Time Value of Money[*]

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Introduction

The outcomes of most business decisions occur over an extended period of time, often several years. Thus, most decisions should be analyzed using the concept of time value of money. The time value of money is the general universal preference for "a dollar in hand today is worth more than the prospect of receiving a dollar on some future date".

It is generally accepted that if you were offered a choice of two alternatives, a gift of $1,000 today or a gift of $1,000 on some future date, such as one year from now, you would elect to receive the $1,000 now. However, suppose that you were offered a choice of $1,000 now or $1,100 a year from now. This decision is not as clear-cut because you have been offered a $100 compensation to forego receiving the funds now. Is this sufficient compensation? This concept of determining if a certain amount of money is worth more or less than a larger amount of money in the future is called the Time Value of Money.

There are three basic reasons for analyzing the time value of money.

Alternative Uses

Possibly you want the $1,000 now to buy something, pay off some bills, or take a vacation. Alternatively, you could invest the $1,000 and earn a return in the form of interest, dividends or capital gains. In other words, there is an **opportunity cost** from waiting to receive the funds.

Uncertainty

We live in an uncertain world; a dollar in hand is a sure thing while the promise of a dollar to be received a year from now is less certain. Examples include: your situation may change, tax rates may be higher, or your income may be different.

Inflation

The price level in the U.S. and elsewhere has risen almost continuously since the great depression of the 1930s. Thus, today's dollar will very likely have less purchasing power in the future.

Calculation of Discount Rate

These three reasons for addressing the time value of money suggest the need to estimate the discount rate to be used in financial analyses. First, let's select a risk-free real rate of return; for example, the yield on inflation- indexed U.S. treasury securities. To this risk-free rate add premiums for inflation and risk. For example:

Risk-free real return	2 %
Inflation	2%
Risk premium	4%
Before-tax discount rate	8%

The premium for inflation can be based on actual inflation in recent years, perhaps modified by your expectations for the future. For example, if the economy is emerging from a recession, one might expect more inflation in the years ahead. The risk premium is a very subjective estimate of the increase in expected return needed to compensate an individual for investing in a risky asset compared to the risk-free alternative. In our example, the individual would be indifferent between a 2% return on an indexed government bond and a 6% return on the risky alternative.

The before-tax rate should then be converted to an **after-tax basis.** The after-tax discount rate is the before-tax rate multiplied by (1 – marginal tax rate). The marginal tax rate is the amount of tax paid on the last dollar of income, including federal, state and local income taxes plus self-employment tax. With progressive income tax rates, the marginal tax rate is higher than the average rate on all income because the tax rate increases as income rises. If the marginal tax rate in our example is 25%, the after-tax discount rate would be 8.0 (1 - .25) = 6.0 %.

Returning to the question posed earlier, is $100 sufficient compensation for waiting a year to receive $1,000? In this example, the answer is **yes**! Given the 6% after-tax discount rate, this individual would be indifferent between receiving $1,000 now or $1,060 ($1,000 + 1,000 x 0.06) a year from now. In other words, $100 would more than compensate for opportunity cost, uncertainty and expected inflation.

Compounding and Discounting

The time value of money implies that present sums (PV) can be converted to equivalent future sums (FV) and vice versa. The formula for converting a known present value to an unknown future value is:

$$FV = PV (1+ i)^n$$

where FV = future value (unknown) ,
PV = present value (known),
 i = discount rate, and
n = the number of compounding periods (generally years).

From our earlier example the future value of $1,000 after one year with a discount rate of 6% is: $1,000(1.06) = $1,060. After 10 years, the future value would be $1,000 $(1.06)^{10}$ = $1,000 x 1.7908 = $1,790.80.

On the other hand, it may be more advantageous in some circumstances to delay receiving $1,000 as long as the future value is known. For example: the formula for converting a known future sum to an unknown present value is:

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

 where PV = present value (unknown),
FV = future value (known),
 i = discount rate and
n = number of periods (years).

For example, the present value of $1,000 to be received a year from now with a discount rate of 6% is $1,000 / 1 .06 = $943.40. The present value of $1,000 to be received 10 years from now is $1,000 / $(1.06)^{10}$ = 1,000 / 1.7908 = $558.41.

The above formulas and calculations are laborious, thus in practice compound interest tables or spreadsheets are used to perform time value of money calculations. They are available on many websites and in many textbooks. In most situations, the analysis is based on the present value of future cash inflows and outflows and not on the future value of present cash inflows and outflows.

Applications

Time value of money concepts have many applications in finance and tax accounting. Appraisals of property usually involve discounting future income streams to estimate the current capitalized value. In tax accounting, an important concept is the advantage of deferring the payment of taxes to some future time period, for example postponing taxes through the use of rapid depreciation or like-kind exchange rules.

To spur investment, the IRC Section 179 allows certain qualifying assets that normally cannot be entirely deducted in one year to be expensed (as an ordinary and necessary business cost) in whole or in part during the first year the asset is put into service. *[See RuralTax.org Article RTE/2010-19. Depreciation: Election to Expense Qualifying Assets (Section 179 Deduction)]*. Thus, taking a Section 179 deduction now is generally preferred over future depreciation deductions over the life of the property. However, if the marginal tax rate is expected to grow

over time, it may be better to forego the Section 179 deduction now and claim depreciation deductions later. Consider a depreciable property with a basis equal to $1,000. If the marginal tax rate is low, say 5% - as in the case of a newly established business- the tax savings from the Section 179 deduction would be $50 ($1,000 x 0.05). Table 1 illustrates the value of future depreciation deductions with an increasing marginal tax rates as the business grows over time. The present value of these future tax savings is $121.46, nearly 2½ times the value of the Section 179 deduction.

Table 1. Tax savings from depreciation deductions with increasing tax rate.

Time (Years)	Depreciation	Marginal Tax Rate (%)	Tax Savings	6% PV Factor	PV of Tax Savings
0					
1	$200	5	$10	0.9434	$9.43
2	200	10	20	0.8900	17.80
3	200	15	30	0.8396	25.19
4	200	20	40	0.7921	31.68
5	200	25	50	0.7473	37.36
				Total PV	$121.46

In this example, total deductions for depreciation or Section 179 are the same: $1,000. However, consideration of changing tax rates and application of the time value of money lead to a more accurate decision. In Rural Tax.org Article RTE/2012-28, Lease vs Purchase of Machinery, application of the time value of money to the lease or buy decision is illustrated.

Conclusion

The time value of money is a key concept to understand in business and in your personal and business investments. It is an excellent item to keep in mind as you look at present and future alternative uses, present and future uncertainty, and inflation rates.

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Additional Topics

This fact sheet was written as part of Rural Tax Education a national effort including Cooperative Extension programs at participating land-grant universities to provide income tax education materials to farmers, ranchers, and other agricultural producers. For a list of

universities involved, other fact sheets and additional information related to agricultural income tax, see RuralTax.org.

Additional fact sheets that may be of interest are:

- Depreciation: Election to Expense Qualifying Assets (Section 179 Deduction) *(RuralTax.org Article RTE/2010-19)*

- Lease vs Purchase of Machinery *(Rural Tax.org Article RTE/2012-28)*