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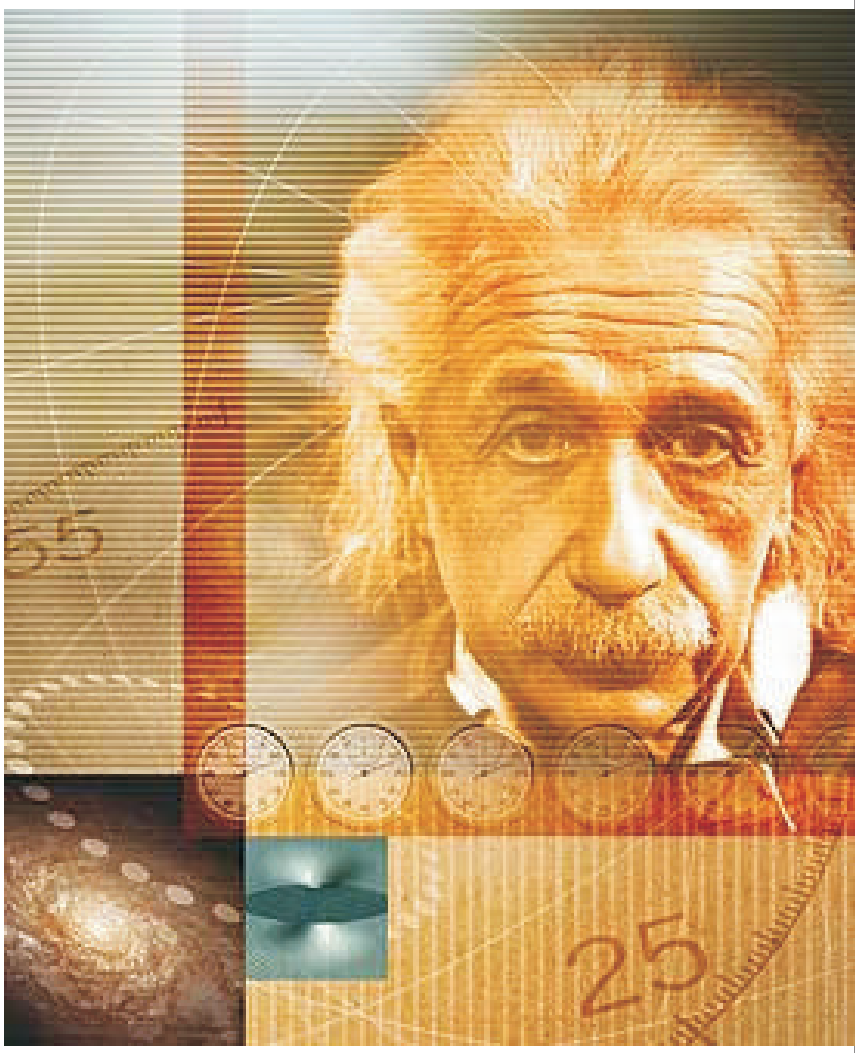
# POWER OF COMPOUNDING

## How Compounding Works

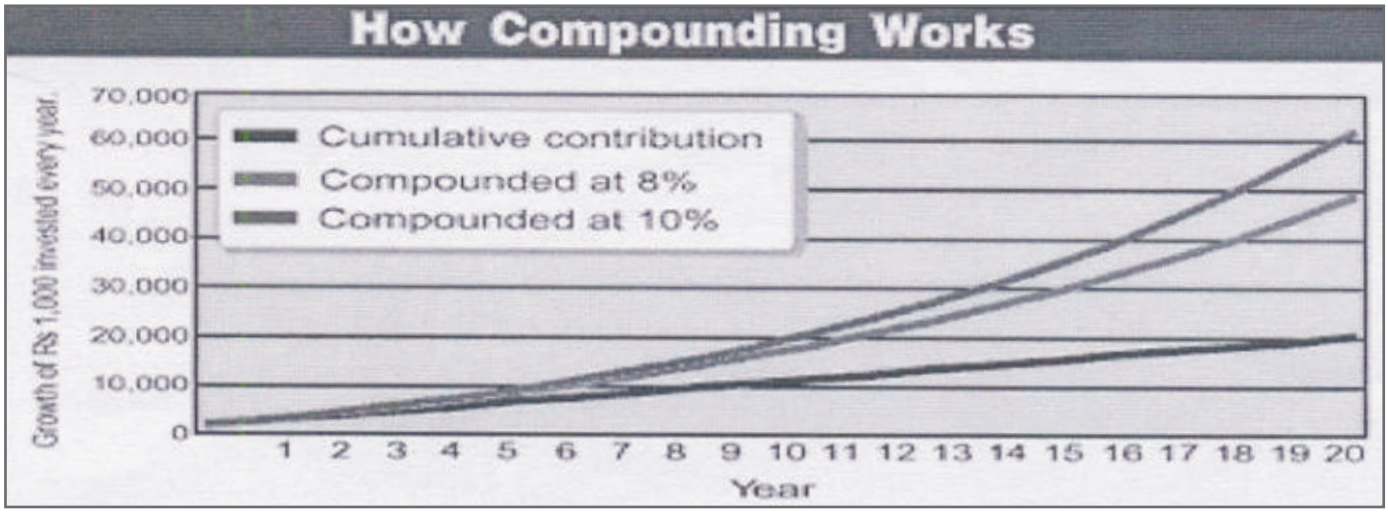
Edition: December 2009

# Power Of Compounding

- Albert Einstein called it the greatest mathematical discovery of all time. Benjamin Franklin supposedly said it was the eighth wonder of the world. That is the Power of Compounding!

## What is Compounding?

- Benjamin Franklin once wrote somewhere: "This the stone that will turn all your lead into gold. Remember that money is of a prolific, generating nature. Money can beget money, and its offspring can beget more." Compounding is a simple, but a very powerful concept. Why powerful? Because compounding is similar to a multiplier effect since the interest that is earned by the initial capital also earns an interest, the value of the investment grows at a geometric (always increasing) rate rather than an arithmetic (straight-line) rate (see How Compounding Works). The higher the rate of return, the steeper the curve.




- For example, at an annual interest rate of 8 per cent, a Rs 1,000-investment every year will grow to Rs 50,000 in 20 years. While at a 10 per cent rate of interest, the same investment will fetch you Rs 63,000 in 20 years. So, it is quite clear that a 2 per cent difference in the interest rate can make you richer or poorer by Rs 13,000. And, by staying invested for a longer period, your capital will earn more money for you. As the number of years goes up, the curve will be steeper, which is the effect of compounding.

- Basically, compounding is a long-term investment strategy. For example, when you own a mutual fund, compounding allows you to earn interest on your principal. Compounding also occurs when you re-invest your earnings. In the case of mutual funds, this means reinvesting your interest or dividend, and receiving additional units. By doing such a thing, you are earning a return on your returns and the principal. When the principal is combined with the re-invested income, your investment will grow at an increased rate. The best way to take advantage of compounding is to start saving and investing wisely as early as possible. The earlier you start investing, the greater will be the power of compounding.

# Power Of Compounding

## Example

- Credit card companies use the power of compound interest against consumers. If a cardholder does not payoff the entire monthly bill, interest accrues. The next billing period, the cardholder is charged interest on the previous period's interest, and so on. Compounding investment earnings can turn your small investments into a whopping sum after a period of time. The best way to take advantage of compounding is to start saving and investing wisely as early as possible. Let's see how the concept of compounding works. Suppose Vishal started investing Rs 2,000 per year at the age of 19 and when he reaches 27, he stops investing and locks all his investments till retirement. Ashish, however, doesn't make any investment till he is 27. At 27, he starts investing Rs 2,000 a year till the age of 58. The adjacent table tells you how their investments would turn out when they both are 58, assuming that the growth rate is 8 per cent per annum. The results are eye-popping (see the Table: Compounding: A Tale of Two Investors).

**Compounding: A Tale of Two Investors**

| | Vishal | | Ashish | |
|---|---|---|---|---|
| Age (Yrs.) | Annual Inv. (Rs.) | Year-end Value (Rs.) | Annual Inv. (Rs.) | Year-end Value (Rs.) |
| 19 | 2,000 | 2,160 | 0 | 0 |
| 20 | 2,000 | 4,493 | 0 | 0 |
| : | : | : | : | : |
| : | : | : | : | : |
| 26 | 2,000 | 22,975 | 0 | 0 |
| 27 | 0 | 24,813 | 2,000 | 2,160 |
| 28 | 0 | 26,798 | 2,000 | 4,493 |
| : | : | : | : | : |
| : | : | : | : | : |
| 57 | 0 | 2,49,686 | 2,000 | 2,66,427 |
| 58 | 0 | 2,69,661 | 2,000 | 2,89,901 |
| **Less Total Inv** | | : 16,000 | | : 64,000 |
| **Total** | | 2,53,661 | | 2,25,901 |
| **Growth Of Inv** | | 16 fold | | 4 fold |

*Assuring a return of 8 percent per annum*

# Power Of Compounding

## Formulas

- We are now familiar with the compound interest and continuous compounding interest formulas

**Compound Interest:** $A = P(1 + r/n)^{nt}$
**Continuous Compounding Interest:** $A = Pe^{rt}$

We will look at these exponential models in more detail now, in addition to simple interest, and represent compound interest in a general form.

**Definitions**

**Principal** – (in financial formulas) is the balance upon which interest is paid.

**Simple Interest** – interest paid only on the original principal, not on any interest added at later dates.

**Compound Interest** – interest paid both on the original principal and on all interest that has been added to the original principal.

**Annual Percentage Rate (APR)** – Interest paid once a year without taking into account the compounding of interest within that year.

**Annual Percentage Yield (APY)** – actual percentage by which a balance increases in one year (= APR if Interest compounded annually.)

**Example**

After 4 years, what total amount and interest gained will you have in a special savings account in which you deposit $600 IF it pays 10% annually

Simple Interest? Compound Interest (if compounded annually)? Compound Interest (if compounded semi-annually)? Continuously Compounded Interest?

## The Compounding Interest Formula (General Form):

- $A=P(1+i)^N$

where A = accumulated balance (also referred to as FV, future value)
P = starting Principal (also referred to as PV, present value)
i = interest rate (express in decimal form)
N = number of times interest is paid

**NOTE:** The General Form of compound interest formula may be used for any compound interest problem. It will be rewritten to satisfy usual cases of a) interest paid once a year (annually), b) interest paid two or more times per year, and interest paid continuously at all times.

**Compound Interest Formula for Interest Paid Once a Year:**

$A=P(1+APR)^Y$

where A = accumulated balance after Y years (referred to as FV, future value)
P = starting Principal (also referred to as PV, present value)
APR = annual percentage rate (express in decimal form)
Y = number of years

**Compound Interest Formula for Interest Paid *n* Times per Year:**

$A=P(1+APR/n)^{nY}$

where A = accumulated balance after Y years (referred to as FV, future value)
P = starting Principal (also referred to as PV, present value)
APR = annual percentage rate (express in decimal form)
n = number of compounding periods per year
Y = number of years

**Annual Percentage Yield (APY):**

$$APY = \text{relative increase} = \frac{\text{absolute increase}}{\text{starting principal}}$$

**NOTE:** see definition in the beginning of these notes. APY is greater than the APR if interest is compounded more than once a year.

**Compound Interest Formula for Continuous Compounding:**

$A=Pe^{APR * Y}$

where A = accumulated balance after Y years (referred to as FV, future value)
P = starting Principal (also referred to as PV, present value)
APR = annual percentage rate (express in decimal form)
Y = number of years

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