**REST Journal on Emerging trends in Modelling and Manufacturing**
**Vol:2(3),2016**
**REST Publisher**
**ISSN: 2455-4537**

**Website: www.restpublisher.com/journals/jemm**

# Evaluation of Present Value

**Nirjhar Chakravorti**

Member, Jalpaiguri Government Engineering College Alumni Association
nirjhar.mechanical@gmail.com

**Abstract**

***Moving cash flows across time is a fundamental tool in capital budgeting. This happens with some defined relationship with interest rate or discount rate decided by reserve bank or federal bank. But at the same time, normally price of all entities increase or in some exceptional cases decrease, which is known as inflation or deflation. It adds a dimension to the valuation of money. There is a standard relation between interest rates and inflation. Real interest rate is roughly equal to nominal interest rate minus inflation rate. So it is interesting to know the present value of any future cost or value. Various evaluating methods are already available to calculate present value of any future cost or value. However, all the evaluating methods have their own limitation. This document gives an alternative method of calculating present value.***

Keywords: Inflation; Present value calculation; Discount Analysis

## I. Introduction

Money available at the present time is worth more than the same amount in the future. Today's 100 dollar is worth more than the 100 dollar after five years. The main reason behind this concept is the earning capacity of money. So after five years if someone earns 100 USD then what shall be present value of that 100 USD? Few methods are already available for economic and financial evaluation of present value for any future value or future cost. Aim of this paper is to develop an alternative method of calculating present value which can be used for general applications in normal logical market scenario. As money deposited in a savings account earns interest, so we prefer to receive money today rather than the same amount in the future. Considering the same, present value of any future amount is calculated on the basis of interest rate. Interest rate is synonymous to discount rate which a central bank charges depository institutions that borrow reserves from it. When present value is calculated considering the effect of discount rate only, then the discount rate is considered as real discount rate. But in actual market scenario, only interest rate or discount rate does not affect the present value of any future cost. Another major factor which affects present value is inflation. When discount rate is adjusted with respect to inflation rate then the modified discount rate becomes nominal discount rate. The inflation rate is the percentage by which prices of goods and services rise beyond their average levels. It is the rate by which the purchasing power of the people in a particular geography decline in a specified period. Based on calculation method, different present value for a certain future value can be obtained. This study emphasizes on evaluation of present value considering combined discount rate and inflation rate.

## II. Prevailing Methods for Evaluating Present Value

The most conventional method for calculating present value is based on real discount rate. The formula for calculating present value on discount rate basis only is as follows:

$$PV = C / (1+d)^{n} \quad .......... \quad [Eqn\ 1]$$

Where:
PV= the present value of any future value or cost
C= the value or cost in the future
d= discount rate
n= no. of year

But in normal market conditions, inclusion of inflation rate is more realistic approach to obtain present value. Financial value or cost for a particular entity not only depends on interest rate but also depends on purchasing capacity, demand and supply and many other considerations. So inclusion of inflation rate is a logical approach to evaluate present value. Some economists replace discount rate, "d" with "$d_{real}$" with following consideration:

$$d_{real} = \{(1+d)/ (i+i)\}-1 \qquad [eqn\ 2]$$

....where "i" is the inflation rate.

With above consideration (as per eqn 2) the formula for present value (as described in eqn 1) turned into

$PV= C/(1+d_{real})^n$ [eqn 3]

$= C (1+i)^n / (1+d)^n$ [eqn 4]

## III. New Method for Evaluation of Present Value

Inclusion of inflation rate provides more realistic approximation for present value for any future value or cost. But same power factor for numerator and denominator (in the above eqn 4), provides some thoughtful insight. Example, if in any circumstances, discount rate and inflation rate become same, then value of present value of a value or cost at $n^{th}$ year become same as future value or cost, which is not a realistic situation. This can also be explained by the exact relationship between interest rate and inflation as per eqn 2.

$d_{real} = \{(1+v)/ (1+v)\}-1$ ....where d = i = v

i.e. $d_{real} = 0$

So, in eqn. 3, PV=C

By virtue of many factors, money always devalued to certain extent irrespective of same discount rate and inflation rate. To take care the same, following relationship has been considered for discount rate and inflation rate:

$d_{real} = \{(1+d)/ (1+i)^{(1-1/n)}\}-1$ [eqn 2']

By applying $d_{real}$ as per eqn 2', new formula for evaluating present value evolved as:

$PV= \{C (1+i)^{(n-1)}/ (1+d)^n\}$ [eqn 5]

## IV. Results & Discussion

Results have been evaluated for different inflation rate and discount rate for all the above formulas for present value. Abbreviations used in tables are as follows:

"d"= Discount rate

"i"= inflation rate

FV= Future Value or Cost at any $n^{th}$ year

$PV_1$= PV of any year (as per eqn 1)

$PV_2$=PV of any year (as per eqn 5, new method)

$PV_3$=PV of any year (as per eqn 4)

Table 1: Present Value for different discount & inflation rate

| **Time Period ($n^{th}$ year)** | **d** | **i** | **FV** | **$PV_1$** | **$PV_2$** | **$PV_3$** |
|---|---|---|---|---|---|---|
| | **%** | **%** | **Monetary Unit** | | | |
| 1 | | | | - | - | - |
| 2 | 8 | 5 | 100 | 85.7 | 90.0 | 94.5 |
| 3 | 8 | 5 | 100 | 79.4 | 87.5 | 91.9 |
| 4 | 8 | 5 | 100 | 73.5 | 85.1 | 89.3 |
| 5 | 8 | 5 | 100 | 68.1 | 82.7 | 86.9 |
| 6 | 8 | 5 | 100 | 63.0 | 80.4 | 84.4 |
| 7 | 8 | 5 | 100 | 58.3 | 78.2 | 82.1 |
| 8 | 8 | 5 | 100 | 54.0 | 76.0 | 79.8 |
| 9 | 8 | 5 | 100 | 50.0 | 73.9 | 77.6 |
| 10 | 8 | 5 | 100 | 46.3 | 71.9 | 75.4 |
| 11 | 8 | 5 | 100 | 42.9 | 69.9 | 73.4 |
| 12 | 8 | 5 | 100 | 39.7 | 67.9 | 71.3 |
| 13 | 8 | 5 | 100 | 36.8 | 66.0 | 69.3 |
| 14 | 8 | 5 | 100 | 34.0 | 64.2 | 67.4 |
| 15 | 8 | 5 | 100 | 31.5 | 62.4 | 65.5 |
| 16 | 8 | 5 | 100 | 29.2 | 60.7 | 63.7 |
| 17 | 8 | 5 | 100 | 27.0 | 59.0 | 61.9 |
| 18 | 8 | 5 | 100 | 25.0 | 57.4 | 60.2 |
| 19 | 8 | 5 | 100 | 23.2 | 55.8 | 58.6 |
| 20 | 8 | 5 | 100 | 21.5 | 54.2 | 56.9 |
| 21 | 8 | 5 | 100 | 19.9 | 52.7 | 55.3 |
| 22 | 8 | 5 | 100 | 18.4 | 51.2 | 53.8 |
| 23 | 8 | 5 | 100 | 17.0 | 49.8 | 52.3 |
| 24 | 8 | 5 | 100 | 15.8 | 48.4 | 50.9 |
| 25 | 8 | 5 | 100 | 14.6 | 47.1 | 49.4 |

Fig. 1: A line graph showing PV calculated for different "d" and "i"

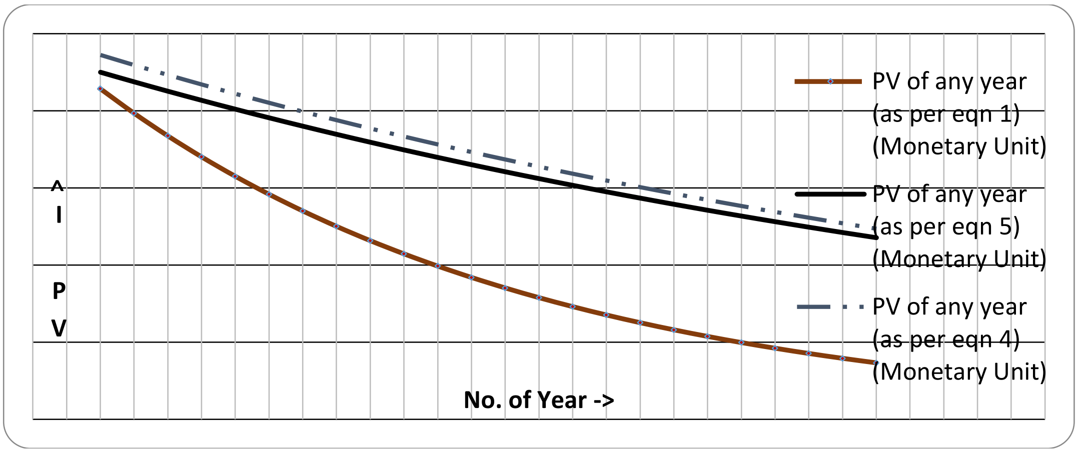



Table 2: present value for same discount & inflation rate

| Time Period ($n^{th}$ year) | d | i | FV | $PV_1$ | $PV_2$ | $PV_3$ |
|---|---|---|---|---|---|---|
| | % | % | Monetary Unit | | | |
| 1 | | | | - | - | - |
| 2 | 8 | 8 | 100 | 85.7 | 92.6 | 100.0 |
| 3 | 8 | 8 | 100 | 79.4 | 92.6 | 100.0 |
| 4 | 8 | 8 | 100 | 73.5 | 92.6 | 100.0 |
| 5 | 8 | 8 | 100 | 68.1 | 92.6 | 100.0 |
| 6 | 8 | 8 | 100 | 63.0 | 92.6 | 100.0 |
| 7 | 8 | 8 | 100 | 58.3 | 92.6 | 100.0 |
| 8 | 8 | 8 | 100 | 54.0 | 92.6 | 100.0 |
| 9 | 8 | 8 | 100 | 50.0 | 92.6 | 100.0 |
| 10 | 8 | 8 | 100 | 46.3 | 92.6 | 100.0 |
| 11 | 8 | 8 | 100 | 42.9 | 92.6 | 100.0 |
| 12 | 8 | 8 | 100 | 39.7 | 92.6 | 100.0 |
| 13 | 8 | 8 | 100 | 36.8 | 92.6 | 100.0 |
| 14 | 8 | 8 | 100 | 34.0 | 92.6 | 100.0 |
| 15 | 8 | 8 | 100 | 31.5 | 92.6 | 100.0 |
| 16 | 8 | 8 | 100 | 29.2 | 92.6 | 100.0 |
| 17 | 8 | 8 | 100 | 27.0 | 92.6 | 100.0 |
| 18 | 8 | 8 | 100 | 25.0 | 92.6 | 100.0 |
| 19 | 8 | 8 | 100 | 23.2 | 92.6 | 100.0 |
| 20 | 8 | 8 | 100 | 21.5 | 92.6 | 100.0 |
| 21 | 8 | 8 | 100 | 19.9 | 92.6 | 100.0 |
| 22 | 8 | 8 | 100 | 18.4 | 92.6 | 100.0 |
| 23 | 8 | 8 | 100 | 17.0 | 92.6 | 100.0 |
| 24 | 8 | 8 | 100 | 15.8 | 92.6 | 100.0 |
| 25 | 8 | 8 | 100 | 14.6 | 92.6 | 100.0 |

Fig.2: A line graph showing PV calculated for same "d" and "i"

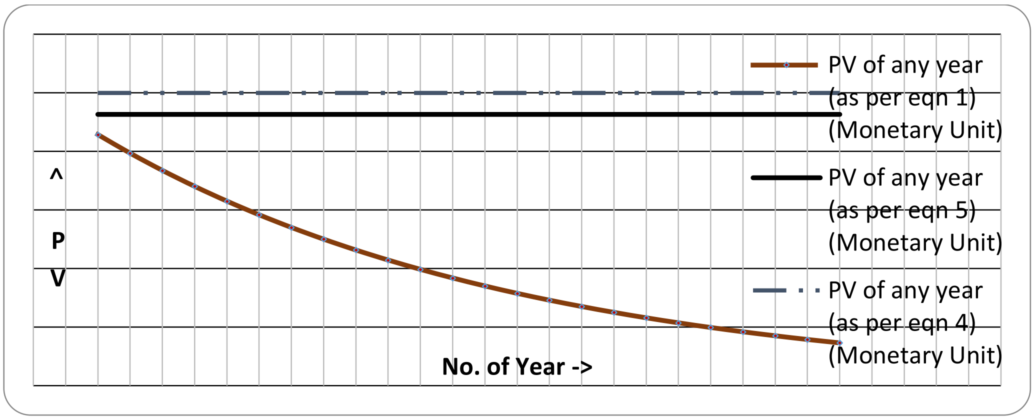


Table 3: Present Value for negative inflation rate

| Time Period (n^th year) | d | i | FV | $PV_1$ | $PV_2$ | $PV_3$ |
|---|---|---|---|---|---|---|
| | % | % | Monetary Unit | | | |
| 1 | | | | - | - | - |
| 2 | 8 | -5 | 100 | 85.7 | 81.4 | 77.4 |
| 3 | 8 | -5 | 100 | 79.4 | 71.6 | 68.1 |
| 4 | 8 | -5 | 100 | 73.5 | 63.0 | 59.9 |
| 5 | 8 | -5 | 100 | 68.1 | 55.4 | 52.7 |
| 6 | 8 | -5 | 100 | 63.0 | 48.8 | 46.3 |
| 7 | 8 | -5 | 100 | 58.3 | 42.9 | 40.7 |
| 8 | 8 | -5 | 100 | 54.0 | 37.7 | 35.8 |
| 9 | 8 | -5 | 100 | 50.0 | 33.2 | 31.5 |
| 10 | 8 | -5 | 100 | 46.3 | 29.2 | 27.7 |
| 11 | 8 | -5 | 100 | 42.9 | 25.7 | 24.4 |
| 12 | 8 | -5 | 100 | 39.7 | 22.6 | 21.5 |
| 13 | 8 | -5 | 100 | 36.8 | 19.9 | 18.9 |
| 14 | 8 | -5 | 100 | 34.0 | 17.5 | 16.6 |
| 15 | 8 | -5 | 100 | 31.5 | 15.4 | 14.6 |
| 16 | 8 | -5 | 100 | 29.2 | 13.5 | 12.8 |
| 17 | 8 | -5 | 100 | 27.0 | 11.9 | 11.3 |
| 18 | 8 | -5 | 100 | 25.0 | 10.5 | 9.9 |
| 19 | 8 | -5 | 100 | 23.2 | 9.2 | 8.7 |
| 20 | 8 | -5 | 100 | 21.5 | 8.1 | 7.7 |
| 21 | 8 | -5 | 100 | 19.9 | 7.1 | 6.8 |
| 22 | 8 | -5 | 100 | 18.4 | 6.3 | 6.0 |
| 23 | 8 | -5 | 100 | 17.0 | 5.5 | 5.2 |
| 24 | 8 | -5 | 100 | 15.8 | 4.8 | 4.6 |
| 25 | 8 | -5 | 100 | 14.6 | 4.3 | 4.1 |

Fig. 3: A line graph showing PV calculated for positive "d" and negative "i"

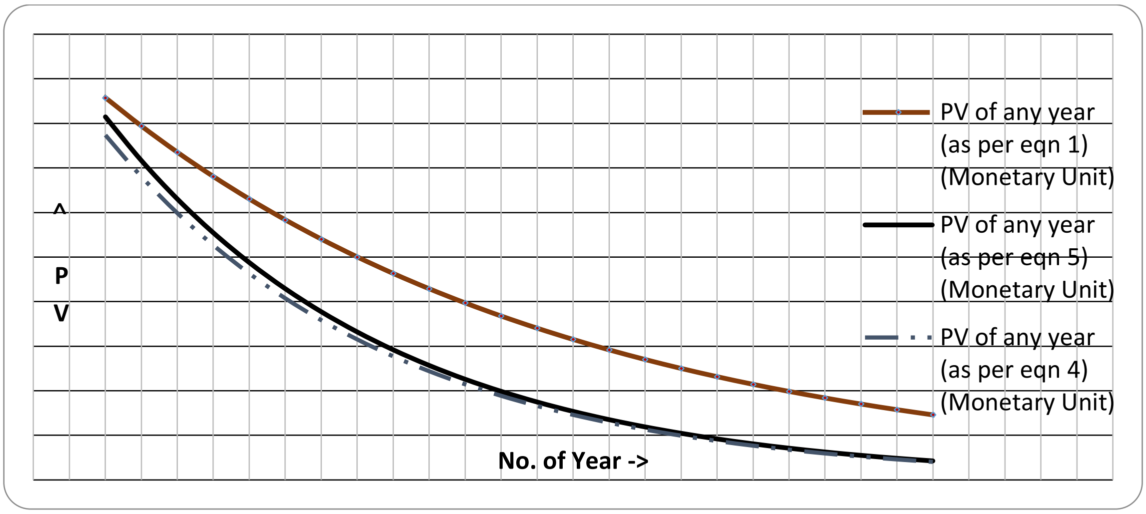
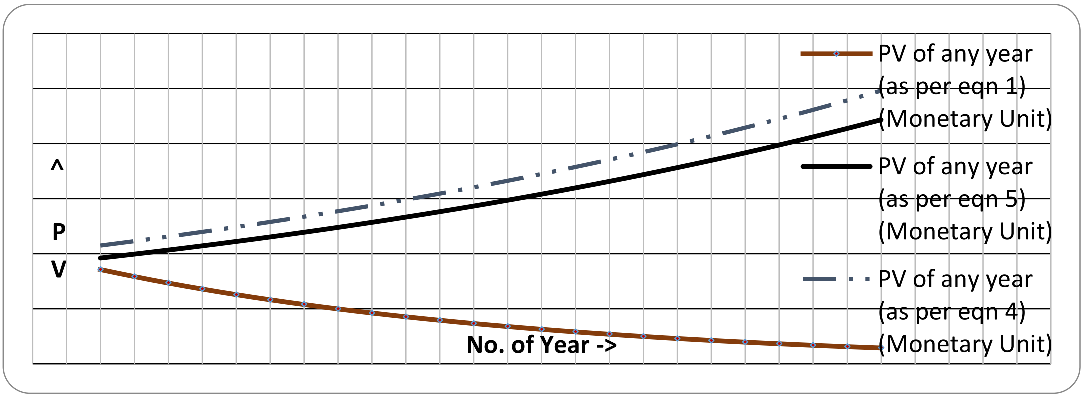



Table 4: Present Value for Higher Inflation Rate

| Time Period(n^th year) | d | i | FV | $PV_1$ | $PV_2$ | $PV_3$ |
|---|---|---|---|---|---|---|
| | % | % | Monetary Unit | | | |
| 1 | | | | - | - | - |
| 2 | 8 | 12 | 100 | 85.7 | 96.0 | 107.5 |
| 3 | 8 | 12 | 100 | 79.4 | 99.6 | 111.5 |
| 4 | 8 | 12 | 100 | 73.5 | 103.3 | 115.7 |
| 5 | 8 | 12 | 100 | 68.1 | 107.1 | 119.9 |
| 6 | 8 | 12 | 100 | 63.0 | 111.1 | 124.4 |
| 7 | 8 | 12 | 100 | 58.3 | 115.2 | 129.0 |
| 8 | 8 | 12 | 100 | 54.0 | 119.4 | 133.8 |
| 9 | 8 | 12 | 100 | 50.0 | 123.9 | 138.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | 8 | 12 | 100 | 46.3 | 128.4 | 143.9 |
| 11 | 8 | 12 | 100 | 42.9 | 133.2 | 149.2 |
| 12 | 8 | 12 | 100 | 39.7 | 138.1 | 154.7 |
| 13 | 8 | 12 | 100 | 36.8 | 143.3 | 160.4 |
| 14 | 8 | 12 | 100 | 34.0 | 148.6 | 166.4 |
| 15 | 8 | 12 | 100 | 31.5 | 154.1 | 172.5 |
| 16 | 8 | 12 | 100 | 29.2 | 159.8 | 178.9 |
| 17 | 8 | 12 | 100 | 27.0 | 165.7 | 185.6 |
| 18 | 8 | 12 | 100 | 25.0 | 171.8 | 192.4 |
| 19 | 8 | 12 | 100 | 23.2 | 178.2 | 199.6 |
| 20 | 8 | 12 | 100 | 21.5 | 184.8 | 207.0 |
| 21 | 8 | 12 | 100 | 19.9 | 191.6 | 214.6 |
| 22 | 8 | 12 | 100 | 18.4 | 198.7 | 222.6 |
| 23 | 8 | 12 | 100 | 17.0 | 206.1 | 230.8 |
| 24 | 8 | 12 | 100 | 15.8 | 213.7 | 239.4 |
| 25 | 8 | 12 | 100 | 14.6 | 221.6 | 248.2 |

Fig.4: A line graph showing PV calculated for higher “i”




## V. Conclusions

The values evaluated from the eqn 5 provide a value which has few insights:

- In case of normal market scenario, when inflation rate is lesser than discount rate (refer table 1), nature of curve for both eqn 4 and eqn 5 are almost similar in nature.
- In case of same discount and inflation rate (refer table 2), present value and future value is same as per eqn 4. But money has natural tendency of devaluation. So, in logical market, money gets devalued even if inflation rate and discount/ interest rates become same. In that context, eqn 5 provides more logical conclusion as money devaluation is captured even if inflation rate and discount rate become same.
- It is said that negative inflation/ deflation has negative impact on economy and money further devalued when inflation is negative. Both eqn 4 and eqn 5 justifies the same notion (refer table 3). So eqn 5 justifies the fundamental of economic considerations.
- When inflation rate increases than discount/ interest rate, then as per eqn. 4, present values of any future cost/ value starts increasing from beginning (refer table 4). It is a common economic concept. As per economics it has a negative impact on economy as people try to hold money in this scenario which makes the market standstill. But it is also true that when inflation rate start increasing then immediately money devalued for first few years and then its’ value start increasing. Eqn 5 catches this real market situation. But due to hyperbolic nature after few years present value increases which justifies economic behavior for monetary valuation.
- When as per eqn 1 present value reduce drastically and as per eqn 4 present value is more or less closer to future value/ cost, eqn 5 provides a mediocre result for any given future value/ cost (for all the cases).

In economic evaluation, various assumptions are made based on situational market condition. So any logically explained method for calculating present value can be used. In this context eqn 5 provides some alternative option which can be further analysed for evaluating present value.

## References

[1]. State of Alaska - Department of Education & Early Development, Life Cycle Cost Analysis Handbook, 1st ed., 1999
[2]. Davis Langdon Management Consulting, Life cycle costing (LCC) as a contribution to sustainable construction: a common methodology, May 2007