The Churchill Falls Memorandum of Understanding (MOU) and the Need to Understand Financial Concepts such as the Present Value(PV), the Net Present Value(NPV),the Payback Period, and the Distinction between Nominal and Real Dollars

Why are they relevant, How do we use them, and how are they calculated?

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The MOU is proposing new infrastructure projects that have long lifetimes, say 50 years. Spread out over their expected lifetime, the projects will incur costs initially and over time, but they will eventually generate revenues once the development starts producing, transmitting, and selling electricity. At a minimum, for these investments to be viable, the cumulative sum of revenues would have to exceed the cumulative sum of costs. If this minimum feasibility criterion were not consistently meet, the investor would find his/her well-being continuously falling and the investment strategy would be unsustainable.

A simple investment criterion is the **payback period**, defined as the year in which the cumulative project revenue exceeds the cumulative project costs. Everything else the same, the shorter the payback period, the more attractive is the investment project. This simple investment criterion recognizes the need to payback scarce capital invested in the project.

Even if cumulative revenues exceeds cumulative costs within an acceptable time, it is important to appreciate that a dollar today is not equivalent to a dollar received in fifty years, given the **impact of inflation, people's marginal rate of time preference, and the opportunity costs of investment funds**.

Inflation is a process by which the prices of goods and services increase over time and reduces the purchasing power of money or given amount of income. This, in turn, affects households' current savings and borrowing decisions. Inflation also influences the investment decisions of private sector firms and crown corporations such Newfoundland and Labrador Hydro (NLH) and Quebec Hydro.

In the presence of general inflation, it will take more dollars to purchase the same quantity of goods and services in the future. By way of illustration, suppose that a product or service costs $100 currently is exposed to a 2% annual inflation for one year. The cost of that product or service next year will $102, comprised of the current price ($100) plus the amount increase due to inflation (2% * $100 =$2).

If this inflation persists for 5 years, then the price for the product or service will be $110.41, which is the impact of inflation price next 5 years ($10.41) plus the original price of $100.

To derive the price in 5 years, the following simple formula is utilized:

$$Price\ in\ 5\ years = (1 + inflation\ rate)^5 * Original\ Price$$

Or, the formula can be written more concisely as:

$$P_t = (1 + \pi)^t (P_0)$$

where P_0 *= the original price (i.e., $100) in year "0" which is the base year*
P_t *= is the price of the product or service in Year "t" (i.e., $110.41)*
π *= is the annual rate of inflation (i.e. 2%) and*
t = the number of years that have occurred since the base year

In this example, P_t (i.e., $110.41) is the future value of P_0 (i.e., $100) in 5 years time give an annual rate of inflation of 2%. Alternatively, P_0 can be thought of the **Present Value** of P_t and can be solved by applying te following formula:

$$P_0 = \frac{P_t}{(1 + \pi)^t}$$

For example, $200 in 5 years has a PV of $181.15. In this case, $181.15 can be thought of as the real purchasing power of $200 in 5 years or **constant dollar value** or the **real dollar value** and $200 is the **nominal value** in 5 years time.

The **marginal rate of time preference** is a concept that even in the absence of inflation, a dollar today is valued more highly than a dollar tomorrow. This is manifested in the real world by a positive interest rate on risk-free assets, such as government saving bonds, which exceeds the rate of inflation to compensate the holder of the asset for having to wait until the asset matures, to use the money invested in the asset.

In the context of the MOU, a significant amount of the revenue expected to flow to NLH, and eventually to the provincial treasury, will have to be discounted to reflect inflation and the marginal rate of time preference. That is, to reflect that money received in later years will have less purchasing power and will be value lower than money received earlier or money invested earlier.

The private sector or the public sector **weighted opportunity costs of funds** is the **discount rate** utilized in calculating the financial viability of investment opportunities. It is the discount rate utilized in calculating the **Net Present Value** of the project, a concept which is explained below.

For a private sector funds, there are two basic ways to fund investment projects: (1) **debt finance** by borrowing the funding through bond issues or loans from financial institutions at whatever the prevailing interest happens to be and (2) **equity finance** by utilizing retained earnings to fund the investment which has an implicit costs of foregone earnings on other investments that are delayed or cancelled. The crown corporation will fund projects with some combination of debt finance (i.e., through bond issue) or equity finance (i.e., retained earning or through direct government transfer to the crown corporation).

A simple illustration of the weighted average costs of capital is given by the following formula:

$$r = r_d * s_d + r_e * s_e$$

where "r" is the weighted average opportunity cost of funds, "r_d" is the cost of debt "s_d" is the share of the project funded by debt, "r_e" is the implicit costs of equity and "s_e" is the share of the project funded by equity

The relationship between **real or constant dollar values and nominal values** are that nominal prices and costs are expressed in dollars of the day or current value in the year in which they are being considered and real or constant dollar values have inflation removed. Where "π"is the rate of inflation, The relationship between real prices (P_0) and nominal prices (P_t), real revenue (R_0) and nominal revenues (R_t), real costs (C_0) and nominal Costs (C_t), and real discount rate "r," the nominal discount rate "i" and the assume annual rate of inflation "π" are illustrated by the following:

$$P_t = P_0 * (1+\pi)^t \quad P_0 = \frac{P_t}{(1+\pi)^t}$$

$$C_t = C_0 * (1+\pi)^t \quad C_0 = \frac{C_t}{(1+\pi)^t}$$

$$R_t = R_0 * (1+\pi)^t \quad R_t = R_0 * (1+\pi)^t$$

$$(1+\mathrm{i}) = (1+\mathrm{r}) * (1+\pi)$$

Given the nominal discount rate (5.822%) and the annual rate of inflation (2%) assumed in the MOU, the implied real discount rate is 3.75%. Everything else the same, the lower is the discount rate, the higher will be the calculated NPV and the implied profitability of the project.

The **Net Present Value (NPV)** is an investment concept that compares the difference the cumulative present value of costs and compares them to the cumulative present value of revenues. The project is viable if the cumulative present value of revenues exceeds the cumulative present value of costs. This is illustrated as follows:

$$\text{Cum PV of Revenue} = \sum_{t=0}^{T} \frac{R_t}{(1+i)^t}$$

$$\text{Cum PV of Cost} = \sum_{t=0}^{T} \frac{C_t}{(1+i)^t}$$

$$NPV = \sum_{t=0}^{T} \frac{R_t - C_t}{(1+i)^t} \Rightarrow \sum_{t=0}^{T} \frac{R_0 - C_0}{(1+r)^t}$$

The same value for the NPV is derived whether real value are used with the real discount rate or nominal values are used with the nominal discount rate.

The higher the NPV, the more profitable is the investment project being considered. However, the credibility of the estimates is contingent on the credibility of the projected revenues, projected costs and the credibility assumed discount rate utilized.