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Effects of Inflation and after-tax present values where business costs are capitalized

Steven H. Bullard
Stephen F. Austin State University, Arthur Temple College of Forestry and Agriculture, bullardsh@sfasu.edu

W. David Kempere

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The impact of inflation on after-tax investment decisions can be derived in two ways. Each is illustrated for an example in Figure 1. The example is for an initial cost of $200, a tax rate of 30.0 percent, a real discount rate of 2.0 percent, inflation rates of 0 and 5.0 percent, and a real rate of appreciation for the investment of 4.0 percent. Figure 1a shows \( V_0 \) as the present value of the investment when inflation is 0 percent, and \( V_0' \) as the present value when inflation is 5.0 percent. \( V_0 \) minus \( V_0' \) is the difference between the two and is also plotted in Figure 1a.1

Figure 1b derives the present value difference by showing the tax savings from being able to deduct the costs from future income with and without inflation. Deducting costs from taxable income represents tax
Figure 1. Example Present Values and Present Value Differences

The primary result is that the present value difference is positive when inflation is positive. This means that present values are lower when inflation occurs, in any analysis where initial costs are capitalized. Ignoring inflation can, therefore, result in accepting bad investments, since present values may be positive without inflation but negative if inflation is considered.

The present value reduction from inflation applies to any situation in which business costs are deducted (in whole or in part) after an inflationary period. In periods of positive inflation, present values calculated with zero inflation (or underestimated inflation) will be too high in any analysis with capitalized costs. For any combination of tax rate and discount rate, the difference increases with the rate of inflation and the deducted basis. The difference increases with the tax rate and is completely independent of total income in year n and the rate of return generated by the investment (see Figure 1b). The investment period, however, does affect the degree of error and is considered below in more detail.

Investment Period and After-Tax Present Values

When adding inflation to after-tax analyses with capitalized costs, the reduction in present value increases, reaches a maximum, and decreases with n, the investment period. The influence of time on the present value reduction depends on the rate of inflation and the real rate of discount. Present value differences per dollar of tax savings are plotted in Figure 2. They increase, reach a maximum, and decrease for longer investment periods. Differences are greater with higher inflation and lower discount rates, and for any given combination there is an investment period which results in the maximum difference (Table 1). If r = .02 and f = .02, for example, differences increase until n = 35. Although the bias from omitting inflation is greater with higher inflation, the point of culmination for \( V_0 - V'_0 \) decreases with f (Figure 2 and Table 1).

Figure 2. Present Value Differences Per Dollar of Tax Savings for Inflation Rates of 4.0 and 8.0 Percent and for Real Discount Rates of 2.0, 5.0, and 8.0 Percent
### Table 1
**Investment Periods for Selected Inflation and Discount Rates**

<table>
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<th>Real Discount Rate</th>
<th>.02</th>
<th>.04</th>
<th>.06</th>
<th>.08</th>
<th>.10</th>
<th>.12</th>
<th>.14</th>
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<td>5.74</td>
<td>5.50</td>
<td>5.29</td>
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</table>

1\n
**Conclusions**

Where business costs are deducted after an inflationary period, after-tax present values are too high if inflation is assumed to be zero. Tax savings from deducting costs are constant in nominal terms, and their present value is overestimated if a real discount rate is used (unless the basis is deflated as mentioned in Footnote 1). The degree of bias can be predicted and may be significant or trivial, depending on all of the variables pertinent to an investment (discount rate, inflation rate, tax rate, initial cost, and investment period). The inflation-induced reduction in present value rises with lower discount rates or with greater inflation, tax rates, and deductible costs. The reduction may increase or may decrease, however, for lengthening investment periods.

Evaluating present values after capital gains taxes, Klemperer [4] correctly concluded that the present value reduction caused by inflation was likely to be trivial for investments with payoff periods longer than 30 years, assuming historic inflation rates and typically acceptable industrial real alternative rates of return in the U.S. Since the present value reduction does not necessarily decrease for longer investments, however, and since the reduction is fairly sensitive to real interest rates, it is recommended that present values after income taxes be calculated with a projected inflation rate, for all investment lives, incorporating the same inflation rate in the cash flows and the discount rate.

**Footnotes**

1 An alternative would be to deflate the initial cost term. The result is equivalent and represents another means of correctly incorporating inflation in after-tax analyses. Generalized expressions for the terms are given below:

Present values with and without inflation and the difference between them in analyses where investment costs are capitalized:

\[ r = \text{real interest rate (in decimal percent), excludes inflation} \]

\[ f = \text{average annual rate of inflation (in decimal percent)} \]

\[ n = \text{investment period (years)} \]

\[ V_0 = \text{present value excluding inflation} \]

\[ V_0' = \text{present value with inflation} \]

\[ I_n = \text{real income in year } n, \text{ excluding inflation} \]

\[ t = \text{tax rate (decimal present)} \]

\[ C = \text{cost basis, to be deducted from taxable income in year } n \]

For depreciation or depletion, the expressions below can be applied to each year in which a deduction is made; in such cases C is the portion of initial costs deducted in year n:

\[ V_0 = I_n \cdot t(I_n - C) / (1 + r)^n \]

\[ V_0' = I_n (1 + f)^n - t(I_n (1 + f)^n - C) / (1 + r)^n (1 + f)^n \]

\[ V_0 \cdot V_0' = t(C) \left[ \frac{1}{(1 + r)^n} - \frac{1}{(1 + r)^n (1 + f)^n} \right] \]

**References**


