ISSN: 2278-3369

International Journal of Advances in Management and Economics
Available online at www.managementjournal.info

TECHNICAL NOTE

Capital Recovery and Return

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Abstract

In addition to the recovery of investment**[1]**, interest should be earned on the unrecovered capital during the life of the asset as a cost of ownership. The economic analysis should consider both capital recovery and interest. The present worth of capital recovery and return is the same regardless of the pattern of capital recovery selected.

Keywords: *Capital investment, Present worth, Inflation.*

JEL Classification: H43, H54

Introduction

Suppose an asset with the initial investment I, the estimated useful life N, the end of life salvage value R , and the annual interest i.Y_k , K=1,N = amount of capital recovery(depreciation) for year K payable at the end of the year.

$$\sum_{K=1}^{N} Y_K + R = I$$

and $i\left(\sum_{j=K}^{N} Y_j + R\right)$ = interest cost for unrecovered portion of the investment for year k.The present worth of investment recovery and return over life of asset is:

$$PV = \sum_{K=1}^{N}\left[Y_K + i\left(R + \sum_{j=K}^{N} Y_j\right)\right]\frac{1}{(1+i)^K}$$

$$\sum_{K=1}^{N}\left[Y_K + i\left(\sum_{j=K}^{N} Y_j\right)\right]\frac{1}{(1+i)^K} = \sum_{K=1}^{N} Y_K$$

and

$$\sum_{K=1}^{N} iR\frac{1}{(1+i)^K} = iR\left[\frac{(1+i)^N - 1}{i(1+i)^N}\right] = R\left[1 - \frac{1}{(1+i)^N}\right]$$

Summing up these two expressions we get:

$$PV = \sum_{K=1}^{N} Y_K + R\left(1 - \frac{1}{(1+i)^N}\right)$$

Since $\sum_{K=1}^{N} Y_K + R = I \Longrightarrow \sum_{K=1}^{N} Y_K = I - R$ So that

$$PV = I - R + R\left(1 - \frac{1}{(1+i)^N}\right) \text{ and } PV = I - \frac{R}{(1+i)^N}$$

or $PV = I(1+i)^N - R$.

It results that the present value of capital recovery and return is equal to the original investment cost less the present value of the salvage value and is independent of the capital recovery cost function which is selected. In order to prove this we will develop an example:

The original investment cost 1=11, 000 €
The useful life of the asset, N = 5 years
The interest cost i = 10%
The end of the life salvage value, R = 1,000€
We will use four depreciation methods: straight line, fixed percentage, sum of year's digits and sinking fund**[2]**.

The calculation consists in four steps:

Computing the unrecovered balance at the beginning of each year;
Computing the interest cost of these amounts at 10%;
Determining the present value of these interest costs;
Determining the present value of the capital recovery costs;

Adding the present value of capital recovery to the present value of intereston the unrecovered investment balance.

Capital Unrecovered at the Beginning of the Year

Table 1

Year	Straight line	Fixed	Sum of years	Sinking fund
1	11,000	11.000	11,000	11,000
2	9,000	6,809	7,667	9,226
3	7,000	4,215	5,000	7,346
4	5,000	2,609	3,000	5,352
5	3,000	1,615	1,667	3,329
6	1,000	1,000	1,000	1,000

The Interest Cost, 10% Computed on above Capital:

Table 2

Year	Straight line	Fixed percentage	Sum of years digits	Sinking fund
1	1,100	1,100	1,100	1,100
2	900	680	766	922
3	700	421	500	734
4	500	260	300	535
5	300	161	166	332

Present value of interest of unrecovered balance

Table 3

Year	$\frac{1}{(1+0.10)^j}$	Straight line	Fixed percentage	Sum of years digits	Sinking fund
1	0.9090	1,000	1,000	1,000	1,000
2	0.8264	744	562	633	762
3	0.7513	526	317	376	552
4	0.6830	342	178	205	366
5	0.6209	186	100	103	206
Total		**2,797**	**2,157**	**2,317**	**2,886**

In order to compute the present value of investment recovery at 10% we have calculated the capital allowance (annual depreciation cost) as follows:

Table 4

Year	Straight line	Fixed percentage	Sum of years digits	Sinking fund
1	2,000	4,191	3,333	1,774
2	2,000	2,594	2,667	1,880
3	2,000	1,606	2,000	1,994
4	2,000	994	1,333	2,023
5	2,000	615	667	2,329

The present value [3] of investment recovery at 10% :

Table 5

Year	$\frac{1}{(1+0.10)^j}$	Straight line	Fixed percentage	Sum of years digits	Sinking fund
1	0.9090	1,818	3,810	3,030	1,613
2	0.8264	1,653	2,144	2,204	1,554
3	0.7513	1,502	1,207	1,503	1,498
4	0.6830	1,366	679	911	1,382
5	0.6209	1,242	382	414	1,446
Total		**7,581**	**8,222**	**8,062**	**7,493**

The total present value of interest on unrecovered balance and present value of investment recovery is as follows:

2,797+7,581=10,379
2,157+8,222=10,379
2,317+8,062=10,379
2,886+7,493=10,379

Table 6

	Straight line	Fixed percentage	Sum of years digits	Sinking fund
Total	10,379	10,379	10,379	10,379

We are aware now of the fact that regardless of the depreciation policy used, the present value of capital recovery and return is the same and also it can be computed.

$$PV = 11{,}000 - \frac{1{,}000}{(1+0.10)^5} = 10{,}379\,€$$

It is now easy to determine the equivalent annual amount of investment recovery and return (Q), multiplying PV by capital recovery factor[4]:

$$Q = \frac{I - R/(1+i)^N}{1/(1+i)+\ldots+1/(1+i)^N} = \left(I - \frac{R}{(1+i)^N}\right)\left(\frac{i(1+i)^N}{(1+i)^N-1}\right)$$

$$Q = (I-R)\frac{i(1+i)^N}{(1+i)^N-1} + iR$$

If the investment cost is considered to be a loan, according to this formula, the debt may be considered formed by two elements: (I-R) that will be repaid by uniform annual amounts and R that will be repaid by annual interest since the end of the useful life salvage value, R, will repay the principal at the end of the project. In our example , using the first expression for Q, we have:

Q = 10,379 • 0.26379= 2,738 €

and the second expression:

Q = (11,000 - 1,000) • 0.26379 + 0.10 • 1,000 = 2,738 €

If we consider the investment cost as an amount of money borrowed, then the principal less the end of the useful life salvage value, R, will be repaid from a sinking fund and interest i on the principal I will be paid annualy:

From $Q = (I-R)\frac{i(1+i)^N}{(1+i)^N-1} + iR$ we can rewrite

$$Q = (I-R)\left[\frac{i}{(1+i)^N-1} + i\right] + iR$$

Q = (11,000 - 1,000) • 0.26379+ 0.10 • 1,000 = 2,738 €

$$Q = (I-R)\left[\frac{i}{(1+i)^N-1}\right] + iI$$

In our example:

Q = (11,000 - 1,000) • 0.16379+ 0.10 • 11,000 = 2,738 €

The Impact of Inflation on the Financial Valuation of a Project

Inflation has many types of effects on the financial valuation **[5]**:

- Direct impacts from changes in investment financing,cash balances,accounts receivables,accounts payable,nominal interst rates and exchanges rates
- Tax impacts including interest expenses,depreciation and inventories.

We are interested here in the effect of inflation on the real value of depreciation allowances for capital goods which are deductible for income tax reasons.Usually,the base of the deductions for capital cost allowances is the original nominal cost of the depreciable capital good.

Let's consider the depreciable cost for an investment project equal to 10,000,the straight line depreciation allowance over 5 years and the fiscal policy with an income tax rate of 30%.

Table 7

Period	0	1	2	3	4	5	6

Inflation= 0%. Depreciable Investment=10,000

Investment	5,000	5,000					
Depreciation			2,000	2,000	2,000	2,000	2,000
Real tax savings			600	600	600	600	600

The present value of real tax savings =600(1+0.10) ^ 5/ (1+0.10) ^ 6 = 2,069.34

Inflation=25%.Nominaldepreciable investment=11,250

Table 8

Investment	5,000	6,250					
Depreciation			2,250	2,250	2,250	2,250	2,250
Tax savings			675	675	675	675	675
Price index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
Real tax savings			432.6	346.1	276.6	221.3	177.1
Change in real tax savings			(167.4)	(253.9)	(323.4)	(378.7)	(422.9)
The present value of change in real tax savings at 10%=(1,024.6)			(138.3)	(190.7)	(221.5)	(235.2)	(238.9)

In this example 25 percent rate of inflation causes the tax savings from depreciation expenses deductions to fall by 1,024 which represents approximately 10% of the real value of fixed assets being depreciated.Consequently,the real amount of income tax liabilities will increase.

Let's consider now the same example in the fiscal context of romanian economy ,where the income tax rate is 16 %.

Table 9

Period	0	1	2	3	4	5	6

Inflation= 0% .Depreciable Investment=10,000

Investment	5,ooo	5,000					
Depreciation			2,000	2,000	2,000	2,000	2,000
Real tax savings			320	320	320	320	320

The present value of real tax savings is 320(1+0.10) ^ 5/ (1+0.10) ^ 6 =1,103.648

Inflation=25% . Nominal depreciable investment=11,250

Table 10

Investment	5,000	6,250					
Depreciation			2,250	2,250	2,250	2,250	2,250
Tax savings			360	360	360	360	360
Price index	1.00	1.25	1.56	1.95	2.44	3.05	3.81
Real tax savings			230.76	184.61	147.54	118.03	94,48
Change in real tax savings			(89.24)	(135.39)	(172.46)	(201.97)	(225.52)
The present value of change in real tax savings at 10%=(545.96)			(73.75)	(101.72)	(117.79)	(125.40)	(127.30)

In this example 25 percent rate of inflation causes the tax savings from depreciation expenses deductions to fall by 545.96 which represents approximately 5.45 % of the real value of fixed assets being depreciated.Consequently,the real amount of income tax liabilities will increase [6].

Conclusions

An investment in an asset is expected to return not only the capital invested in that asset but also to provide for interest earnings on the diminishing investment remaining, similar to interest on the unpaid balance when a loan is discussed. These two forms of earnings are referred to as capital recovery plus return. The analysis should also consider the effects of inflation in the financial valuation of an investment project. Another approach of valuing an asset consists in determining its market value i.e. the amount a willing buyer will pay a willing seller so the only time when this is feasible is at the end of the economic life of an asset, when it is sold; both asset value and depreciation are determined by a process of estimation.

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