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INFLATION AND PROJECT EVALUATION:
A CASE STUDY OF THE EFFECT OF
PRICE CHANGES ON RATE OF RETURN

by

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INFLATION AND PROJECT EVALUATION: A CASE STUDY OF THE EFFECT OF
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Inflation has proven to be a singularly pervasive and disruptive factor in our economic life. It is an important economic variable which is playing an ever-expanding role in the decision making processes of business, industry and government.¹ A frequently asked question these days is how significantly the inflation alters the precision of accounting data which is a primary source of information in decision-making. The evaluation of capital expenditure projects are based on estimation of future economic benefits from such expenditure, and if such benefits are susceptible to changing prices, it becomes necessary to measure such effects due to price-level changes. The opinions vary widely. Some believe it has no effect on the investment merit, while others claim it vastly affects its attractiveness.²

A recent survey of the techniques used in evaluating the investment projects by Porwal³ indicates that the Internal Rate of Return (IRR) is gaining in importance as one of the criteria of

choice. Basic to the traditional use of this technique there is an assumption of stable monetary unit throughout the life of the project. Frequently, this assumption is imposed unknowingly, by simply estimating the future cash flows on the basis of existing prices. In recent years due to general inflationary trends in the economy, the soundness of this assumption has been under serious question. Changes in prices affect the cash flow estimates, and thereby affect the rate of return. Therefore, the identification of the effects of price level changes on rates of return will assist in making better capital budgeting decisions.

The problem of incorporating inflation into capital budgeting decisions has been very well put by F.M. Wilkes.⁴ He states that:

"Inflation can increase the difficulty of the problem of the assessment or comparisons of investment projects in several ways. First by adding one more factor to the problem, uncertainty is increased. Second, data difficulties are added to, in that future costs and revenues have to be calculated in terms of future technical processes and ambient economic conditions. Third, conceptual difficulties are increased in respect of any effects of inflation on the validity of decision rules formerly employed."

A review of current business practices may indicate that many firms are incorporating general and specific price-level changes in their analysis of new investments by adjusting for such price-changes in their future cash flow estimates, or target cut-off rates. However, these practices are ad.hoc, and are not based on objective

determinants. Changes are made intuitively with the result that future estimates become unreliable. Moreover, the effects become more pronounced when cash receipts expenditures for different periods are not sensitive to the same extent to the general price-level changes. Some costs increase at a more rapid rate than others, e.g. material costs normally tends to respond more quickly to the general price changes than labour costs which are sticky due to comparative long term wage agreements. Same way, for some firms it is easier to change their output prices for increased input costs than others. In large measure, this study shows some effects of the purchasing power of cash receipts being out of phase with the purchasing power of cash disbursement - which is a very likely case.

The major thrust of this study is that the discounted cash flow rate of return measure used in making capital investment decision is sensitive to price-level changes. It is anticipated that a careful reading of this study will cause the reader to render more concern for the subtle degree of effects in such behaviour patterns. In proving this thesis, empirical data were obtained from Gujarat Industrial Investment Corporation for a company which was established in 1972. The company⁵ manufactures metal clad cells in technical collaboration with an internationally known firm in Japan. The company started with a production capacity of 60 million dry battery

cells a year with total project costs of Rs.187.5 lakhs. The project was to be financed by Rs.62.5 lakhs as equity investment and remaining Rs.125 lakhs as debt from various sources (ICICI, GSFC, GIIC etc.). The investment of Rs.187.5 lakhs was made in land (5 lakhs), building (30 lakhs), plant & machinery (110.5 lakhs), preoperating expenses (20 lakhs) and Rs.22 lakhs were set aside for working capital needs.

We have selected this company for the reasons that its profitability in last 5 years has changed mainly due to price changes in raw material costs. The company uses zinc and zinc chloride, ammonium chloride, acetylene (filter), magnesium die oxide, carbon rods, and metal printed covers and caps for raw material. For this project, 70% of the cost of production is raw material cost and of those raw material costs 50% is accounted for by zinc (zinc oxide, and zinc chloride) and 20% by packaging sheets. Due to restrictions on imports and heavy price fluctuation in domestic prices, zinc prices increased drastically (from Rs.3.40 per kg. to Rs.10 per kg. during the planning period. In August 1974 to compensate for such cost increases, the selling price of the cells were increased to some extent. In May 1975 it was noted that aluminium prices have gone up considerably and therefore, decision was made to switch over progressively from metal clad to paper clad batteries. We found that this project would be quite suitable for studying the effect of specific price changes

and general price level changes on profitability (Internal Rate of Return) of the project.

For this study, we specifically collected the revenue and expenditure data for last 5 years (1973-74 to 1977-78). From the collected data set cash flow for each year was computed. The initial investment the company made was Rs.62.5 lakhs in equity form (excluding loan financing). In computing cash flows periodic interest payments on debt have been provided, and therefore, only equity investment has been considered as initial outlay. It is assumed that project life ends at the completion of 5 year period, when fixed assets can be realised in cash form, working capital of Rs.22 lakhs would be released and Rs.125 lakhs as debt would have to be repaid. These would help us in estimating terminal cash flow. All estimates except realisation from fixed assets are of deterministic nature. Realisation from fixed assets has been treated in various ways : at written down value, and at written down value adjusted for specific price changes in machinery. We will see later that it is really not very restrictive assumption because these end-period figures would be common in all situations and for comparative purposes this should not affect our conclusions considerably.

From operating data of the company (table 1) it can be noted that depreciation is provided at written down value, preliminary expenses has been written off over the life of the project (preli-

minary expenses in the first year includes Rs.7.05 lakhs for pre-operating expenses). For simplification purpose, it has been assumed that the company can have tax savings at the rate of 55% of its losses presuming that it can write off its losses from other projects' income. If to the reader, this assumption seems unrealistic, analysis can be modified by accumulating tax loss and writing it off from profitable years. This would involve little time -- differences in accrual of cash flows resulting in slight modification in IRR. Again, for comparison purposes results would not be considerably affected. To make the study general, the author has made the assumption of tax savings accruing in the year of tax losses.

METHODOLOGY

Actual costs for operating revenue and expenses are given in table (1). Cash flow generated from these data are also provided in table (1). In table (2) adjustments for specific price level changes in input costs and sales revenue have been made and the cash flow has been recomputed. This means that in the absence of specific price level changes what the operating expenses and sales revenue would have been. The adjustments have been made on the following basis:

(1) Sales revenue have been deflated by the Finished Goods (Chemical) Index in the Wholesale Price Index series published by

Reserve Bank of India. Chemical finished goods is closest approximation to their output batteries.

(2) For raw material costs, extensive analysis of company's records was done. From the purchasing prices paid by the company at various point of time the raw material costs index was obtained.

(3) Excise Duty is paid ad valorem and, therefore, is deflated by same index as of the sales revenue.

(4) Manufacturing expenses are deflated by the consumer price index (CPI) for industrial workers in Ahmedabad area - since wages formed the major part of manufacturing expenses and the CPI was the closest approximation available.

(5) Selling and Administrative expenses are deflated by CPI for urban non-manual employees in Ahmedabad area - since salaries formed the major part of such expenses and the above index was the closest approximation available.

The only other cash expenses left is interest on debt which does not require any adjustments. It is a cash expense paid periodically based on the agreed interest rate on loans. For cash flow computation non-cash expenses need not be adjusted.

Thus, we have two series of cash flow data for five operating years - one is based on actual operating data and the second one

for sales revenue and operating expenses adjusted for specific price changes.

ANALYSIS AND RESULTS

Assume that no price level changes (general or specific) has occurred during the period 1973-78. Such cash flows which have been neutralised for the effect of specific price level changes in input costs and sales revenue have been computed in Table (2). With an initial equity outlay of Rs.62.5 lakhs and terminal cash outflow of Rs.18.3 lakhs (debt repayment of Rs.125 lakhs reduced by inflow from release of working capital Rs.22 lakhs and sale proceeds of fixed assets at written down value Rs.84.7 lakhs) if there is no change of any kind in prices, we get a rate of return of .71%. This rate has been obtained by discounting the stream of net cash flows to a cumulative net worth of zero without adjustment for price level changes. We call it a base rate of return.

Actual Effect of Price-Level Changes:

In order to observe the sensitivity (effect) of price level changes on the discounted cash flow rate of return, the base rate of return must be modified to include adjustment for price level changes. There are three kinds of price level adjustments necessary to calculate properly the rate of return on investment projects when prices are changing. First, if specific output price changes occur,

they should be reflected in the cash flows through changes in the firm's revenue. Second, specific input price changes should also be incorporated in computing cash flows. This adjustment accounts for the impact of price changes on the firm's operating costs. The third adjustment which may be necessary is for general price (purchasing power of rupee) level changes. This adjustment is made so that the resulting net cash flows may be equated in real (constant purchasing power) value terms with the initial equity investment. This adjustment is accomplished by dividing the relevant net cash flows for each period by a deflating factor obtained from the wholesale price index number for that period.

We have calculated rate of return (ROR) in each of the following situations.

	Nominal ROR	ROR adjusted for General Price Level Change
1. Absence of specific price changes in costs and revenue items (cash flow given in Table (2))	.71	-5.91
2. Actual cash flow (incorporating specific price changes) Cash flow given in table (1)	-18.53	-24.16

From the above table, we notice that if there would have been no price change (specific as well as general) we would have earned a rate of return of .71%. The effect of price level changes (both specific as well as general) reduced the rate of return to -24.16%. A major factor in erosion of the real after tax rate of return is the increase in prices paid for operating expenses. On the average actual prices paid for operating expenses (exclusive of fixed charges like depreciation and interest expenses) rose by about 59% for a total increase of 489 lakhs (from 829 lakhs to 1318 lakhs) in total payments made for inputs over ^a5-year period. This increase is based upon the level of input prices during the beginning of the period. During the same period wholesale prices rose by about 40% and thus, percentage increase in operating expenses were of much higher magnitude compared to general price level changes. If we compute the weighted average index of different components of the operating costs at the end of the period taking 1973-74 as base year, the composite index comes out to be 212. (The weights in proportionate to its share in the total operating cash costs are raw material 67.6%, excise duty 14.7%, wages 4.2% and the administrative and selling expenses 13.5%). This composite index for operating expenses shows that operating expenses have been approximately 2.8 times responsive to the general price level changes over the period.

The sales receipts during the period on an average due to specific price changes increased by 40.3% (from 1030.6 to 1446.3 lakh rupees, the total sales revenue for all the 5 years) which is approximately equal to the changes in general price level during the period.

When the prices paid for operating expenses raise without an equal offsetting increase in revenues, it is obvious that the earned cash receipts decrease. Such loss in terms of IRR has been from .71% to -18.53%. When the earned cash receipts are further subject to general price-level increase (inflation), there is an even greater reduction in terms of the rupees of investment. Such loss for general price-level changes in the company comes out to be 5.63% (ROR being reduced from -18.53% to -24.16%).

In summary, specific input price increases reduced the rate of return by 19.24 percentage points, and general price level changes (inflation) reduced the rate of return further by 5.63 percentage.

Effect of General Price-Level Changes Without Specific Price Change

Assume that no changes occurred in the prices paid for operating expenses and the prices received for its output, the real after-tax rate of return, which discounts the stream of net cash flows to a cumulative net worth of zero after adjustment for general price level changes is also shown in table (2). The effect of general price level changes would have reduced the rate of return from .71% to

-5.91%, a reduction of 6.62 percentage points. Such reduction in ROR accrues even after accounting for monetary gains due to repayment of Rs.125 lakhs debt in cheaper rupees.

Asset Disposal Revenue Prices

So far in our computations we have assumed that cash available from working capital at the end of the project would be same as what we invested to begin with i.e., rupees 22 lakhs. We have also assumed that fixed assets would be sold at the written down value. In real life both assumptions do not seem to be valid.

The working capital mainly consists of raw material and the finished goods. If we assume that working capital value would keep pace with specific price changes in operating cost items, then the funds available from such working capital would be much larger than 22 lakh rupees. If we adjust the available working capital funds at the end of the period with the composite index of all the input items in costs which comes out to be 212, the funds released would be equal to 46.64 lakhs.

Similarly, we have adjusted the disposal value of fixed assets at the end of the period to 128.50 lakh rupee. The adjustment factor has been calculated from the specific price indices of machinery subgroup in wholesale price index series of RBI. The relevant price

indices are 165 at the end of the period compared to 108.8 at the beginning of the period.

The computed rate of return using above values for working capital and the fixed assets at the end of the period are as follows:

	Nominal ROR	ROR Adjusted for General Price Level Changes
1. Absence of specific price changes in costs and revenue items	18.4	10.71
2. Actual cash flow (incorporating specific price change)	11.35	4.07

From the above table, we can notice that if there were no price changes in the prices paid for the input items and the prices received for its output, the nominal rate of return would have been 18.4%. Measured in real terms (i.e. in purchasing power of the investment rupee) the rate would have declined to 10.71, a reduction of 7.71 percentage point. If we incorporate specific price changes for revenue and cost items the nominal rate of return is 11.35 with a further decline of 7.28 percentage points to 4.07 if measured in real rupees.

In short, we may observe that profitability of a project is very sensitive to the specific price changes (a decrease of 7.05 percentage points, from 18.4% to 11.35% which is about 38% decline from base rate of return of 18.4%). The effect of general price level changes on rate of return is further decline of 7.28 percentage points which is about 40% decline from the base rate. Both kinds of price level changes reduces the rate of return from 18.4% to 4.07% which is a decline of about 78% from the base rate of return. Can we really ignore such effects?

CONCLUSION

As a result of this study a number of conclusions can be drawn which should help capital investment decision makers in deciding whether improving the accuracy of estimate by adjusting the price-level changes is worth the efforts.

1. Several factors constitute the determinants of the resulting effects of price-level changes on rate of return. Some of these factors are repayment of debt principal, interest on borrowed funds, tax deductions for depreciation and interest, price level responsiveness of operating expenses, terminal salvage value etc. The resulting behaviour of rate of return under conditions of price instability is complex and therefore, no generalisation can be made.

2. When relative and general prices are continuously changing no precise computation of return from investment can be made without converting future cash flow in terms of rupees of investment. The varying units of rupees in terms of purchasing power must be **expressed** in homogeneous units.

3. The financing of the project by debt reduces the sensitivity of the real rate of return on equity to price level changes. The debt is received in current rupees but is repaid in future rupees where in times of inflation are of cheaper values. Thus, the use of leverage either through higher debt level or by use of longer **repayment** intervals, protects the real return to equity in times of inflation.

This study has been a modest attempt to highlight the effect of specific and general price level changes on an investment decision. In past, capital expenditure evaluation techniques have generally ignored the price-level changes, and if attempts ^{were} ~~are~~ made to incorporate such changes, assumption of cash revenue and expenditure being fully responsive to general price level changes has been made. We have to separate the responsiveness of operating expenses from revenues, it is wholly conceivable that two are not equally responsive to general price changes. Another important aspect is that we have used the empirical data, where feasible, as opposed to hypothetical data.

TABLE (I)
ACTUALS

(In lakh rupees)

	1973-74	1974-75	1975-76	1976-77	1977-78
1. Sales Revenue	164.5	153.6	292.5	402.2	433.5
2. Cash Expenses:					
a. Raw material	90.7	70.9	157.2	248.2	257.2
b. Excise Duty	29.5	30.8	50.5	49.4	55.8
c. Manufacturing expenses	9.5	10.4	12.2	14.0	15.8
d. Admn. & Selling expenses	33.4	37.7	43.2	49.4	51.9
e. Interest on Debt	16.2	23.5	25.2	25.1	26.7
	<u>179.3</u>	<u>173.3</u>	<u>288.3</u>	<u>386.1</u>	<u>407.4</u>
3. Non-Cash Expenses					
a. Depreciation	15.0	13.4	12.2	11.0	9.2
b. Preliminary Expenses written off	8.6	1.6	1.6	1.6	6.6
	<u>28.6</u>	<u>15.0</u>	<u>13.8</u>	<u>12.6</u>	<u>15.8</u>
4. Taxable Income (1-2-3)	(38.4)	(34.7)	(9.6)	3.5	10.3
5. Income Tax (55% of item 4)	(21.1)	(19.1)	(5.3)	1.9	5.7
6. Cash Flow (1-2-5)	6.3	(.6)	9.5	14.2	20.4
7. Cash Flow adjusted for General Price-level Changes	6.02	(.46)	7.33	10.74	14.59
				<u>Adjusted for General Price-level change</u>	
A. Initial Equity Outlay		(62.5)		(62.5)	
B. Terminal Cash Flow					
Debt Repayment	(125.0)				
Working Capital Released	22.0				
Proceeds from sale of Fixed Assets at W.D.V.	<u>84.7</u>	(18.3)		(13.09)	
C. Internal Rate of Return		-18.53%		-24.16%	

TABLE ②

Adjusted for Specific Price Changes in Sales Revenue and Operations
Expenses

(In lakh rupees)

	1973-74	1974-75	1975-76	1976-77	1977-78
1. Sales	164.5	105.9	193.7	273.6	292.9
2. Cash Expenses					
a. Raw Material	90.7	46.3	91.9	107.4	104.1
b. Excise Duty	29.5	21.2	33.4	33.6	37.7
c. Manufacturing Expenses	9.5	8.4	16.2	12.2	12.3
d. Admn. & Selling Expenses	33.4	30.9	35.1	41.9	39.3
e. Interest on Debt	16.2	23.5	25.2	25.1	26.7
	179.3	130.3	195.8	220.2	220.1
3. Non-Cash Expenses	23.6	15.0	13.8	12.6	15.8
4. Taxable Income (1-2-3)	(38.4)	(39.4)	(15.9)	40.8	57
5. Income Tax (55% of item 4)	(21.1)	(21.7)	(8.7)	22.4	31.4
6. Cash Flow (1-2-3)	6.3	(2.7)	6.6	31.0	41.4
7. Cash Flow adjusted for General Price-level Changes	6.02	(2.06)	5.09	23.45	29.61
				<u>Adjusted for General Price Level Change</u>	
A. Internal Equity Outlay	(62.5)			(62.5)	
B. Terminal Cash Flow	(18.3)			(13.09)	
C. Internal Rate of Return	.71%			-5.91%	

TABLE (3)
PRICE LEVEL ADJUSTMENT FACTORS

	General	Sales Revenue/ Excise	Raw Material	Wages	Admn. & Selling Expenses
1973-74	104.7	100	100	100	100
1974-75	131.1	145	153	124	122
1975-76	129.6	151	171	120	123
1976-77	132.2	147	231	115	118
1977-78	139.8	148	247	128	132

- Source:
1. General: Wholesale Price Indices for all Commodities
 2. Raw Material: From Companies Records (Annual reports and other documents)
 3. Wages: CPI Industrial Workers for Ahmedabad
 4. Admin. & Selling Expenses: CPI Urban non-manual Employees for Ahmedabad
 5. Sales Revenue: Wholesale Price Indices for Chemical Products
 6. Excise is levied ad volorem, therefore, same indices as of Sales Revenue

All indices (except General Price level index) have been converted to 1973-74 as base year. For General Price-Level Changes the base period is June 1973 (for which wholesale price index is 133.4) to convert the resultant cash flow in terms of purchasing power of the investment date.

In RBI Bulletin (Jan - Dec. 1977) the indices appear as follows:

	Wholesale Price Indices 1970-71 = 100	Chemical Products 1970-71 = 100	Ahmedabad CPI	
			Industrial Workers (1960 = 100)	Urban non-manual employees
1973-74	139.7	116.4	245	222
1974-75	174.9	168.8	305	271
1975-76	172.9	175.6	293	272
1976-77	176.4	171.2	281	263
1977-78	186.5	172.6	314	293

NOTES

1. Largay and Livingstone, Accounting for Changing Prices, John Wiley and Sons, 1976.
2. George R. Terborgh, "Effects of Inflation on Investment Analysis". (Washington: Machinery and Allied Products Institute and Council for Technological Advancement, 1960).
3. L. S. Porwal, Capital Budgeting in India, Sultan Chand & Sons, Delhi 1976.

Porwal survey of the use of evaluation techniques for capital expenditure decisions reveals that 45 per cent of the companies with low profitability have given preference to IRR (Internal Rate of Return) in case of new lines. He also concludes that size of a company does not very much influence the selection of a technique.

4. Wilkes, F.M. "Inflation and Capital Budgeting." Journal of Business Autumn 1972, p.46.
5. All the pertinent information for this project has been obtained from Gujarat Industrial Investment Corporation's files. The disclosure of the company's name has not been made deliberately to preserve the confidentiality. The data collection work was done by a group of students enrolled in my course 'Changing Prices and Financial Decisions' Taught at Indian Institute of Management, Ahmedabad. I sincerely thank them for their efforts. I must also thank Mr. Pillai for his secretarial assistance and Professor Ramani for helping me in computer work.