a bit low. This reduces the stock's estimated risk premium and hence the CAPM's cost of capital estimate.

However, the impact of these effects can safely be ignored. Like the default premium in (investment grade) debt itself, the measurement effects for the cost of equity will be small. In fact, given the level of uncertainty associated with all estimates of the cost of equity, these effects are likely to be undetectable in any particular application. Nonetheless, they will (slightly) affect the quantity being estimated and therefore have an equivalent impact on (well-conducted) cost of equity estimates themselves on average.

The slight overestimate in the cost of corporate debt due to inclusion of the default premium will therefore tend to be offset by a slight underestimate in the cost of equity. The weighted average of the two will therefore be off at most by an amount that is small in comparison with the size of the default premium, which itself is small for investment grade debt. Therefore, even cost of capital experts who consider these effects in some contexts find them irrelevant in standard regulatory applications.

## IV. ISSUES RAISED BY THE AEUB DECISION

**Q32. What do you wish to discuss concerning AEUB *Decision U99099*?**

A32. Here this section addresses the concerns raised by the AEUB over use of market-value weights in detail, and which may be of interest to the Board as it determines whether to adopt my recommendation of relying upon the ATWACC.

The AEUB decision accepted that the ATWACC principles govern the returns of unregulated firms, and adopted ATWACC as a (still subordinate) tool to arrive at a fair return for TransAlta Utilities ("TAU"). However, based in part on analyses introduced for the first time on brief, without the opportunity to introduce a response from an expert in the area, the ATWACC the AEUB used was calculated with book-value, not market-value, weights.

There is nothing inconsistent about using market values to estimate the cost of capital and then applying that rate of return to a book-value rate base – indeed, that is what is done routinely in estimating the cost of equity. It is just as important to do so for estimating the ATWACC.

**Q33. What issues raised in the AEUB's *Decision U99099* need to be addressed?**

A33. I believe two interrelated issues need clarification: (1) if the ATWACC is flat, as I claim, why can some graphs of ATWACC against the debt ratio show a downward slope, and (2) should book- or market-value capital structure weights be used to calculate the ATWACC for companies regulated on a book-value rate base?

*(a) Measured ATWACC vs. the Debt Ratio*

**Q34. What is the answer to the first of these questions?**

A34. There are a number of forces responsible for a downward slope of ATWACC against the debt ratio. They may be broadly grouped into two categories: factors that distort the comparison, and factors that are left out of the measured ATWACC. To put these factors in context, however, it is useful first to review the facts established by careful research.

For example, the study by Carl Kester, "Capital and Ownership Structure: A Comparison of United States and Japanese Manufacturing Concerns," *Financial Management*, Vol. 15:5-16, (Spring, 1986), documents that in both countries, it is often the most profitable firms in individual industries that have the lowest debt ratios. Yet the most profitable firms have the most to gain from the tax advantage of debt if it is a real advantage, and the most profitable firms in an industry presumably tend to be the best managed.

Also, the study by Lakshmi Shyam-Sunder and Stewart C. Myers, "Testing static tradeoff against pecking order models of capital structure," *Journal of Financial Economics* 51, No. 2 (February 1999), 219-244, demonstrates that firms do not tend towards a target capital structure, or at least do not do so with any regularity, and that studies that seemed to show the contrary actually lacked the power to distinguish whether the hypothesis was true or not. In the words of that paper at page 242, "If our sample companies did have well-defined optimal debt ratios, it seems that their managers were not much interested in getting there."

In addition, this conclusion is further confirmed by Eugene F. Fama and Kenneth R. French, "Taxes, Financing Decisions and Firm Value," *The Journal of Finance*, 53, No. 3 (June

1998), 819-843. This article is an exhaustive study based on over 2000 firms for 28 years (1965 to 1992, inclusive). They conclude at page 841, "Our tests thus produce no indication that debt has net tax benefits." They view their results as generally supportive of the work by Professor Myers, which views the tax effects of debt as relatively insignificant.

These results are not *theory*; they are empirical *fact*. Firms do not behave as if debt makes any material difference to value. To conclude that more debt does add more value, the implication of belief in a downward sloping ATWACC for any given firm, is to conclude that corporate management in general is either blind to an easy source of value or otherwise incompetent.

**Q35. Why does a downward sloping ATWACC for a particular firm imply more debt adds more value?**

A35. The standard investment evaluation methodology using ATWACC is to discount all-equity cash flows (i.e., the cash flows investors would get if they used no debt) at the ATWACC, which builds in whatever advantage there is to modest amounts of debt. The ATWACC used needs to be carefully matched to the risk of the investment in question. For example, if using the company's ATWACC, the project needs to be of identical risk to the company's other investments. But if more debt meant the appropriate ATWACC were lower, one could always get a more valuable project simply by adding debt. Firms would spend a lot of time worrying about optimal capital structure, and we would see firms moving aggressively to reach their optimum. We do not. The research reveals the exact opposite. Thus, if the right ATWACC to

use in an investment valuation really went down as debt was added, all of the firms behaving as though capital structure does not matter over a broad middle range are being foolish.

**Q36. Please describe the first type of force you said was responsible for the downward slope, "factors that distort the comparison."**

A36. Estimation of the cost of capital is an inherently imprecise exercise. Part of this imprecision is statistical, which may give rise to anomalous comparisons in any particular case, and part is due to the inevitable shortfall of a real sample from the ideal sample of "pure plays" identical to the company in question. However, it is also a general feature of cost of capital estimation. Therefore the sample companies in reality will have somewhat different ATWACCs not because of capital structure, but because of differences in capital market *business* risk.

All else equal, less capital market business risk means the broad middle range of capital structures over which the ATWACC is constant will contain more debt on average. This in turn will result in a negative correlation between measured ATWACC and the debt ratio, not because more debt lowers the ATWACC, but because a lower ATWACC tends to lead to more use of debt. That is, the negative correlation may be real, but the causality the exact opposite of that hypothesized in the AEUB's decision.

**Q37. Are such distortions alone enough to explain a negative correlation between measured ATWACC and the debt ratio?**

A37. No, in my view they are not. Instead, the ATWACC measured at higher debt ratios understates the ATWACC that would be ideal to use in capital budgeting and in rate regulation. The reason is that some of the non-tax effects of excessive debt discussed above may be hard to detect and not show up in cost of capital measurement This is handled in capital budgeting by strict prohibitions against artificially inflating the debt ratio when evaluating a project. For example, Brealey and Myers, *op. cit.* at 551 caution against such adjustments under the subtitle, "Mistakes People Make in Using the Weighted-Average Formula." This implies that the non-tax costs of excessive debt are valued by not reducing the ATWACC for tax effects beyond those embodied in the ATWACC value estimated from the market. Rate regulation using ATWACC needs to adopt similar standards.

**Q38. Why do you say the ATWACC at high debt ratios understates the ideal number for use in rate regulation?**

A38. The same logic used in capital budgeting also applies to rate regulation. For regulatory purposes, the non-tax costs of excessive debt would wrongly be ignored if regulators assumed the ATWACC would continue to go down as debt was added. Those costs, discussed above, consist of such factors as reduced financial flexibility and a higher risk the firm may have to bear the costs of financial distress. Such factors may not show up when the cost of capital is estimated, but they do not show up as line items in a regulated company's revenue requirement, either. There is no place a board can point to and say, "well, we're adding to the debt ratio without holding the ATWACC constant, but that's okay because we've added X dollars for the

costs of excessive debt to the revenue requirement." If anything, this factor implies that the true ATWACC for project valuation or regulatory purposes is somewhat *higher* than the simple average of the industry sample ATWACCs, but this refinement cannot be made with available estimation techniques.

Firms consistently *behave* as if such non-tax costs matter more than the net tax advantage of debt. If anything, the logic of such behavior is *stronger* in Canada than in Japan or the U.S., since equity is at a bigger a corporate tax disadvantage in those countries than in Canada (i.e., Japan and the U.S., unlike Canada, have no form of dividend tax credit at the personal level to offset corporate taxes on equity). To accord with these facts, the Board should recognize the implications of that behavior and adopt a similar standard for rate regulation. In my view, the best way to do that is to measure the ATWACC from the best sample available and to treat that number as independent of capital structure.

*(b) Market vs. Book Capital Structure Weights*

**Q39. Should book value weights be used in the estimation of the ATWACC for firms regulated on a book-value rate base?**

A39. No, that would be economically incorrect.

**Q40. Why?**

A40. The cost of capital is determined in the market for regulated and unregulated firms alike. Regulated shareholders will be unhappy if the market value of their shares falls, even if the book

value is constant.[21] They will be indifferent to a fall in book value as long as the market value is unaffected. In this they are no different from any other group of shareholders.

**Q41. Would use of market-value weights to calculate ATWACC for rate-regulated companies be circular or lock in an excessive return?**

A41. I address these issues in the body of my evidence. The answer is no, for reasons explained there.

**Q42. Can you clarify the issue of how beta changes with changes in market leverage?**

A42. I can try. To start, recognize that the magnifying effect of leverage on the true beta has to be true for any individual firm.

For example, consider a firm that rents out buildings in a given geographic market and has mortgages equal to 60 percent of the buildings' market values. A 20 percent decline in building prices in that market wipes out 50 percent of the firm's equity stake (rate of return = -50 percent). If the owner had only borrowed 40 percent, with 60 percent initial book equity (*or* if an increase in the market value of the buildings had made the owner's initial book equity of 40 percent grow to a market value of 60 percent), a subsequent 20 percent decline in building prices would "only" wipe out one-third of the firm's equity (rate of return = -33 percent).

Note that it does not matter whether the market equity ratio is high because the firm borrowed less initially or because the market value has grown to be larger than the book value.

[21] For example, TAU's parent's shareholders got a roughly negative 20 percent return on market value in November 1999. This was painful but the company's book value was unaffected.

The percentage rate of return relative to the fluctuation in the value of the underlying assets depends on the market equity share, not the book equity share. Such leverage-induced magnification of variable returns on assets into even more variable returns on equity is the essence of financial risk. The degree of variability, and hence beta, clearly depends on the *market* share of equity.

Another such example is borrowing on margin to invest. Suppose two investors hold exactly the same portfolios, both of which own shares in companies regulated on a book-value rate base. Suppose the true betas against the stock market for these regulated company shares are all 0.5. Suppose one investor makes the investment with 100 percent of his or her own equity, while the other borrows 50 percent of the money and invests 50 percent of his or her own money. The returns on these portfolios thus both depend directly on the performance of the overall market, through the beta of the regulated company portfolio. A 10 percent decline in the market lowers the value of the regulated company portfolio by 5 percent on average, because the regulated company beta is 0.5. This wipes out 5 percent of the equity of the first investor, but wipes out 10 percent of the equity of the second investor. Leverage has doubled the beta of the second investor until it matches that of the market, even though the beta of the regulated company portfolio is the same. If the investors in question were themselves publicly traded mutual funds rather than individuals, the true beta of the first would equal the beta of the regulated company portfolio, while that of the second would be twice as large. The fact that the companies are regulated on book value changes nothing about the impact of leverage on beta, which is measured in the market, not on the books.

**Q43. So why doesn't this effect always show up when someone plots beta against the debt ratio?**

A43. The forces outlined above are at work. Part of the problem is in measurement (e.g., the perverse effect of bad news for a company in a month when the market rose turning a major loss in market value turning into a reduction in beta as well). Part of the problem is the "decoupling" of beta from the market that accompanies regulatory transitions, financial distress and mergers. And part of the problem is that some of the costs of excessive leverage don't show up in measured beta, leading to an underestimate of the appropriate ATWACC for capital budgeting and regulation when sample companies with relatively high debt ratios are used.

But none of these forces imply it would be circular to use market-value weights to calculate ATWACC for a company regulated on a book-value rate base. The cost of capital is just as much a market-driven parameter for regulated companies as it is for unregulated firms. Use of book-value weights to calculate a regulated company's ATWACC when the market-to-book ratio is greater than one definitely underestimates the regulated company's true cost of capital.

**Q44. Would use of market-value weights to calculate ATWACC imply an abandonment of regulation based on book value?**

A44. Absolutely not. The ATWACC is a *rate of return*. It is still applied to a book-value *rate base*. The only question involved in the choice of ATWACC weights is how to understand what the market is telling us about the rate of return investors require. The risk of shares depends on

market values, not book values, so market values need to be used to calculate the cost of capital. (If this were not true, book value rather than market value would be the appropriate denominator for the dividend yield in the DCF model!) Regulation looks to market values for every other part of the rate of return calculation, and it should look to market values for the weights to use to calculate ATWACC as well. Then, with the overall cost of capital correctly calculated based on market evidence, it can be applied to the book value rate base in the traditional way.

## V. RELATIONSHIP TO THE TRADITIONAL REGULATORY APPROACH

**Q45. How does your recommendation that the Board make use of the constancy of overall after-tax weighted-average cost of capital over a broad middle range of capital structures relate to the traditional way of setting the allowed rate of return on a rate base?**

A45. I make two recommendations for the Board to consider: (1) to make explicit use of the constancy of the after-tax weighted-average cost of capital over a broad middle range of capital structures to improve the accuracy of cost of equity/capital structure determinations; and (2) to adopt the after-tax weighted-average cost of capital as its primary rate of return standard as it enters the new world of deregulated generation. If the Board wished, the first of these recommendations could be adopted without any change in the mechanics of traditional ratemaking, by simply using the principles to make sure that the cost of equity and the capital structure the Board selects are internally consistent with the right overall after-tax weighted-

average cost of capital. The second would require some change in ratemaking mechanics, but the payoffs (discussed in the body of my evidence) would be a simpler set of procedures, and an improved ability to relate regulated returns to the rate of return standard used in the rest of the economy.

## A. IMPROVEMENT IN ACCURACY

**Q46. Please describe exactly how your first recommendation could be adopted without changing traditional rate making mechanics.**

A46. In my experience, the basic approach to determining the (after-tax) equity return to be applied to the rate base ordinarily looks something like this:

**Table B-4A**
**Ordinary Approach to Determination of After-Tax**
**Weighted Equity Return on Rate Base**

<table>
<tr><td rowspan="3">1. Select Sample of Comparable Companies</td><td>2a. Estimate Sample's Cost of Equity</td><td>3a. Consider Other Relevant Information on the Cost of Equity</td><td>4a. Determine Allowed Rate of Return on Equity</td><td rowspan="3">5. Combine the Equity Return and Equity Share to get the Weighted Equity Return on Rate Base</td></tr>
<tr><td colspan="3">No Explicit Interaction Between<br>Cost of Equity and Equity Share of Capital</td></tr>
<tr><td>2b. Consider Sample's Equity Share of Assets</td><td>3b. Consider Other Relevant Information On Capital Structure</td><td>4b. Determine Equity Share of Rate Base</td></tr>
</table>

Once Step 5 is complete, the weighted returns of the other forms of capital are added to the equity return, the sum is adjusted for taxes if any, and the resulting pre-tax return is applied to the rate base. Of course, the precise order of the eventual steps may vary from place to place (e.g., the weighted equity return may be adjusted for taxes before the components are added up, or the allowed return on equity may be adjusted for taxes even before the equity share weight is applied). Nonetheless, the basic result is the same.

The key danger in this approach is that the cost of equity and the equity share of the rate base are specified without an explicit effort to ensure internal consistency between those values. However, since the cost of equity depends fundamentally on the amount of financial risk equityholders bear (i.e., on the capital structure), this independence creates the risk of error or

internal inconsistency. The regulated entity might inadvertently end up with a materially higher or lower overall return than the comparable-risk sample companies. That is, if the sample matches the company in question well, its true weighted-average after-tax cost of capital should be the same across the sample (although variations will exist in estimated values due to slightly different business mixes and random estimation errors). However, the true costs of equity for these firms will *not* generally be the same, even if their business risk is *identical*, because the cost of equity depends on both capital market business risk and financial risk. The sample companies typically have different capital structures and so expose their shareholders to different levels of financial risk. Focus on the overall return controls for differences in capital structure and therefore is the most reliable way to interpret the risk information the sample companies provide.

**Q47. How would your recommendation prevent problems caused by differences in financial risk among the sample companies and between the sample companies and the regulated company?**

A47. Explicit consideration of the sample's after-tax weighted-average cost of capital would ensure that whatever the ratemaking capital structure used, the return on equity would reflect the corresponding amount of financial risk. An approach that uses the after-tax weighted-average cost of capital to ensure consistency between capital structure and equity return, but which otherwise is completely conventional, could look something like this:

**Table B-4B**
**Integrated Approach to Determination of After-Tax**
**Weighted Equity Return on Rate Base**

| 1. Select Sample of Comparable Companies | 2. Calculate Sample's Overall After-tax Weighted Average Cost of Capital | 3. Consider Other Relevant Information on Overall Capital Market Business Risk of the Regulated Company | 4. Determine the Resulting Overall After-tax Weighted-Average Cost of Capital that Should Be Allowed | 5. Specify the Equity Share of Assets for Ratemaking and Calculate the Associated Cost of Equity Given the Overall Return | 6. Combine the Equity Return and Equity Share to get the Weighted Equity Return on Rate Base |
|---|---|---|---|---|---|

Note that the end result of Step 6 in Table B-4B is exactly the same as the end result of Step 5 in Table B-4A, and ordinary procedures can be followed from this step forward. However, the Table B-4B approach prevents the unintended windfalls for investors or customers that can be caused by unanalyzed differences in the level of financial risk among the sample companies or between the sample and the regulated company in question.

## B. IMPLEMENTATION METHOD FOR HYDRO'S CAPITAL CHARGES

**Q48. How could the Board implement your second recommendation, direct use of the after-tax weighted-average cost of capital?**

A48. For Hydro the difference between its capital charge and the ATWACC is the need to recover the before tax cost of its embedded debt. Recall that the ATWACC is estimated on the basis of the after-tax market cost of debt, so to calculate the BTWACC for Hydro simply requires an addition to the ATWACC to recover the difference between the embedded cost of debt and the after-tax market cost of debt times the amount of debt in the capital structure.

**Table B-5**
**Determination of Overall Pre-Tax Return on Rate Base Using the After-Tax Weighted-Average Cost of Capital**

| 1. Select Sample of Comparable Companies | 2. Calculate Sample's Overall After-tax Weighted-Average Cost of Capital | 3. Consider Other Relevant Information on Overall Capital Market Business Risk of the Regulated Company | 4. Determine the Resulting Overall After-tax Weighted-Average Cost of Capital that Should Be Allowed | 5. Add the Weighted Difference between Embedded Pre-tax Debt and Market After-tax Debt Costs |
|---|---|---|---|---|

Note that Steps 1 to 4 in Table B-5 are identical to those in Table B-4B. Step 5 in Table B-5 converts the weighted market after-tax market costs of debt to the weighted pre-tax embedded costs. Because Hydro pays no income taxes, there is no need to gross up the result from Step 5 for taxes. Please note also that Step 5 in Table B-5 is the end of the process of setting the pre-tax return on the rate base, while several steps still remain after those in Tables B-4A and 4B. Effort can be saved because there need be no concern over the "right" share of equity, since the

overall number automatically embodies a cost of equity that corresponds to the financial risk implicit in any given capital structure.[22]

**Q49. Can you provide a quick numerical example of the process you describe in Table B-5?**

A49. Yes. Steps 1 to 4 essentially amount to deciding on the market-based after-tax weighted-average cost of capital the Board concludes is appropriate. For example, suppose the Board accepts the ATWACC standard, considers all factors it finds relevant, and concludes that the overall after-tax weighted-average cost of capital is 5.89 percent as implied by Ms. McShane's recommendation. Exhibit No. MJV-5 shows the calculations to determine the BTWACC for Hydro corresponding to an embedded cost of debt is of 8.35 percent, a market cost of debt also of 8.35 percent, the marginal corporate tax rate 40 percent used in estimating the ATWACC, the share of debt in capital structure of 83.18 percent. Then Step 5 to calculate BTWACC for Hydro is to add [8.35 percent - (8.35 percent x (1 - .40))] times 83.18 = 2.78 percent to the after-tax weighted-average cost of capital. The result of 8.66 percent multiplied times the ratebase gives the capital charges for Hydro. Note that the result of 8.66 percent is higher than requested by the Company in this proceeding because it assumes that the appropriate market return on Hydro's equity is the 11.25 percent Ms. McShane recommends instead of the three

[22] Of course, if a regulated company for some reason chose to operate outside the broad middle range of capital structures, its actual overall after-tax weighted-average cost of capital could be higher than necessary. That need not concern its customers, however, if the Board has granted an overall return based on the minimum-cost value within the broad middle range.

percent the Company is requesting. Using the three percent return on equity, the result is 7.40 percent as requested by the Company and as shown on Exhibit No. MJV-1 in the first row..

**Q50. Does this complete your discussion of the impact of capital structure on the cost of capital?**

A50. Yes, it does.