

Time value of money

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Time value of money:

The concept of the **Time Value of Money** is fundamental in finance and economics, and it explains why money available today is more valuable than the same amount of money received in the future. This principle is based on the idea that money has the potential to earn returns over time, so having it now allows one to invest or use it productively, making its current value higher than its future value.

What is the Time Value of Money?

The time value of money means that ₹100 today is worth more than ₹100 one year from now. This is because if one has that ₹100 today, they can invest it in a savings account, stock, or some other opportunity that earns interest or profit. Over time, the original amount will grow due to these earnings.

For instance, if one keeps ₹100 under mattress, it won't grow. Actually, due to inflation (the rise in prices), that ₹100 will buy less in the future. But if one invest it in a bank's savings account earning 5% interest per year, after one year, you will have ₹105. So money today is worth more because it can grow.

Why Time Value of Money Matters

1. **Investment Decisions:** TVM helps investors decide whether to accept money now or in the future by comparing present and future values.
2. **Loan and Borrowing:** Banks charge interest on loans because of Time Value of Money they are compensated for deferring the use of money.
3. **Financial Planning:** Helps individuals plan for retirement, education, or other goals by understanding how money grows over time.
4. **Opportunity Cost:** Considering TVM ensures better decision-making by reflecting the cost of waiting or losing potential returns.

Formula to Calculate Time Value of Money

TVM is often quantified by calculating the **Future Value (FV)** or **Present Value (PV)** of money:

Future Value (How much money grows in the future)

$$FV = PV \times (1 + r/n)^{nt}$$

Where:

- FV = Future value
- PV = Present value (initial money)
- r = Annual interest rate (decimal)

- n = Number of compounding periods per year
- t = Number of years

Present Value (What a future sum is worth today)

$$PV = FV(1+rn)^{nt}$$

Example of Time Value of Money

Suppose a student is given a choice to receive ₹10,000 now or ₹10,000 one year from now. If the annual interest rate is 6%, then receiving ₹10,000 now and investing it would grow to:

$$FV = ₹10,000 \times (1+0.06)^1 = ₹10,600$$

So, ₹10,000 today is worth more than ₹10,000 next year because if taken today it can grow to ₹10,600.

On the other hand, if the student wants to know how much ₹10,600 one year from now is worth in today's terms:

$$PV = ₹10,600 / (1+0.06)^1 = ₹10,000$$

Thus, **Time Value of Money** teaches that money is more valuable the sooner it is received because it can be invested to earn returns. This principle guides personal finance, investments, loans, and business decisions. Understanding Time Value of Money helps in making well-informed choices about spending, saving, and investing for the future.

Future Values:

The calculation of **Future Value (FV)** answers the question: "How much will a sum of money invested today be worth at a specific time in the future?" This is an important concept in finance because it takes into account the time value of money, showing how money grows over time with interest.

Future Value Calculation

The future value depends mainly on three factors:

- The original amount invested (called the **Present Value, PV**)
- The interest rate or rate of return (usually expressed as a percentage)
- The number of time periods (usually years) the money is invested or saved

Basic Future Value Formula (For One-Time Investment)

If an amount of money is invested once and earns an interest rate r compounded annually over n years, the future value is calculated as:

$$FV = PV \times (1+r)^n$$

Where:

- FV = Future Value (amount after n years)
- PV = Present Value (initial investment)
- r = Interest rate per period (decimal, so 5% is 0.05)
- n = Number of compounding periods (years)

Example 1:

Suppose a student invests ₹10,000 in a savings account that offers 6% interest compounded annually. We want to find out how much this investment will be worth after 3 years.

$$\begin{aligned} FV &= 10,000 \times (1+0.06)^3 \\ &= 10,000 \times 1.191016 \\ &= ₹11,910.16 \end{aligned}$$

So after 3 years, the student will have ₹11,910.16 in the account.

Compounding More Frequently than Annually

Interest can be compounded more frequently, such as semi-annually, quarterly, or monthly. The general formula for compounding periodically is:

$$FV = PV \times (1+r/m)^{n \times m}$$

Where:

m = number of compounding periods per year (e.g., 12 for monthly)

For example, if the same ₹10,000 was compounded monthly at 6% annual interest for 3 years:

$$\begin{aligned} FV &= 10,000 \times (1+0.06/12)^{3 \times 12} \\ &= 10,000 \times (1.005)^{36} \\ &= 10,000 \times 1.19668 \\ &= ₹11,966.80 \end{aligned}$$

This is slightly higher than annual compounding because the interest itself earns interest every month.

Future Value of Multiple Payments (Annuities)

If a student saves a fixed amount regularly, say ₹1,000 every month, the future value of these regular payments compounded over time is calculated differently, using the annuity formula. Calculating this requires summing the future values of each payment, but simplified formulas or calculators are generally used.

- Future value calculation shows the potential growth of money with interest over time.
- Money grows faster with a higher interest rate, longer investment periods, and more frequent compounding.
- Knowing how to calculate future value helps students plan their savings, understand investments, and compare financial options.

Present Value:

The calculation of **Present Value (PV)** answers the question: “What is the value today of a certain amount of money that you expect to receive in the future?” Present Value is the inverse of Future Value and is essential for understanding the time value of money.

Present Value Calculation

Since money today is more valuable than the same money in the future due to potential earning capacity, we use Present Value to discount future money to today’s terms.

Present Value Formula

The basic formula to calculate Present Value is:

$$PV = FV / (1+r)^n$$

Where:

- PV = Present Value (today’s equivalent amount)
- FV = Future Value (amount to be received in the future)
- r = Discount rate or interest rate per period (in decimal)
- n = Number of time periods (usually years)

Explanation

- The **discount rate**, r, reflects the rate of return you could earn by investing money today.
- The number of periods, n, represents how far in the future the money will be received.
- Dividing the future amount by $(1+r)^n$ discounts it to the present value, adjusting for the time and interest lost.

Example 2: Suppose a student is promised ₹12,000 one year from now. If the annual discount rate is 6%, the present value of that ₹12,000 is calculated as:

$$PV = 12,000 / (1+0.06)^1 = 12,000 / 1.06 = ₹11,320.75$$

This means ₹12,000 received one year later is worth ₹11,320.75 today assuming you could invest at 6%.