# INFLATION AND COST-BENEFIT ANALYSIS

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## I. INTRODUCTION

One of the most frequent errors made in the preparation of investment project evaluations arises out of the improper accounting for the impact of inflation on the financial and economic performance of a potential project. In the case of commercial projects, it is not uncommon to find the returns to the owner of the project (either private sector, government, or public enterprise) underestimated or overestimated by 50 percent or more simply as a result of the use of incorrect procedures in accounting for expected inflation. Similiarly, in economic appraisals of projects, economists usually have ignored the financing and liquidity constraints which inflation imposes on the investment and operation of projects even when the realized rate of inflation is equal to the rate anticipated.

Most of the published literature on the investment appraisal of public and private sector projects avoids consideration of the impact of movements in the general level of prices and recommends that the appraisal be carried out with all variables expressed in terms of the price level of a given year[3]. In this case, only the changes in the relative prices of the various inputs and outputs need be projected through the life of the investment. However, movements in the general level of prices can and do affect the financial and economic performance of projects in a number of ways which, if ignored, will often lead to incorrect project preparation and evaluation and might severely jeopardise the project's performance.

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## II. IMPACTS OF INFLATION ON INVESTMENT APPRAISAL

There are six principal ways in which movements in the general level of prices can have an impact on the financial analysis of a project. First, if the project will require additional loan or equity financing over a period of years, these financing arrangements must be made in terms of the price levels of the years in which such financing is required. Often "cost overruns" are reported to have occurred because of inflation when in fact the real project costs expressed in terms of a constant price level may have occurred as expected. Often the financial analysis has not included the change in the general price level through time; thus, the correct financing arrangements were not made. As a result, the project may experience a liquidity crisis or insolvency due to inadequate financing.

Secondly, most countries which levy corporation income taxes base the deductions for depreciation expense (capital cost allowances) on the historical cost of the depreciable assets.[2] If inflation occurs through time, then the relative value of this deduction will fall causing the real amount of income tax liabilities paid by private or taxed public enterprises to increase relative to the no inflation situation[4]. For the economic appraisal of an investment, this increase in taxes is not an increase in the resource cost of the project but is simply a transfer from the project to the government. However, if such increases in tax payments are levied on a private, public, or joint public-private endeavour, it might force the project into a situation where it experiences severe cash flow difficulties or insolvency. If this occurs, the expected economic and social performance of the project may be drastically altered. In cases of public sector enterprises, we would expect that the government would come to the project's rescue. However, by the time the Treasury has carried out the requisite investigations prior to approving additional funds the operations may be significantly damaged.

Thirdly, a further tax implication of inflation is experienced by commercial enterprises which must maintain inventories of inputs and outputs. In many countries, companies are required to

carry the value of inventories in their accounts on a first-in-first-out basis. This means that the oldest priced inventories are the ones that are included in the cost of goods sold.

In a period of rapid inflation, the historical cost of inventories now being used in production will be substantially less than the current replacement cost of these items. If taxable income is calculated using the historical cost of the inventory items, the real cost of goods will be underestimated and taxable income will be overestimated. Therefore, real income tax liabilities will be greater than they would be if no inflation had existed[3]. Again the higher income taxes on the spurious income created by the interaction of the existing accounting system and inflation may cause the project to be financially weakened; thus, its ability to attain its economic and social potential is decreased.

A fourth way in which inflation will alter the real net financial cash flow of a project is through its impact on nominal interest rates. The nominal interest rate (i) which is determined in the financial markets is made up of at least three components: (a) there is an element (r) which reflects the real time value of money that lenders require in order to be willing to forego consumption or other investment opportunities, (b) a risk element (R) which measures the compensation the lenders demand to cover the possibility of the borrower defaulting on the loan, and (c) an element which is compensation for the expected loss in the real purchasing power of the loan principal still outstanding because of the expected future rate of inflation ($g^{P^e}$). Therefore, the nominal or market rate of interest (i) can be expressed as:

$$i = r + R + (1 + r + R)\, g^{P^e} \qquad (1)$$

If we consider a situation where the risk premium for default (R) is zero and the expected rate of inflation $g^{P^e}$ is zero, then $i = r$. Suppose in this situation the real rate of interest (r) is equal to .05. On a thousand dollar loan the interest payment due each year is $50 and is deducted as a cash outflow of the project to derive the net cash flow from the owner's point of view.

However, if the rate of inflation increased to 10% per year, lenders would no longer be willing to lend their funds for 5%. With this rate of inflation, they lose 10% of the real value of the principal of the loan each year. Therefore, just to offset the rate of inflation, they need to obtain a 10% interest rate and to be as well off as before, they will need a nominal interest rate of at least 15.5%[4]. Over the lifetime of the loan, the real present value of the interest payments plus loan repayments will be the same if there is no inflation and a 5% rate of interest or a 10% rate of inflation and a 15.5% nominal interest rate. If there is inflation, the nominal interest rate will be higher but the real cost of the loan repayments will be less. This is illustrated in Table 1.

Case 1 in Table 1 presents the cash flow items whichwill arise out of a $1000 loan bearing 5% interest annually, which is repaid in four years' time. With a discount rate of 5%, the net present value of this transaction is exactly zero. In case 2 we assume that a 4 year loan is made for $1000 at 5% interest and at the same time, a 10% rate of inflation occurs in each year the loan is outstanding. Therefore, in order to calculate the net present value of this loan, we must first deflate the future interest and principal repayments so that they are expressed in the same price level as that of the year the loan was initially made. Then we can discount the deflated cash flow to evaluate it as of the initial year. In this case, we find that the net present value of this transaction from the lender's point of view is-$296.79. This is the present value of the amount that the unexpected inflation of 10% a year has transferred to the borrower from the lender.

In case 3, we assume that the lender anticipates the future rate of inflation of 10% per year and increases the nominal rate he charges the borrower to compensate for the loss in purchasing power of his loan repayments. This will require him to charge a nominal interest rate of 15.5% per year. Again, we first have to deflate the cash flow stream to express each element in terms of the price level of the initial year. These deflated elements are then discounted by 5% to obtain a net present value (NPV). The final result is a net present value of zero which is the same as in case 1. Here we find that a 15.5 percent nominal interest

rate, when the rate of inflation is 10% per year, yields the same NPV as a 5% nominal interest rate and a zero inflation rate.

TABLE 1

INFLATION AND ITS EFFECT ON INTEREST AND PRINCIPAL PAYMENTS

| | CASE | ITEM | PERIOD 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|
| 1. | $1000 loan @ 5% interest no inflation | Loan | -1000 | | | | |
| | | Interest | | 50 | 50 | 50 | 50 |
| | | Loan Repayment | | | | | 1000 |
| | Cash Flow in year 0 price level | | -1000 | 50 | 50 | 50 | 1050 |
| | Net Present Value @ 5% | | -1000 | 47.69 | 45.33 | 43.30 | 863.68 |
| | | = | 0 | | | | |
| 2. | $1000 loan 5% interest 10% annual inflation | Loan | -1000 | | | | |
| | | Interest | | 50 | 50 | 50 | 50 |
| | | Loan Repayment | | | | | 1000 |
| | Cash Flow in Current Prices | | -1000 | 50 | 50 | 50 | 1050 |
| | Cash Flow in year 0 price level | | -1000 | 45.45 | 41.32 | 37.57 | 717.17 |
| | Net Present Value @ 5% | | -1000 | 43.28 | 37.46 | 32.45 | 590.02 |
| | | = | - 296.79 | | | | |
| 3. | $1000 loan 15.5% interest 10% annual inflation | Loan | -1000 | | | | |
| | | Interest | | 155 | 155 | 155 | 155 |
| | | Loan Repayment | | | | | 1000 |
| | Cash Flow in Current Prices | | -1000 | 155 | 155 | 155 | 1155 |
| | Cash Flow in year 0 Price level | | -1000 | 140.91 | 128.10 | 116.45 | 788.89 |
| | Net Present Value @ 5% | | -1000 | 134.20 | 116.19 | 100.50 | 649.02 |
| | | = | 0 | | | | |
| 4. | Cash Flow (1-3) in year 0 price level | | 0 | -90.91 | -78.10 | -66.45 | +261.11 |

While the NPV remains unchanged, the real (constant price level) cash flow is dramatically altered through time. Item 4 in Table I measures the difference between the cash flow of the no inflation case 1 and the equivalent (NPV) but with 10% inflation case 3. Both cash flows have been deflated to the price level of the initial year. With the inflation, the cash outflows for years 1 to 3 have been increased by 90.91, 78.10, 66.45 while in year 4, when the loan is repaid, the real cash outflow is reduced by $261.11.

It is the required compensation for the loan in the purchasing power of the outstanding loan principal built into the nominal interest rate which creates this change in the timing of the real cash flow over time. Implicitly, the existence of inflation is forcing the borrower to repay his loans faster than he otherwise would.

If the rate of inflation is expected to change through time and refinancing of the project's debt is required, then the nominal interest rate paid must be adjusted to be consistent with this new expected rate of inflation. This should have little or no direct effect on the overall economic viability of the project as measured by its NPV; however, it may impose very severe constraints on the liquidity position of the project because of its impact on interest and principal payments. It has been very common to see basically sound firms go bankrupt because of inadequate cash to meet the increased interest charges arising from an increase in the rate of inflation. While enterprises might have adequate fixed assets to meet all their liabilities, they can find themselves in a position where they cannot borrow to meet their short-term interest obligations and thus are driven into insolvency.

The fifth way in which inflation can alter the financial feasibility of a project is through the impact that the increased nominal interest payments have on the income tax liabilities of the enterprise. In most countries, interest payments are deductible from income for the calculation of taxable income. On the other hand, principal repayments are not treated as an expense and are therefore not deductible.

When the expected rate of inflation increases, we find (from equation 1) that the nominal interest rate rises in order to compensate the lender for the loss in the purchasing power of the principal outstanding[5]. From Table 1, Item 4, we find that the ultimate result is to transfer some of the real value of the principal repayments into interest payments. However, because these interest payments containing the compensation for expected inflation are deductible from taxable income, they serve to reduce the amount of taxes which the enterprise would otherwise be required to pay. This element will tend to offset the other effects of inflation which serve to increase income tax liabilities although, in all cases where the impact of inflation has been studied empirically, the overall effect of inflation has been to increase tax payments significantly.[6]

The sixth way in which changes in the general price level have an impact on the financial appraisal of a project is through the effect they have on the real value of cash balances held in order to facilitate transactions.

A commercial enterprise will usually try to maintain either cash in the till or bank balances equal to a given proportion of sales and purchases. If such activities are maintained at a constant level through time and there is no inflation, then, after setting aside the required cash balances in one of the early years of the project, no further investments in cash balances would be required. However, if there is an increase in the general price level through time, even if the quantity of goods and services bought and sold stays the same, their value expressed in current prices will increase. In such a situation, the enterprise will have to add to its holdings of cash balances in order to be able to carry on the business with the same ease as it did before. These additional cash balances are a financial cost to the project and must be deducted from the financial cash flow of the project to determine its viability. The loss in the purchasing power of cash balances has been referred to in economics literature as the inflation tax on cash balances. Its primary effect isthe transfer financial and economic resources from the sectors who use cash to the banking sector which produces the economy's money supply.[7]

In each of the above six ways in which the changes in the general level of prices have an impact on the evaluation of a project, it is only the financial analysis of a project which is directly altered. However, if the financial viability of a project is weakened and as a result its operations are constrained, this is likely to have a significant impact on the project's economic and distributive performance.

Traditionally, economists dealing with project evaluation have tended to ignore the financial feasibility of a project and go straight to the economic and distributive appraisal of a project. However, even purely public sector projects must have an adequate cash inflow to meet their financial costs if they are going to survive. A bankrupt project will always be a very poor generator of economic or distributive benefits.

It is equally true that not all financially viable projects are economically worthwhile to undertake; therefore, both financial and economic appraisals are required to determine if the project should be undertaken. Assumptions concerning the rate of change in the general price level will only affect the economic appraisal indirectly but it has a direct impact on the financial analysis. If these impacts necessitate an adjustment in either the financial investment or operating plans of the project, or point to critical (if not fatal) liquidity problems in the future, then it is the responsibility of the analysts conducting the economic appraisal to reflect these possibilities in their evaluation.

## III. CONSISTENCY IN THE PROJECTION OF MOVEMENTS OF THE GENERAL LEVEL OF PRICES AND INTEREST RATES

The factors which determine the future changes in the general level of prices are quite different from those which determine changes in relative prices. Changes in relative prices of inputs and output items will generally be determined by the relative growth of demand and supply for the individual goods and services through time. However, the general level of prices will be primarily determined by the relative growth rates of the country's money supply and real output, and by the growth in the world prices of goods which the country trades internationally.

Accurate forecasts of the future growth in the level of prices are usually beyond the responsibility of the project analyst. However, trends in the growth of prices and the recent history of government policies will often provide a substantial basis for such forecasts. By far the most important aspect in the construction of projections of the general level of prices for use in project evaluation is to insure that such forecasts are consistent with the projections of the nominal rate of interest.

For most countries, the real rate of interest will be a fairly constant value because it is primarily determined by the productivity of investment and the desire to consume and save in the economy. Also, the value of the risk premium can be determined by the difference in interest rates of the same issue date and maturity but with different risk ratings. If the long run real interest rate and the risk premium are subtracted from the nominal interest rate, then the difference will be a measure of the expected rate of inflation. Alternatively, if a projection is made of the growth rate of the level of prices ($gP^e$), the nominal interest rate (i) which is consistent with this forecast can be estimated by adding this projected growth in prices to the real rate of interest and risk premium, i.e. $i = r + R + (1 + r + R)gP^e$.

## IV. STEPS IN DEVELOPMENT OF A CONSISTENT TREATMENT OF INFLATION FOR THE FINANCIAL ANALYSIS OF A PROJECT.

In this section we wish to provide a set of the steps which should be undertaken to integrate correctly the projections for both the movement of relative prices and the general price level into the financial appraisal of a project. To assist in the understanding of these steps, a sample set of calculations will be carried out in the final section of the paper.

We start this step by step treatment of price changes in the financial appraisal of investments at the point where information on the quantities of inputs required for the construction and operation of the facility has been obtained. Our task is now to prepare the cash flow statement (and the profit and loss statement for income tax purposes) in a manner so that relative price changes and price level changes are

properly integrated . To do this, we first have to build up the values of the variables in terms of their nominal or current year prices; then, often the estimation of the financing requirements along with desired cash balances and taxes, all values in the pro forma cash flow statement are deflated to the price level of a specific year. By constructing the financial analysis in this manner, we insure that: first, all the effects of inflation are consistently reflected in the projected variables and secondly, all variables are deflated by the projected general level of prices. The steps required to carry this out are as follows:

1. Estimate the future changes in the price, relative to the general price level, for each input and output variable. This will involve the examination of the present and future demand and supply forces that are expected to prevail in the market for the item.

2. Estimate or develop a set of assumptions concerning the expected annual changes in the general level of prices over the life of the project.

3. Determine what the nominal rate of interest will likely be over the lifetime of the project given the above expected changes in the price level.

4. The expected changes in relative price for each item are combined with the expected change in the general price level to give the expected change in the nominal price of an item through time.

5. The nominal prices of each item are multiplied by the projections of quantities of inputs and outputs through time to express these variables in the current year's prices of the period in which they are expected to occur.

6. The current (nominal) values for the variables are now used to begin the construction of a pro forma cash flow statement. At this point, the timing of sales and receipts as well as purchases and expenditures will have to be determined.

7. A pro forma profit and loss statement is constructed for each year of the project's life to determine income tax liabilities. At this point all variables are expressed in their nominal values. Capital cost allowances, cost of goods sold, and interest expenses and income tax liabilities are estimated according to taxation laws of the country. The estimated income tax liabilities are now included in the pro forma cash flow statement.

8. Cash requirements are now estimated and any changes in the stock of cash are reflected in the pro forma cash flow statement.

Financing

9. Financing requirements are now determined along with the interest payments and principal repayments. These items are also included in the pro forma cash flow statement. This completes construction of the projected variables in terms of their current (inclusive of inflation) values.

Deflate

10. All items in the pro forma cash flow statement for each year are deflated by a price index which is the ratio of the general price level in the particular year (t) to the general price level of the base year.

Equity

11. The net financial cash flow is calculated from the point of view of the owners of the enterprise. In this case loans, interest payments, and loan repayments are included at their deflated values in the determination of the net cash flow.

Discount equity

12. Discount the net financial cash flow to the owners of the enterprise by either the real (net of inflation) private opportunity cost of equity financing (if it is a private owner) or by the target financial rate of return (net of inflation) set by government (if it is a public sector enterprise).

Total invested funds

13. The net financial cash flow should now be estimated from the point of view of the total invested capital. In this case, the form of financing only alters the income taxes to be paid, but loans, interest and ~~principal~~ payments do not enter into the calculation of the net financial cash flow.

14. Discount the net financial cash flow from the total investment by either the real (net of inflation) private opportunity cost of capital (if it is a private owner) or the target financial real rate of return (net of inflation) set by the government (if it is a public sector enterprise) to estimate the financial NPV of the project.

15. The deflated financial input and output items calculated by the above steps can now be used as a data base for estimating the economic values for the benefits and costs of the project. A complete economic and distributive appraisal of the project should follow.

The development of the pro forma financial cash flow statements in this way insures that the impact of inflation on the financial performance of the project is correctly accounted for. At the same time, the final financial analysis (steps 11 to 14) is all completed with the variables expressed in terms of a constant general price level. In this way, the movement of such variables as receipts, labor costs and material costs can be compared over time without being distorted by changes in the general price level.

When the financial analysis is carried out in terms of a constant price level, it is essential that the private opportunity costs of capital or the target financial rates of return used as discount rates be expressed net of any compensation for the expected rate of inflation. These discount rates must be real not nominal variables. If a nominal interest rate or target rate of return is used, the result will be the deflation of the items in the cash flow statementtwice for the expected changes in the general price level. Such practices will greatly distort the conclusions of the analysis concerning the financial viability of the project. However, at the present time, it is common to find such incorrect practices used in the financial appraisal of both public and private sector projects.

## V. AN ILLUSTRATIVE EXAMPLE

The following example of the financial analysis of an aircraft production project is designed to serve two purposes. First, it illustrates with figures how the computational steps outlined above are applied. Secondly, it will show how, in the presence of inflation, the results of the recommended procedures differ from those commonly used in financial analysis.

These incorrect procedures which enjoy widespread use by both accountants and economists arise in the attempt to apply directly "generally accepted accounting rules" used in business financial reporting to the financial and economic analysis of investment projects. To conduct a financial analysis in constant prices, traditional practice is to project input and output prices in terms of changes in their relative prices only. Capital cost allowances are estimated according to the historical cost of the depreciable assets and deducted from income expressed in a constant price level in order to calculate income taxes without deflating them for the expected changes in future prices. Interest expense is similarly estimated by applying the financial or nominal interest rate to the amount of borrowed funds. It is then deducted from income for the estimation of income taxes without any further deflation for the expected changes in the price level. Also "real" cash requirements are estimated from the projections of the values of sales and purchases expressed in terms of a constant price level.

These traditional practices in investment analysis are usually justified by the argument that they are believed to introduce only a slight conservative bias into the financial analysis of an investment project. From the following example, we find that this need not be the outcome. These traditional procedures can introduce a drastic downward bias in the estimates of the performance of the investment from the equity holders' point of view, while at the same time introducing a serious bias in the opposite direction for the investment appraisal from the point of view of the total invested capital.

In this case, we consider an aircraft project which is expected to enjoy a market demand for five years. It is assumed that the enterprise is subject to the same tax system as are all private firms. The information on production sales, inputs, and prices is presented in Table 2. This information contains the output of the marketing and engineering modules of the appraisal, although for the purpose of this example most of the detail has been suppressed.

The information in Table 2 will now be used to carry out the financial analysis of a project following the recommended steps outlined above.

Step 1: In Table 2, rows 8, 10 and 12 wage rates, material input prices, and the selling price of the airplanes are reported relative to the general level of prices.

Step 2: The assumptions concerning the expected rate of inflation are presented in Table 2, row 14.

Table 2

BASIC DATA FOR FINANCIAL ANALYSIS FOR AIRCRAFT PROJECT

| Item \ Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1. Production number. | | 1,000 | 1,500 | 2,000 | 1,500 | 1,000 | |
| 2. Sales number. | | 800 | 1,200 | 2,000 | 1,700 | 1,300 | |
| 3. Quantity paid for:[a] | | | | | | | |
| Current Year sales | | 640 | 960 | 1,600 | 1,360 | 1,040 | |
| Previous Year production | | | 160 | 240 | 400 | 340 | 260 |
| 4. Production licence | $182,000 | | | | | | |
| 5. Cost of plant (millions) | $500 | | | | | | |
| 6. Equipment (millions) | $2,000 | | | | | | |
| Liquidation value (millions) | | | | | | | 80 |
| 7. Number of Labor | 1,000 | 15,000 | 17,500 | 20,000 | 17,500 | 15,000 | 1,000 |
| 8. Average wage per person if no inflation ($).[c] | 10,000 | 10,200 | 10,400 | 10,610 | 10,820 | 11,040 | 11,260 |
| 9. Materials (quantity) | | 1,000 | 1,500 | 2,000 | 1,500 | 1,000 | |
| 10. Material prices $/unit (in price level of year 0) | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| 11. Cash requirements as (%) of ~~receipts~~ sales | | 10% | 10% | 10% | 10% | 10% | 10% |
| 12. Price of airplane if no inflation (millions) | $1.0 | $1.0 | $0.8 | $0.8 | $0.8 | $0.5 | $0.5 |
| 13. Amount borrowed[b] (millions $) | $2,000 | | | | | | |
| 14. Expected rate of inflation (%) | | 10 | 10 | 10 | 10 | 10 | 10 |

a/ Accounts receivable are 20 percent of sales. All accounts are paid within one year.

b/ The loan is to be paid in 5 equal instalments in years 2 to 6. The net of inflation rate of interest is 5 percent.

c/ Real wages are assumed to grow at 2% a year because of growth of productivity in the economy.

Step 3: Given that the real rate of interest is expected to be .05, the expected rate of change in the general price level is .10 and the risk premium is assumed to be zero, the nominal interest rate can be calculated according to equation 1, $(i = r + (1+r)\ gP^e = .05 + (1+.05)(.10)$. Therefore, the nominal interest rate i = .155.

Step 4: With the assumption of a 10 percent expected growth in the general price level, the nominal prices of the aircraft workers' wages and material inputs through time will be as follows:

Table 3

NOMINAL PRICES OF INPUTS AND OUTPUTS

| Item | Year 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1. Aircraft Prices (millions $) | $1.0 | 1.1 | .968 | 1.065 | 1.171 | .805 | |
| 2. Wages ($) | $10,000 | 11,200 | 12,584 | 14,122 | 15,841 | 16,164 | 19,948 |
| 3. Materials prices ($) | $100,000 | 110,000 | 121,000 | 133,100 | 146,410 | 161,410 | 177,156 |

Steps 5, 6, 7, 8 and 9

The nominal values of the receipts and expenditures are estimated by multiplying the prices of the outputs and inputs and are organized into the pro forma cash flow statement as follows:

Table 4

PRO FORMA NET FINANCIAL CASH FLOW FROM EQUITY HOLDER'S POINT OF VIEW

CURRENT PRICES INCLUDING INFLATION

| Item \ Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | | | | (000 $) | | | |
| 1. RECEIPTS (+)[a] | | 704,000 | 1,105,280 | 1,936,320 | 2,018,560 | 1,235,340 | 209,300 |
| Less: | | | | | | | |
| 2. PAYMENTS (-) | | | | | | | |
| 3. Production licence | 182,000 | | | | | | |
| 4. Plant | 500,000 | | | | | | |
| 5. Equipment | 2,000,000 | | | | | | - 141,844 |
| 6. Labor | 10,000 | 168,300 | 220,220 | 282,440 | 277,218 | 242,460 | 19,948 |
| 7. Materials | | 110,000 | 181,500 | 266,200 | 219,615 | 161,410 | |
| 8. Cash Balances [b] | | 88,000 | 28,160 | 96,840 | -13,930 | -94,420 | -104,650 |
| 9. Net Cash Flow Before Financing | -2,692,000 | 337,700 | 675,400 | 1,290,840 | 1,535,658 | 925,890 | 435,846 |
| 10. Loan | +2,000,000 | | -400,000 | -400,000 | -400,000 | -400,000 | -400,000 |
| Less: | | | | | | | |
| 11. Interest (-) | | 310,000 | 310,000 | 248,000 | 186,000 | 124,000 | 62,000 |
| 12. Income Taxes (-)[c] | | | | 271,987 | 318,203 | | |
| 13. NET FINANCIAL CASH FLOW | -692,000 | 27,700 | -34,600 | 370,853 | 631,455 | 401,890 | -26,154 |

a/ In calculating receipts, it is assumed that 20% of current year sales become accounts receivable and are paid for in the following year.

b/ Cash requirements are assumed to be equal to 10% of sales.

c/ Income taxes are calculated in Table 5.

In order to complete the pro forma net cash statement, it is also necessary to estimate the cash and financing requirements, including interest payments, and the income tax liabilities of the enterprise. For this example, the enterprise obtains a loan for $2,000 million in the first year at a real rate of interest of 5%. Because the expected rate of inflation is 10%, we calculate that the nominal interest rate will be approximately 15.5% per annum.

The estimation of income taxes is made in Table 5. All values are expressed in current prices. As stipulated by current tax law in most income tax jurisdictions around the world, the capital cost allowance and the cost of goods sold are priced in the year the inputs were purchased.[8]

When comparing the pattern of net (after tax) profit (Table 5 row 10), with the net financial cash flow of the enterprise (Table 4 row 11), it would appear that on the basis of net-after-tax profit the enterprise runs at a loss for every year except years 3 and 4. However, according to the cash flow statement, they will earn sufficient cash in all years except year 0, 2, and 6 to pay all expenses and the net positive cash flows in years 1 and 5 are more than enough to finance the next year's shortfall.

Table 5, rows 11 and 12 contain the estimates of income taxes and net-of-tax profits if traditional procedures of financial analysis are used. Comparing the values for these variables with those estimated using the recommended methodology, Table 5 rows 9 and 10, we find that the traditional method would underestimate future income tax liabilities by 75 percent and would predict cumulative losses after taxes to the equity holders of $134,090,000 rather than cumulative profits of $720,601,000 as estimated by the recommended procedures!

At the present time the elements in the pro forma net financial cash flow statement (Table 4) are all presented in nominal or current year values. In order to compare cash flows over time, they must be expressed in terms of a given year's price level.

Step 10: Because we assume that the expected rate of inflation is 10% per year, we have to estimate a deflation factor for each year in order to express all values in terms of the price level of one year. In this case we choose the price level of year zero. The deflation factor for any year (t) can be expressed as $\prod_{i=o}^{t-k} \frac{1}{(1 + gP_i)_i}$, where t is the year of the project's life to which we wish to deflate all other values, k is the year of the project which is chosen as the baseyear, and $gP_i$ is the rate of change of the price level in year i.

Table 5

PRO FORMA PROFIT AND LOSS - ESTIMATION OF INCOME TAX LIABILITIES

| Item \ Year | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| | | | (000 $) | | | |
| 1. SALES | 880,000 | 1,161,600 | 2,130,000 | 1,990,700 | 1,046,500 | |
| Less: | | | | | | |
| 2. COST OF GOODS SOLD: | | | | | | |
| 3. Labor and Materials [a] | 222,400 | 376,976 | 519,256 | 507,194 | 503,236 | 19,948 |
| 4. Capital Cost Allowance [b] | 502,000 | 502,000 | 502,000 | 502,000 | 502,000 | |
| 5. Interest Expense | 310,000 | 310,000 | 248,000 | 186,000 | 124,000 | 62,000 |
| 6. Gross Profit Before Taxes | -154,400 | -27,376 | 861,744 | 795,507 | -82,736 | -81,948 |
| 7. Loss Carry Forward [c] | | | -181,776 | | | |
| 8. Taxable Income | 0 | 0 | 679,968 | 795,507 | -82,736 | -81,948 |
| Less: | | | | | | |
| 9. Income Taxes [d] at .4 | 0 | 0 | 271,987 | 318,203 | 0 | 0 |
| 10. Net Profit After Tax | -154,400 | -27,376 | 589,757 | 477,304 | -82,736 | -81,948 |
| | | | RESULTS USING TRADITIONAL PROCEDURES [e] | | | |
| 11. Income Taxes | | | 28,632 | 127,250 | | |
| 12. Net Profit After Tax | -214,380 | -168,052 | 425,381 | 190,875 | -294,663 | -73,251 |

a/ Cost of goods sold is calculated assuming that inventories consist only of finished goods and they are costed on a first-in first-out basis.

b/ Capital cost allowance is calculated using straight line depreciation over 5 years.

c/ It is assumed that losses for tax purposes can be carried forward, but not backward.

d/ Income taxes are assumed to be equal to 40 percent of taxable income.

e/ In order to conserve space, the details of the estimation using traditional procedures are not reported.

For this example, if k = 0, and $gP_i^e$ = .10 for each year, the deflation factors are 1.000, .909, .826, .751, .683, .621 and .564 for years 0 to 6 respectively. It is completely arbitrary as to which year is chosen as the base year, except that all projects being compared must be evaluated in terms of the same year's price level.

Steps 11 and 12: The deflation factors are now applied to the elements in Table 4 to estimate the net financial cash flow of the project from the point of view of the owners of the project, expressed in the price level of year zero.

Row 12 of Table 6 contains the net financial cash flow in the price level of year zero which accrues to the equity holder (owner) of the facility. If we now assume that the opportunity cost of equity capital is 8% net of inflation, the net present value of this net financial cash flow can be calculated. From rows 13 and 14, we find that the net present value of this project from the owner's point of view is $4,989,000, expressed in the price level of year 0.

In rows 16, 17 and 18 of Table 6, the net present value of the project is also reported using traditional procedures. This estimation predicts a negative net present value of $415,663,000 to owners of this project. Traditional accounting practices thus introduce a substantial downward bias in the estimation of the return to the equity holders of a project if a positive rate of inflation is expected in the future. This bias arises because these procedures overestimate the real constant price level of the cost of future interest payments, debt repayment, and cost of holding cash balances. These overestimates of financial costs are somewhat offset by the underestimation of income tax liabilities.

Steps 13 and 14: To estimate the net financial cash flow from the point of view of total invested capital, we use the same constant price level values from Table 6 but eliminate the financing provisions of loans, interest, and loan repayments from the calculations. This estimation is shown in Table 7.

Table 6

PRO FORMA NET FINANCIAL CASH FLOW FROM EQUITY HOLDERS' POINT OF VIEW

Constant Price Level of Year Zero

| Item \ Year | | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | | | | (000 $) | | | |
| 1. RECEIPTS (+) | | 639,936 | 912,961 | 1,454,176 | 1,378,676 | 767,146 | 118,045 |
| Less: | | | | | | | |
| 2. PAYMENTS (-) | | | | | | | |
| 3. Production licence | 182,000 | | | | | | |
| 4. Plant | 500,000 | | | | | | |
| 5. Equipment | 2,000,000 | | | | | | -79,000 |
| 6. Labor | 10,000 | 152,985 | 181,902 | 212,112 | 189,340 | 150,560 | 11,251 |
| 7. Material Inputs | | 99,990 | 149,919 | 199,916 | 149,997 | 100,236 | |
| 8. Cash Required | | 79,992 | 23,261 | 72,727 | -9,514 | -58,635 | -59,023 |
| 9. Net Cash Flow Before Financing | -2,692,000 | 306,969 | 557,880 | 969,421 | 1,048,854 | 574,977 | 244,817 |
| 10. Loan | 2,000,000 | | 330,400 | -300,400 | -273,200 | -248,400 | -225,600 |
| Less: | | | | | | | |
| 11. Interest (-) | | 281,790 | 256,060 | 186,248 | 127,038 | 77,004 | 34,968 |
| 12. Income Taxes (-) | | | | 204,262 | 217,333 | | |
| 13. NET FINANCIAL CASH FLOW | -692,000 | 25,179 | -28,580 | 278,511 | 431,283 | 249,573 | -15,751 |
| 14. NPV @ 8% | -692,000 | 23,315 | -24,493 | 221,138 | 316,993 | 169,959 | -9,923 |
| 15. NPV @ 8% = $4,989 | | | | | | | |
| RESULTS USING TRADITIONAL PROCEDURES a/ | | | | | | | |
| 16. NET FINANCIAL CASH FLOW | -692,000 | -3,039 | -144,859 | 301,516 | 350,090 | 63,342 | -211,206 |
| 17. NPV @ 8% | -692,000 | -2,814 | -124,144 | 239,404 | 253,815 | 43,136 | -133,060 |
| 18. NPV @ 8% =-$415,663 | | | | | | | |

a/ In order to save space, the details of this estimation are not reported.

If the financial opportunity cost of funds is assumed to be 6% net of inflation, then the net financial cash flow (row 10) can be evaluated as a net present value. In this example, the net present value is a minus $2,613,000, also expressed in the price level of year zero.

From Table 6, we find that from the equity holders' point of view this project is acceptable using a discount rate of 8%. However, we find from Table 7 that the project is unacceptable if we consider the total investment expenditures undertaken and their financial opportunity cost.

The results from the financial analysis using traditional procedures are radically different. In Table 7, rows 14 to 17, the net present value for the project from the point of view of total invested capital is a positive $254,968,000. While the recommended methodology indicates that the investment is acceptable from the equity holders' position but is not a good overall investment, the traditional procedure indicates that the project is a very bad investment for the owners but is a very good project for all investors combined. Thus, traditional procedures for the financial analysis of investment projects can provide totally incorrect recommendations to potential investors if inflation should occur in the future. Because of the magnitude of the difference between the net present values using these two alternative procedures, the analyst should pay special attention to the proper treatment of inflation in project appraisal.

The application of the net present value criterion to the financial analysis in order to accept or reject a public sector project is highly suspect. Usually there will be items such as taxes and subsidies which should be included in the analysis before an accurate assessment of the project's potential can be made. It is the estimation of these adjustments and their integration into the analysis of the project's cash flow which constitute the economic appraisal of a project. However, the financial analysis serves to develop the data base for the subsequent economic appraisal and sets out the financing requirements for the project.

Table 7

PRO FORMA NET FINANCIAL CASH FLOW FROM TOTAL INVESTED CAPITAL POINT OF VIEW

Constant Price Level of Year Zero

| | Item / YEAR | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| | | | | | (000 $) | | | |
| 1. | RECEIPTS (+) | | 639,936 | 912,961 | 1,454,176 | 1,378,676 | 767,146 | 118,045 |
| 2. | PAYMENTS (-) | | | | | | | |
| 3. | Production licence | 182,000 | | | | | | |
| 4. | Plant | 500,000 | | | | | | |
| 5. | Equipment | 2,000,000 | | | | | | -79,000 |
| 6. | Labor | 10,000 | 152,985 | 181,902 | 212,112 | 189,340 | 150,568 | 11,251 |
| 7. | Material Inputs | | 99,990 | 149,919 | 199,916 | 149,997 | 100,236 | |
| 8. | Cash Required | | 79,992 | 23,261 | 72,727 | -9,514 | -58,635 | -59,023 |
| 9. | Net Cash Flow Before Taxes | -2,692,000 | 306,968 | 557,880 | 969,421 | 1,048,854 | 574,977 | 244,817 |
| | Less: | | | | | | | |
| 10. | Income Taxes | | | | 204,262 | 217,333 | | |
| 11. | NET FINANCIAL CASH FLOW | -2,692,000 | 306,968 | 557,880 | 765,159 | 831,521 | 574,977 | 244,817 |
| 12. | NPV @ 6% | -2,692,000 | 289,471 | 496,513 | 642,734 | 658,565 | 429,508 | 172,596 |
| 13. | NPV @ 6% = -2,613 | | | | | | | |
| | RESULTS USING TRADITIONAL PROCEDURES a/ | | | | | | | |
| 14. | NET FINANCIAL CASH FLOW | 2,692,000 | 306,960 | 565,141 | 949,516 | 936,090 | 587,342 | 250,794 |
| 15. | NPV @ 6% | -2,692,000 | 289,463 | 502,975 | 797,593 | 741,383 | 438,744 | 176,810 |
| 16. | NPV @ 6% = +$254,968 | | | | | | | |

a/ In order to save space, the details of this estimation are not reported.

In order to carry out the basic financial analysis of a project, proper account must be made of the effect of future inflation in the economy. This paper has set out a methodology so that movements in the general level of prices can be properly integrated into the financial and subsequent economic analysis of a project. Failure to use these techniques is likely to result in the derivation of spurious conclusions from such investment appraisals.