

# Choosing capital investments when resources are limited

Timo Attenhauser, 2008-09-26

## Introduction

In practice companies are not able to invest in every opportunity that would result in a positive net present value. There are several limitations which have to be considered. The most common limitation is the limitation of capital, also called capital rationing. Companies need to have a method to clarify which projects they should invest in so as to achieve the highest possible net present value.

This chapter will explain the ratio profitability index and its application and constriction in economic decisions. To begin with, there will be an explanation of how capital can be rationed.

## Reasons for capital rationing

If capital is not limited, companies could invest in every good opportunity which would have a positive net present value. So why is capital limited?

The field of economics distinguishes between "soft rationing" and "hard rationing".<sup>1</sup>

Soft rationing means there are internal reasons for limiting capital. Budgets are given by the management to several divisions to exercise financial control and an estimate of the cash flow forecast. Divisions "are forced" to take their own decisions in compliance with the given conditions. By proscribing these budgets to the divisions, the management avoids mistakes made by managers that are 'over-motivated' – ie, managers who would like to seize every investment opportunity. The management can loosen or tighten constrictions as needed.

---

<sup>1</sup> "Principles of Corporate Finance" (2008) by Richard A. Brealey, Stewart C. Myers and Franklin Allen, 9<sup>th</sup> edition, p. 133

Hard rationing is when there are external reasons for limited capital. The company can borrow as much as the bank will lend them and/or issue new stocks. If the bank won't lend any more money or the owner doesn't want to release more stocks in fear of losing control of his company, then the company will have limited access to capital.

Hard rationing does not invalidate the net present value rule. The shareholders can borrow or lend, buy more shares or sell their shares. The shareholders have free access to a well-functioning capital market.

## Investment with limited capital

The following example should illustrate the problem that turns up when a company has only limited capital to invest in several projects.

Cash flow (millions €)				
<i>possible projects</i>	$C_0$	$C_1$	$C_2$	<i>NPV at 10%</i>
"Miami"	-20	+60	+10	43
"St. Pete"	-10	+10	+40	32
"Orlando"	-10	+10	+30	24

All three projects have a positive net present value. If the company is not subject to any constrictions it should invest in all three projects to increase shareholder wealth. But in a case where the company has limited resources its capacity to invest is limited to €20 million. Now the company has to decide which projects to choose. There are two possibilities for spending the entire amount:

1.

Invest €20 million in project "Miami" and achieve an assumed net present value of €43 million.

2.

Invest €10 million in project "St. Pete" and €10 million in project "Orlando" and achieve an assumed net present value of €6 million.

## Profitability index - application

When capital is limited the consideration of what decision to make cannot be restricted to the net present value only. Investors have to check what project earns the highest net present value per euro of initial outlay. This consideration produces the profitability index:

$$\text{profitability index}^2 = \frac{\text{net present value}}{\text{investment}}$$

The following chart shows the profitability index for the three above-mentioned projects:

Cash flow (millions €)			
Possible projects	investments (millions €)	NPV (millions €)	profitability index
"Miami"	20	43	2.2
"St. Pete"	10	32	3.2
"Orlando"	10	24	2.4

After calculating the profitability index it is possible to create a project ranking:

1.  
The "St. Pete" project has the highest profitability index.
2.  
The "Orlando" project has the next highest
3.  
The "Miami" project has the lowest profitability index

The conclusion is that a company limited to a €20 m investment capacity should invest in the "St. Pete" and "Orlando" projects to attain the highest net present value per euro of initial outlay.

---

<sup>2</sup> Sometimes the profitability index is defined as present value/ investment. This ratio is also known as the benefit-cost ratio. To calculate this ratio you just need to add 1.0 to each profitability index. The above-mentioned rankings are unchanged.

As follows a summary:

If there is only one resource (capital) rationed in one period, then the simple ranking method via the profitability index should be used. The company is advised to select those projects with the highest profitability indices until all money is invested.

If the investment has a profitability index of 0.0, then the company will not make or lose any money. A positive profitability index means that the investment has a positive net present value. If the profitability index is less than 0.0, then the investment is a bad investment as the net present value is negative. The higher the profitability index, the greater the attraction of the investment.

### Profitability index - constriction

But is this method valid for all cases? To give an answer to this question we will take a look at another example:

possible projects	Cash flow (millions €)			NPV at 10%	Profitability index
	C <sub>0</sub>	C <sub>1</sub>	C <sub>2</sub>		
"Miami"	-20	+60	+10	43	2.2
"St. Pete"	-10	+10	+40	32	3.2
"Orlando"	-10	+10	+30	24	2.4
"Sarasota"	0	- 80	+120	26	0.4

As shown in the chart above, the "Miami", "St. Pete" and "Orlando" projects have equal assumptions. The investors now have the possibility of investing also in the "Sarasota" project during period 1. The capital is still limited to €20 million per period.

If the company accepts the "St. Pete" and "Orlando" projects as mentioned before, it is not possible to invest in the "Sarasota" project during period 1 as well:

- Period 0:

Investment €20 m (limitation) in "St. Pete" and "Orlando"

- Period 1:

Positive cash flow from the €20 m investments

- Period 1:

Possible €40 m investment

→ **Insufficient cash to invest in the "Sarasota" project**

Now the company can think about the following alternative:

- Period 0:

€20 m investment in "Miami"

- Period 1:

Positive cash-flow from the €60 m investment

- Period 1:

Possible €80 m investment

→ **Enough cash to invest in "Sarasota" project**

The "St. Pete" and "Orlando" projects have higher profitability indices (3.2 and 2.4 compared with 2.2 and 0.4) than the "Miami" and "Sarasota" projects, but they have a lower net present value (€56 m versus €69 m).

The simple ranking method using the profitability index fails in this case because the resource (capital) is limited during *more than one period*. It also fails when there is *more than one constricting factor*. The company would not achieve the highest possible net present value if it uses the profitability index method. This method is also not advisable if a project depends upon another project or if two or more projects are mutually exclusive (e.g. if two opportunities require the same and unique resource).

## **Technical tools for finding investment solutions**

The aim is to find the package of projects that includes all constrictions and achieves the highest net present value. To achieve this aim, it is necessary to check if the projects satisfy all constrictions and to calculate the specific net present values. It is very time-consuming to calculate everything manually. Companies develop *linear programming models* to automate the search through all possible packages. These models are very complex and they require good data input to calculate future development. In practice, it is often very difficult to obtain good and useful data. These models assume that all future investment opportunities are known – this is just a theoretical stance as the search for good investment opportunities is an ongoing process. The linear programming models are not generally accepted in practice for these reasons although they are very helpful in locating good investment opportunities.

## Summation

The profitability index is a very good ranking method if *one resource ( e.g. capital) is rationed within one period only*. The company chooses the investment opportunities with the highest profitability indices until the limited amount of money is invested.

If there is *more than one constriction or if the resource is rationed in more than one period* the ranking method using the profitability index is not advisable as it yields inadequate results. The company would not achieve the highest possible net present value.

When resources are limited, the company has to find the best possible package of projects that takes all constrictions into consideration and achieves the highest net present value.