Capital budgeting with taxes and inflation

1. Taxes

In most capital budgeting problems, income taxes play an important role because they affect both the amount and the timing of cash flows.

1.1 Tax Policy Affects Business Decisions

Taxation is a key instrument for implementing the policies of any government at any level (local, state, or federal). By taxing activities differentially, governments can encourage certain activities and discourage others:

Suppose our benchmark is an asset whose returns are taxed fully each year at ordinary rates. That is, tax is not deferred on any part of the economic gain that accrues from holding the asset. A fully-taxable bond that is default-free, the interest rate on which is set to market rates each period, is an example of such an asset. The interest earned on the bond is fully taxable each year. Moreover, there are no changes in the economic value of the bond over time with which to contend. We would then refer to investments that are taxed more lightly than fully-taxable bonds as tax-favored investments and those that are taxed more heavily as tax-disfavored investments.

Investments may be granted one or more of several types of tax-favored status, including

- full tax exemption (e.g., municipal bonds in the U.S.);
- partial exemption (e.g., capital assets in most countries);
- tax credits (e.g., investment tax credit, targeted jobs credit, alcohol fuel credit, research and experimental credit, low-income housing credit, energy investment credit, payroll tax credit, and rehabilitation investment credit);
- tax deductions permitted at a rate faster than the decline in economic value of the asset (e.g., accelerated depreciation on
business property and immediate expensing of research and experimental costs, advertising expenditures, and personnel costs incurred to expand to new markets); and

- taxable income permitted to be recognized at a rate slower than the increase in the economic value of the asset’s cash flows (e.g., most assets that appreciate in value).

Similarly, there are many sources of tax-disfavored treatment. These include:

- special tax assessments (e.g., Windfall Profits Tax on oil, import duties, and excise taxes);

- taxable income recognition at a rate faster than income is earned (e.g., risky bonds, where the high coupon rate received is fully taxable even though it includes a default premium that, economically, represents a return of capital rather than interest income); and

- tax deductions at a rate slower than the decline in economic value (e.g., non-amortizable goodwill or trademarks that have finite economic lives).¹

The U.S. federal government has made frequent and dramatic changes in tax policy in the past. Changes in tax rules induce changes in the rates of return of various projects to different classes of investors. In turn, the prices of assets change, the organizational forms of business ventures change, and the optimal pairing of investors to investments changes.

1.2 Tax Amortization

Tax codes contain rules that prescribe the manner in which costs can be deducted from revenues over time to calculate taxable income in each reporting period. Certain expenditures may be deducted immediately (e.g., advertising); others may be deducted over time (e.g., the cost of a building); and some are not deductible at all (e.g., the cost of land). The tax rules resemble Generally Accepted Accounting Principles (GAAP), but there are important differences.

Tax laws and regulations prescribe:

• the amount of a cost that may be amortized;
• the time period over which to amortize the cost;
• the method of amortization; and
• the timing of revenue recognition.

These tax rules often differ from the corresponding rules under GAAP. This gives rise to differences between income under GAAP and income for tax purposes.

The depreciation charge appearing on financial statements prepared for external reporting purposes is a non-cash expense. GAAP depreciation is irrelevant in a cash flow analysis. Depreciation allowed by a taxing authority as a deduction in determining net income subject to taxes reduces tax payments and thus represents a cash flow. The tax-savings effect of depreciation has a present value that depends upon the depreciation method employed.

1.2.1 Sum-of-Years’-Digits method (SYD)
Depreciation rate in year \( k = \frac{n-k+1}{S_n} \), where \( S_n = \frac{(1+n)^n}{2} \). This rate is applied to the original cost.

1.2.2 Double-Declining-Balance method (DDB)
Twice the straight line depreciation rate, applied to the declining balance. No adjustment is made for the salvage value. Similarly, 150%-DB refers to 1.5 the straight line (SL) depreciation rate, applied to the declining balance.

1.3 Alternative Minimum Tax (AMT)
In the United States, the corporate AMT is a second tax calculation, parallel to, yet separate from, the regular tax calculation. The AMT calculates an alternative minimum taxable income (AMTI) by adjusting the regular taxable income for certain tax preference items and “AMT adjustments.” AMTI differs from regular taxable income (TI). Two important adjustments are:

• inclusion of a portion of accelerated depreciation in AMTI; and,

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2 If there were no differences between income for tax purposes and income under GAAP, GAAP taxes expense would equal taxes payable. There would never be deferred tax debits or credits on the balance sheet.
• restatement of revenues from long-term contracts according to the percentage completion method rather than the completed contract method.

Corporate tax liability is equal to the larger of regular income tax \( (TI \times \text{corporate tax rate}) \) and the alternative minimum tax \( (AMTI \times \text{AMT tax rate}) \).

1.4 Tax Rates

Detailed information on current U.S. tax rates is available from:
http://www.smbiz.com/sbrl001.html

1.5 Summary

In capital budgeting problems, note the following:

• Cash flows representing revenues and expenses must be stated \textit{net of tax} in any cash flow analysis.

• To encourage investment in income producing assets, some tax codes provide for a tax credit on some investments. The investment tax credit (ITC) should be included as part of the current cash flow because the ITC reduces the cash outflow needed to acquire an asset.

• Accountants commonly speak of three values for an asset: its book value, market value, and tax basis. Assets whose tax basis differs from market value on the disposal date trigger tax-related cash flows (i.e., capital gains or losses and recapture) that should be included in capital budgeting analyses. Assets whose book value differs from market value on disposal date trigger gains or losses for financial accounting purposes that should not be included in capital budgeting analyses of cash flows.

2. Inflation

Rates of return can be expressed in pre-tax or after-tax terms. After-tax cash flows should be discounted at an after-tax rate of return. In an inflationary environment we distinguish between:

\textit{Real Dollars}: The amount the future cash flow will be if the inflation rate is zero. [If there is inflation, then nominal the cash flow will be higher.]
Nominal Dollars: The amount the cash flow will be, allowing for inflation. This is the actual dollars to be received at a future date.

The cash flows and the cost of capital can be specified either (i) in nominal terms with an allowance for inflation or, (ii) in real terms. In order to complete an accurate discounted cash flow analysis, both the dollars and the discount rate must be specified in the same terms (either real or nominal).

Because tax amortization is always stated in nominal terms, that amount must be converted into real terms when doing an analysis in real terms (but not when doing an analysis in nominal terms).

Some notation is useful in describing the relationships among before- and after-tax rates of return both in real and nominal terms. Let:

- $i$ be the rate of inflation,
- $t$ be the tax rate,
- $R_n$ be the nominal pre-tax rate of return,
- $r_n$ be the nominal after-tax rate of return,
- $R_r$ real pre-tax rate of return, and
- $r_r$ real after-tax rate of return.

Note that (1) nominal rates or return are denoted by a subscript $n$ and real rates are denoted by a subscript $r$, and (2) pre-tax rates are denoted by a capital $R$ while after-tax rates of return are denoted by a lower case $r$. Then a consistent set of relationships among these variables is as follows:

\[
R_n = (1 + R_r)(1 + i) - 1
\]
\[
r_n = (1 + r_r)(1 + i) - 1
\]
\[
r_n = R_n(1 - t)
\]
\[
r_r = R_r(1 - t) - \frac{it}{1 + i}.
\]

The first two relationships can be summarized as:

\[
\text{Nominal rate} = (1 + \text{Real rate}) \times (1 + \text{Inflation rate}) - 1,
\]

where both the nominal and real rates are either before-tax rates or after tax rates. The third equation says

\[
\text{After-tax nominal rate} = \text{Before-tax nominal rate} \times (1 - \text{Tax rate}).
\]
The fourth equation is the most complicated and the least likely to be encountered in practice. It says that

\[
\text{After-tax real rate} = \text{Before-tax real rate} \times (1 - \text{Tax rate}) - \text{Inflation effect}.
\]

The inflation effect, \( \frac{it}{(1 + i)} \), is attributable to the fact that taxes are levied on nominal returns. So, when inflation is high, the nominal return is higher, and taxes expressed as a fraction of the real return are higher.\(^3\) Hence, the real cost of taxes is higher than when inflation is low.

**Example**

A machine costs $18,000 and has a 3-year life. It will be depreciated on a straight line basis. It produces before-tax nominal cash flows of $9,540 in year 1, $10,112 in year 2, and $10,718 in year 3 (or, in real terms, $9,000 a year). The firm’s tax rate is 50% and the inflation rate is 6%. The firm has an alternate project available that will yield a real pre-tax return of 20%.

**Required:** Calculate the NPV using nominal terms and real terms. Do you get the same NPV’s?

**Answer:** Provided consistent definitions of returns are used, the same present value obtain, as the calculations below illustrate. The real pre-tax rate of return, \( R_r \), is 20%. Discounting of after-tax nominal flows is done at the nominal after-tax rate. Discounting of after-tax real flows is done at the real after-tax rate. The pre-tax nominal rate of return is

\[
R_n = (1 + R_r) \times (1 + i) - 1
= (1 + 20\%) \times (1 + 6\%) - 1
= 27.2\%.
\]

The preceding calculation is an illustration of how the nominal pre-tax rate of return can be calculated from the real pre-tax rate of return and the inflation rate. In practice, pre-tax rates of return are easier to observe and

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\(^3\) Here is an more detailed interpretation of \( \frac{it}{(1 + i)} \). Relative to an inflation rate of 0%, an inflation rate of \( i \) implies that nominal tax payments are higher by \( it \) dollars per nominal dollar invested, or \( \frac{it}{(1 + i)} \) per real dollar invested.
measure than real rates of return or rates of inflation. Thus, one can usually skip this first step and work directly with the nominal pre-tax rate of return observed in the marketplace. Also mainly as an exercise, we compute the after-tax real rate of return.

Nominal after-tax rate = \( r_n \)
\[
= R_n (1 - t)
\]
\[
= 27.2\% (1 - 50\%)
\]
\[
= 13.6\%
\]

After-tax real rate = \( r_r \)
\[
= R_r (1 - t) - \frac{it}{1 + i}
\]
\[
= 20\% (1 - 50\%) - \frac{6\% \times 50\%}{1 + 6\%}
\]
\[
= 7.17\%.
\]

1. **Nominal terms (This is the preferred method.)**

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow net of taxes</td>
<td>4,770</td>
<td>5,056</td>
<td>5,359</td>
</tr>
<tr>
<td>Tax saving from depreciation</td>
<td>3,000</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Total</td>
<td>7,770</td>
<td>8,056</td>
<td>8,359</td>
</tr>
<tr>
<td>Present value factor at 13.6%</td>
<td>0.8803</td>
<td>0.7749</td>
<td>0.6821</td>
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<tr>
<td>Present value</td>
<td>6,840</td>
<td>6,243</td>
<td>5,702</td>
</tr>
</tbody>
</table>

Total PV = $18,785; so NPV = $785.

2. **Real Terms**

The cash flows given above in real terms are $9,000 per year (e.g., $9,540(.9434) = $9,000). In order to put the nominal depreciation deductions into real terms they must be discounted at the inflation rate.

Real depreciation deduction year 1 = $6,000(.9434) = $5,660
Real depreciation deduction year 2 = $6,000(.8900) = $5,340
Real depreciation deduction year 3 = $6,000(.8396) = $5,038
3. **General Remarks**

The basic discount rate we use in capital budgeting is the after tax risk-adjusted rate of return, \( R \). This rate varies with risk from project to project; the higher the risk, the higher must be \( R \). Thus, the divisions or other subunits within an organization should not necessarily use the same discount rates.

A general rule for evaluating capital projects is to undertake any project with a positive net present value after discounting cash inflows at the appropriate rate of return. However, it may be necessary to practice *capital rationing* because of an overall capital-spending budget limit (influenced by such factors as management philosophy and the feasibility of obtaining funds). In such cases, the best general guide for choosing among alternative investments is the NPV method. If there are investment indivisibilities within a budget constraint, however, total returns in some instances would be maximized by accepting smaller, though less attractive, projects.

<table>
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<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow net of taxes ((1-50%) ( \times $9,000 ))</td>
<td>4,500</td>
<td>4,500</td>
<td>4,500</td>
</tr>
<tr>
<td>Tax saving from depreciation (50% ( \times ) dep’n.)</td>
<td>2,830</td>
<td>2,670</td>
<td>2,519</td>
</tr>
<tr>
<td>Total</td>
<td>7,330</td>
<td>7,170</td>
<td>7,019</td>
</tr>
<tr>
<td>Present value factor at 7.17%</td>
<td>0.9331</td>
<td>0.8707</td>
<td>0.8124</td>
</tr>
<tr>
<td>Present value</td>
<td>6,640</td>
<td>6,243</td>
<td>5,702</td>
</tr>
</tbody>
</table>

Total PV = $18,785; so NPV = $785.