# DISCOUNTING, TIME AND VALUE. VARIABILITY OR PREFERENCE

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## 1. Introduction into discounting

Capital budgeting or investment decisions depend heavily on forecasts of the cash flow and a correct calculation of the firm's cost of capital. Given the cost of capital, the appropriate discount rate and a reasonable forecast of the inflows, the determination of a worthwhile capital investment will be not a difficult task. An investment is desirable when the present value of the estimated net inflows of benefits over time, discounted at the cost of capital, exceeds or equals the initial investment of the project. If the project's present value of expected cash flow meets these criteria, it is potentially profitable. Its yield equals or exceeds the appropriate discount rate.

Discounting is used to mean any process of revaluing a future event, service or product to give a present equivalent value (present value). The mechanisms of discounting are well presented in the economics literature text books and are commonly expressed in the general form:

$$PV = X_t / (1+r)^t$$

Where:

$X_t$ is a benefit, cost or revenue expected t years after some reference date;

PV is the present value of $X_t$ discounted to that reference date;

r is the discount rate;

$1/(1+r)^t$ is the discount factor.

At a first view, it does not seem to be too difficult to carry out the theoretical criteria. The stream of the forecasted net future cash flows must be quantified, each year's return must be discounted to obtain its present value. The sum of the present values is compared to the total investment outlay on the project. If the sum of the present values exceeds this outlay, the project should be accepted.

But how do we discount the cash-flows? How do we find the appropriate discount rate? The discount rate captures a pure rate of "time preference" for getting cash-flow from the asset now rather than later. Can we safely assume that the interest rate used to discount the future consumption is a constant? Do we discount a dividend payment delayed from this year to next by the same amount as one paid from 25 years to 26 years?

The process of discounting reflects the complexities of financial markets, of natural resource availability but also of human psychology, investment behavior and aversion towards risk. And these last aspects we will try to point out more in the paper. In general way, discounting implies that the future has less importance than the present.

The effects of discounting are easily set out. Suppose that, for whatever reason, we as humans prefer to have something good now, rather than on the same date next year. But soon as the element of time will be present and a postponement will interfere, it will be necessary to quantify "how much" better it is to have it now.

Let's consider a "10% better" to have that thing now rather than in a year's time and thus:

[a good thing now] is equivalent to [a good thing in a year] + 10% X [a good thing in a year]

## 2. The Discounted Utility model. Risk premium and the risk of costs

Paul Samuelson (1973) advanced the Discounted Utility Model, model that became almost universal accepted. In its most restrictive form, Samuelson's discounted utility model, states that a sequence of consumption ($c_1,c_2,\ldots,c_t$) is preferred to another ($c'_1,c'_2,\ldots,c'_t$) if and only if:

$$\sum_{t=1}^{T} U(c_t)\delta^t > \sum_{t=1}^{T} U(c_t^{'})\delta^t$$

where $0 < \delta < 1$ and U is the utility measure for which the first derivative regarding to consumption is positive and the second derivative regarding to consumption is negative:

($\delta U/ \delta c_t > 0$ and $\delta U/ \delta^2 c_t < 0$).

This says that utility increases in consumption at a decreasing rate. Here, the discount rate δ captures that pure rate of time preference while the two utility functions capture differences in the level of the two streams of consumption under consideration.

On the other hand, aversion towards risk may arise because losses of income are given greater weight than equivalent gains, while increasing losses have increasing marginal disutility, and increasing gains have decreasing marginal utility.

The theory of adjusting rates for risk was developed in relation to risk revenues. But risk premiums on discount rates give less weight to future costs too. Havemann (2005) argues that the normal rules for adjusting discount rates should be reversed for risk costs: risk aversion implies greater emphasis on risky costs.

Blossfeld (2004) points out that if risky costs of a project reduce the net benefits in future years then an increased discount rate has the desired effect: working against the project. However, consider the breakdown of net benefit discounted according to this rule:

$$\frac{Net\,benefit}{(1+risky\,rate)^t} = \frac{Benefit}{(1+risky\,rate)^t} - \frac{Cost}{(1+risky\,rate)^t}$$

Risky benefit is treated appropriately here. Risky cost is given less emphasis than a risk-free cost discounted at a lower rate. This is justifiable in the particular case where variation in benefit and cost is well correlated. If benefit is variable, it is better that cost should vary in line with it, rather than that cost should be fixed, leading to even greater percentage variation in net benefit.

The same point is made by Lewellen (1977) in relation to variability of costs in a systematically risky portfolio. Costs which are high when revenues are high reduce the variability of returns from the portfolio: it is appropriate that a risk premium on the discount rate should reduce the seriousness of such costs.

In conclusion, unpredictable future costs and benefits should be valued by considering the probability distribution of outcomes and calculating corresponding changes in marginal utility. It is also desirable to estimate the degree of uncertainty.

However, because of the difficulties of making these estimations, conventional ways tend to take the easy way: adding a premium to the discount rate, in proportion to the degree of risk.

## 3. Discounting as behavioral aspect

But discounting is not as "mathematical" as presented and in practice is influenced by many potential factors. The same decision can be discounted for evaluation in different ways, by different people. It is influenced by the human behavior, their aversion towards risk and perspectives on future.

People act as though they discount the future, even if they know nothing about the calculations outlined above. Given a choice of income now or income later, we, as humans, tend to prefer income now. Given a choice of paying now or paying later, we tend to prefer paying later. Given a choice of enjoyment now or later we prefer now. Thus, in general people require a reward to persuade them to postpone good things.

Another aspect shows us that discount rates are not constant over time. This can be shown from the following example quoted by Forbes William (2009) in the "Behavioural Finance" book.

Let's consider two choices:

Choice A.

i) Receive one apple today
ii) Receive two apples tomorrow

Choice B.

i) Receive one apple in one year's time
ii) Receive two apples in one year and a day's time.

Most people would choose i) from Choice A, but ii) from Choice B.

They have a much higher discount rate when considering outcomes in the near future compared to choices involving distant choices. To some degree, this is simply because the future involves uncertainty. Who knows what will be happening in a year's time and how much the number of oranges we have, will affect our fate.

Thaler (1981) surveyed some undergraduate students to get an idea of the sort of discounts rates they apply in making choices over different time horizons. So he asked the students how much they would be willing to pay for a prize in three months, a year and three years' time. Further he varied the amount of the prize to see if the discount rate applied by the students varied with the amount of the prize offered, table no.1.

Table no.1 – Results of Thaler's experiments to elicit personal discount rate used in evaluating prizes

| Prize USD | Value of prize deferred by (USD) | | | Implied discount rate (%) | | |
|---|---|---|---|---|---|---|
| | 3 months | 1 year | 3 year | 3 months | 1 year | 3 years |
| 15 | 30 | 60 | 100 | 277 | 139 | 63 |
| 250 | 300 | 350 | 500 | 73 | 34 | 23 |
| 3000 | 3500 | 4000 | 6000 | 62 | 29 | 23 |

Source: Thaler, R. (1981) Some empirical evidence on dynamic inconsistency, Economic Letters

The most striking thing about the results is the amazingly high discount rates used at short times, which seem to bear no comparison with the market rates of interest. At longer horizons the discount rate applied begins to look more sensible, especially for larger amounts of money. It seems that, at least among the students, the discount rates fall with the horizon of time considered and the amount of money invested/delayed in receipt.

Investors are sensitive to absolute differences in payoffs received, not just relative differences. So the perceived difference between100 USD now and 150 USD in a year's time may be greater than between 10 USD now and 15 USD in a year's time, although in terms of percentage we are talking about the same thing. (Lowenstein and Prelec 2002)

Investors may put small differences in different mental accounts to large differences. Small differences are marked for spending and heavily discounted while large differences are marked for saving and so less heavily discounted (Thaler and Shefrin 1981)

As presented, discounting has several uses. First, it can offer a descriptive model of human behavior. Then, discounting aids investment evaluations and other decisions between present and future. Those who undertake projects need to judge which ones are worthwhile. They may also need to decide which, among several projects, are the most valuable. To make such judgments, they must compare the value of early costs with that of late benefits. Given the fact that the cash-flows do not have the same value irrespective of time, straight summation of benefits is not accepted. Only when all cash-flows have been discounted to equivalent values at the same point in time can discounted benefits (cash-flows) be summed up.

On this kind of evidence it is argued that positive pure time preference exists. The importance of "now" in time preference has been also emphasized by other authors (Shackle 1961, Ekman 1971, Lundberg). They find emotional reactions to past and future events declining rather symmetrically either side of the peak corresponding to the present.

The importance of "present" seems clear, but the degree of importance depending on the evaluator can explain many apparent inconsistencies of choice.

## 4. Conclusion

In practice, imperfections are numerous and spreading through the market making difficult to observe what the equilibrium is and what it means. Time preference is not sole reason for requiring a return on investment. The likely inequality of time preference rate and market rate of return creates a problem in agreeing the investment allocation and time weighting roles of a discount rate. That means that a different basis for judging time preference rates would be desirable. Biases and preferences will rather make discounting rate more of a preference then a variability.

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