Time Value of Money : Concepts and Applications

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Abstract

The case, at its core, explored the concepts of time value of money from the perspective of a newly joined intern in Money Smart Consultancy Pvt. Ltd. The value of money doesn't stay static because of certain factors such as inflation at play. The value of money changes as it moves on the timeline either forward or backward. The concept of compounding was used for finding out the equivalent amount of money in the future when one moves forward on the timeline. Different types of cash flows such as lump sum, annuity, perpetuity, etc. were discussed to make the reader understand through the questions of the protagonist of this case. The rates used for compounding/discounting are indicative of the cumulative risk assumed by the investor for which he/she ought to be compensated. Through different cases of various companies, Joy discussed the concepts and their applications with his intern.

Keywords : **time value of money, compounding, discounting, timeline**

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"Compound interest is the eighth wonder of the world. He who understands it, earns it ; he who doesn't, pays it."

- Albert Einstein

It is the first of January 2020 and Joy Sircar (Joy, hereafter) is feeling elated today as it is the fifth anniversary of his company Money Smart Consultancy Pvt. Ltd. He reminisces the tinge of hesitation before leaving his comfortable position in a reputed MNC where he worked in the capacity of senior consultant for almost a decade before starting his own enterprise. After realizing that there are a large number of small and medium tier investors and firms that don't opt for consultation in the large consultancies, he decided to start a venture of his own where he would provide consultation to these clients at an affordable price. Clients can subscribe the consultation service for a 1 year period for a fee of ₹ 150,000.

Few of the clients associated with Joy's previous firm were so impressed with his work that they switched to his new company. Notable clients among them who had subscribed for a 3 - year unlimited consultation service are Ranjan Textiles Pvt. Ltd., Nilay Sudhiram Entertainments Pvt. Ltd., Singh & Jeevan Constructions Pvt. Ltd., Vipin Heavy Metal Works Pvt. Ltd., and Medsafe Medical Instruments Ltd. His new intern, Keya just walked in the office, wished him "Happy New Year!," and brought him a set of files belonging to various clients.

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Curious, as Keya was, she asked Joy about the contents of those files. Joy responded that these files had cash flow schedules of his and his clients' companies. Responding to Keya's question of what cash schedules were, Joy said that a cash schedule is the representation of cash inflows/outflows on a time line. "What is a timeline, sir?" asked Keya. Joy smiled at her [1] inquisitiveness and said that a time line is a horizontal line depicting equal periods of time equidistant from each other (see Shim & Siegel, 2007). A time line is useful in determining the value of money at different time periods.

"Does the value of money change?" asked a visibly surprised Keya. Of course, it does. The value of money changes with time. As a matter of fact, this a cornerstone concept in the stream of corporate finance that value of money does not stay static and it changes with time. "What!" exclaimed a bamboozled Keya. She continued, "Does that mean that the value of ₹100 in my purse would change with the passage of time?" "Yes Keya, and I know that you are confused at this point as to how can the value of money change," said Joy.

He continued,

> You see, the notional value of money remains the same. For example, a ₹ 100 currency bill will remain as a ₹ 100 currency bill only even after a decade, but the purchasing power of that bill will be reduced (see Misra & Srivastava, 2011). This erosion of purchasing power of money with the passage of time is due to inflation.

Upon realizing that Keya would like to see the value of money change with time and learn more about it, Joy asked Keya to read more about it by tomorrow and let him know of other factors which are responsible for value of money to change with time (see Chandra, 2008). Additionally, he asked her to familiarize herself with the concept of timeline, compounding, discounting, and types of cash flows (see Besley, Brigham, & Parasuraman, 2018).

Joy excused himself and asked Keya to meet him tomorrow at 11:00 am sharp in the office so that he would show her some cash schedules when she would be better equipped to understand.

Next day, after preparing her assignment, Keya was prepared to go through the cash schedules with her boss. "Good morning, sir! How are you today? " asked Keya as she brought the files to Joy.

Joy replied, "Good morning, Keya! I hope you are prepared today with the concepts of timeline, compounding, discounting, etc. Let us take up the files of our clients and begin by analyzing the cash schedule of Ranjan Textiles Pvt. Ltd. "

Joy lets Keya open the file of Ranjan Textiles Ltd.

File # 1 : Ranjan Textiles Pvt. Ltd.

Ranjan Textiles Ltd. was founded in the year 1995 as a small scale vendor of bespoke yarns and weaves in the suburbs of Surat, Gujarat supplying to large textile firms. Riding the wave of a growing economy, coupled with increase in demand of looms, it grew into a full scale textile company of moderate size. It suffered considerable setback around the year 2010 when the economic meltdown affected the economy.

↳ The management decided to set aside a sum of ₹ 1 million into a tax saving fixed deposit for a period of 4 years. The rate of interest offered by the bank was 8% compounded annually. Draw the cash schedule for the above case on a timeline, clearly mentioning how much the money would grow into every period till maturity.

[1] A time line is usually denoted with equal annual intervals, but it can be drawn for any other equidistant period like semi-annually, monthly, etc.

↳ The company also contemplated to invest a lump sum amount of ₹ 250,000 into a battery of risky asset classes. Notwithstanding the risk involved, how much should be the average rate of return of the asset class for the investment to double/ treble/ quadruple in 5 years ?

↳ Medsafe Medical Instruments, one of the debtors of the company, owes a sum of ₹ 95,000 payable after 2 years. However, the company intimated that it is willing to receive the equivalent value of the payment immediately. How much amount can the company expect if it places that debtor in a risk class category of 8% ?

↳ Finally, the company is willing to commit a sum of ₹ 150,000 in the safest investment option, that is, government bond, which pays a modest return of 2.5% compounded monthly. How much time would it take for this investment to double/ treble/ quadruple itself ?

After working out the cash schedule of Ranjan Textiles Ltd., Keya felt happy and exhausted at the same time. "Can we take a break for some time, sir?" asked Keya. She returned after 10 minutes to resume the exercise. "Next file is that of Nilay Sudhiram Entertainments Pvt. Ltd.," said Keya while opening it and presenting it to Joy.

File # 2 : Nilay Sudhiram Entertainments Pvt. Ltd.

Nilay Sudhiram Entertainments Pvt. Ltd. (Nilay Inc.) was founded by Nilay Shukla and Richa Sudhiram in the summer of 2011. Both of them met during a management training program and exchanged their views on the changing landscape in the entertainment sector in India. After a few meetings, they decided to join hands together and venture into the entertainment sector. Primarily, the company is into event management and show business. It owns around 15 cinema halls in the Eastern part of India. It also produces short films, giving a platform to young and talented artists in line with Nilay's philosophy of tapping the youth's potential. The company also organizes various theme based events among other allied activities. The company has plans to expand, and thus, it is working on those lines.

↳ Nilay Inc. invested a sum of ₹ 600,000 into fixed deposit for a period of 2 years. The rate of interest offered by the bank was 7.5% compounded monthly. However, due to some unforeseen exigency, the amount was prematurely withdrawn at the end of 9 months only. How much amount would the company fetch as a result of such withdrawal?

↳ Nilay Inc. is interested in getting two cinema halls in Bhubaneswar on lease for a period of 15 years. At the end of the lease period, Nilay Inc. reserves the option of buying out the cinema halls for a cumulative sum of ₹ 10 million. The fee for leasing both the cinema halls would cumulatively be ₹ 400,000 that should be paid at the end of each year by Nilay Inc. The company wants to know the amount/capital that should be invested now in a security yielding a return of 9% per annum to cover just the lease fee expenses.

↳ At the end of the 5th year of the lease period, Nilay Inc. decided to exercise its option of buying out the halls. How much amount should it invest in a bank yielding 7% compounded weekly at the end/beginning of each period till the maturity of the lease to be able to buy out the cinema halls ?

↳ At the end of the lease period, the firm fell short by ₹ 200,000 because it couldn't invest in the sinking fund [2] properly. It took a loan of ₹ 200,000 from a bank to fund its purchase. The loan agreement stated that the bank

would charge 15% per annum for the loan and it has to be repaid in five equal installments. Draw the loan amortization schedule for the cash flow.

↳ Nilay Inc. leased out one of its own cinema hall for a period of 5 years to garner funds to produce a short film. The lease term stated that Nilay Inc. would receive ₹ 200,000 per year at the end of each year, which would grow by a factor of 5% per year. How much would Nilay Inc. receive if the lessee agrees to pay equivalent to the present value of all the future cash flows? Consider 8% as the discount rate for all the cash flow.

File # 3 : Singh & Jeevan Constructions Pvt. Ltd.

Singh & Jeevan Constructions Pvt. Ltd. was founded by Rohit Singh and Nishant Jeevan when they realized the potential that India holds in terms of demand of physical infrastructure. With a middle class population larger than the population of several countries, the Indian market was just getting ready for major infrastructure upgradation. New highways, railways track expansion, roadways, bridges, airports, affordable housing, etc. were projects for which tenders keep coming in. Taking advantage of a large pool of semi-skilled and unskilled labor force, Singh & Jeevan Constructions Pvt. Ltd. did work as sub-contractors for large enterprises and also took up moderate sized projects independently.

↳ The company would need a sum of ₹ 30 million after few years for the construction of a narrow service lane. It is willing to invest in an asset class that yields a return of 15% per annum. It wants to know how much time will it take to achieve its target amount if it is willing to invest a sum of ₹ 5 million at the end of each year ?

↳ The company would need another sum of ₹ 15 million after 4 years for the construction of a small bridge. What return should the asset yield if the company wants to achieve its target amount if it is willing to invest a sum of ₹ 3 million at the end of each year ?

↳ The company wishes to receive an assured sum of ₹ 500,000 at the end of each year forever. How much would they need to commit now if the rate of return offered by the bank is 9% per annum ?

↳ Later, the management realized that the buying power of a constant sum of money would keep on eroding with time. So, they wanted to commit another perpetuity that would give half a million every year that would grow each year by 8% per annum. How much would they need to commit now if the rate of return offered by the bank is 9% per annum ?

↳ The company finally wants to know the value of money at the end of the 5th year if it is investing ₹ 150,000 each year at the end of every year. The amount of investment by the company increases each year by 6% and the rate of return offered by the bank is 8% per annum.

File # 4 : Vipin Heavy Metal Works Ltd.

Vipin Heavy Metal Works Ltd. specializes in making drill tip for mining. The process of mining exerts a huge

[2] Sinking fund factor is the future value interest factor annuity (FVIFA) factor which, when multiplied with the annuity amount, gives the future value of an annuity. Sinking fund is the annuity amount that one invests at the end of each period for a given number of years in order to arrange funds in future for either a big ticket purchase or retiring a liability.

amount of stress and pressure on the structure of metal used at the molecular level, resulting in wear and tear. Vipin Jog (Founder of Vipin Heavy Metal Works Inc.) studied this phenomenon deeply with his engineer friends Sowmya and Shubhankar and tried different combinations of additives to strengthen the metal. Finally, they developed a special kind of alloy which was three times as stronger than the traditional metal used contemporarily. They got the formula patented and Vipin incorporated his company to produce drilling metal tip customized in accordance with customer requirements.

↳ The cash flow is difficult to determine in the mining sector as success or failure of drilling is uncertain. A successful drill would result in less sales of drill tip and vice-versa. Mining is a heavily regulated sector, so government policy is also a determinant of sales of drill tip. The personnel at Vipin Inc. have charted the cash flow for the next 5 years as follows :

Year	Cash Inflow (in ₹ 000)
1	250
2	350
3	400
4	425
5	500

Find out the present value/ future value of the above cash flow schedule using 10% rate of interest.

↳ The company bought 30 deep discount bonds of Medsafe Medical Instruments Ltd. for ₹ 10,000 each which would be redeemed at ₹ 300,000 each after 20 years. How much would Vipin Inc. earn as return?

File # 5 : Medsafe Medical Instruments Ltd.

Medsafe Medical Instruments Ltd. got listed on a recognized stock exchange in the year 2020 after a successful run as a private limited company for about two decades. Initially, the company manufactured hospital beds, mattresses, linen, and other upholstery products. Later, it extended its product offering by entering into the production of surgical instruments. The company has gained reputation for manufacturing excellent quality medical and surgical tools.

↳ The company would need a sum of ₹ 30 million after 20 years to retire a bond liability. How much money does the company need to invest in a recurring deposit account (which gives a rate of return of 7% per annum) at the beginning year till the maturity of the bond to be able to fulfill its target ?

↳ The company also wants to invest in an annuity of ₹ 250,000 semi-annually at the end of each period for 10 years in a bank that yields 6% compounded monthly. How much should it expect that investment to become at the end of the period ?

↳ The company would need a sum of ₹ 3 million every year from the end of the 5th year onwards for a period of 6 years. How much money should it invest today in a bank (one time investment) which gives a rate of interest of 8% per annum ? Alternatively, how much money should it invest as an annuity till the time it starts paying ₹ 3 million each year ?

↳ The company would need a sum of ₹ 5 million every year from the beginning of the 7th year onwards for a period of 5 years. How much money should it invest as an annuity due (once in 2 years) till the time it starts paying ₹ 5 million each year ? Applicable rate of interest is 8% per annum.

↳ The company would need a sum of ₹ 100,000 every year from the beginning of the 8th year onwards till perpetuity. How much money should it invest today in a bank (one time investment) which gives a rate of interest of 8% per annum ? Alternatively, how much money should it invest as an annuity till the time it starts paying ₹ 100,000 each year ?

↳ The company would need a sum of ₹ 100,000 every year from the beginning of the 8th year onwards till perpetuity. How much money should it invest today in a bank (one time investment) which gives a rate of interest of 16% every 2 years ?

↳ The company has invested a sum of ₹ 1,000,000 currently in a bank. It wishes to withdraw an annuity of ₹ 300,000 at the end of each year for 5 years out of its investment. What should be the rate of return offered by the bank to facilitate such cash schedule ?

"Phew! What a relief!" sighed Keya after completing the analysis of all the files. Joy asked her to go through the PVIF, FVIF, PVIFA, and FVIFA tables [3] as most of the problems related to the concept of time value of money can be solved by looking at the values for the right combination of *n* (time period) and *r* (rate of return) from those tables. "It was quite a fruitful day." Keya thanked Joy and got back to other pending tasks.

Implications and Conclusion

The implications of the concepts of time value of money are profound in the financial world. Keya kept on wondering about the principle of compounding as it accelerates the growth of funds in future on a timeline. Companies, banks, and even individuals can take advantage of compounding for fulfilling their future goals such as retiring a debt, any important event in life, big ticket purchases, etc. On the contrary, the principle of discounting can be used to find the equivalent amount of future scheduled cash flows. It is necessary for the finance managers of the above mentioned companies, in particular and other executives, in general to possess a working knowledge of the concepts discussed in this case.

Note and Disclaimer

The teaching note of this case would be made available on request. Please contact the Editor of *Indian Journal of Finance* at : editor@indianjournaloffinance.co.in for details.

This case is prepared by the author for the sole purpose of aiding classroom discussion. It is not intended to serve as endorsements/ sources of data/ illustrations of effective or ineffective management.

Author's Contribution

This case prepared by Naseem Ahamed is by far the most comprehensive case written on the topic of "Time Value

[3] PVIF stands for present value interest factor, FVIF stands for future value interest factor, PVIFA stands for present value interest factor annuity, and FVIFA stands for future value interest factor annuity.

of Money" with all the formulae and derivations thereof provided in the teaching note. The teaching note of this case provides valuable insights into the core topic and touches upon ancillary factors influencing the time value of money as well.

Conflict of Interest

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter, or materials discussed in this case study and teaching note.

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