

# The Net Present Value Rule in Comparison to the Payback and Internal Rate of Return Methods

Sascha Rudolf, 2008-10-02

## Preamble

In the context of investment decisions companies have a large variety of investment appraisals. A distinction can be made between static and dynamic investment appraisals. Examples of static investment appraisals are the *comparative cost method*, the *average return method* and the *payback rule*. The *method of accumulation of an annuity*, the *net present value method* and the *internal rate of return method* are representative of the dynamic investment appraisal. This chapter examines the pros and cons of *payback rule* and the *method of the internal rate of return* compared to *net present value rule*.

## Net present value rule

As already mentioned, the *net present value method* is representative of the dynamic investment appraisal and a discounted cash flow method. The basis for the *net present value method* is the assumption that one euro today is worth more than one euro will be worth tomorrow. The reason for this is quite simple. Today's euro can be invested and generates interest. This is the inclusion of the *net present value method*. The profitability will be assessed by examining the return on the invested capital is achieved under the assumption of a discount rate. All investments whose net present value:

> is zero, achieve the same return as the alternative investment;

> is greater than zero, in comparison to alternative investment, achieve a capital increase;

> is less than zero, achieve a worse return than the alternative investment and the capital expenditure may not be recovered.

The *net present value method* is suitable for both the assessment of new investments as well as the comparison of investment alternatives. The investment with the higher net present value is the more favourable alternative. Because it is an additive process, the net present values of different investments with different discount rates, which are not mutually exclusive, can be added up. The net present value is derived by adding all the discounted cash flows  $C$  minus investment expenditure  $C_0$ :

$$\text{Net present value (NPV)} = C_0 + \frac{C_1}{1+r_1} + \frac{C_2}{1+r_2} + \frac{C_3}{1+r_3} + \dots$$

Project	Investment	Cash Flows (million €)			NPV	Interest Rate
	$C_0$	$C_1$	$C_2$	$C_3$		
A	-20	10	10	10	4,87	10%
B	-35	15	15	0	-8,97	10%
C	-40	0	30	30	7,33	10%

*Example 1*

Conclusion: *Net present value method* is an arithmetically simple procedure that offers easy interpretation as the capital value is expressed in monetary units. Another advantage is the possibility of adapting the discount rates for different periods.

## Payback rule

An example of the static investment appraisal is the *payback rule*. In the context of the *payback method*, the period is determined that is needed to get the invested capital back via the repayments. The investment with the shortest payback period is the most advantageous option. The *payback rule* can be used for more than comparing the alternatives. It can also be used to assess the absolute risk of an investment. In many large companies there are targets for the period during which an investment is recouped. In the calculation, there are two different variants:

- Average method  
Is used when the annual returns are equal.

$$t = \frac{C_0}{C_1}$$

Project	Investment	Cash Flows (million €)		
	$C_0$	$C_1$	$C_2$	$C_3$
A	-20	10	10	10

*Example 2*

$$\frac{20.000.000}{10.000.000} = 2$$

- Cumulative method  
When the annual repayments vary, they are added up until the amount of the investment is reached.

$$\sum = C_1 + C_2 + C_3 + \dots \text{ in comparison to } C_0$$

Project	Investment	Cash Flows (million €)			Payback
	C <sub>0</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Period
A	-20	10	10	10	2
B	-35	15	15	0	-
C	-40	0	30	30	3

*Example 3*

As the extended version of the example shows (below), the *payback rule* should not be the sole basis for an investment decision.

Project	Investment	Cash Flows (million €)			Payback	NPV	Interest Rate
	C <sub>0</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	Period		
A	-20	10	10	10	2	4,87	10%
B	-35	15	15	0	-	-8,97	10%
C	-40	0	30	30	3	7,33	10%

*Example (modified) 4*

As is made clear in the example, a decision purely on the *payback rule* would lead to an assessment of investment alternatives that is completely wrong. Only the use of the *net present value method* allows a decision according to an economic point of view.

Conclusion: The *payback rule* involves only those cash flows during the amortization period. All subsequently incurred cash flows are of no consequence. In addition, all predominant cash flows are on an equal footing, regardless of whether an investment has a faster return or not. The payback period should therefore be only a complementary, but not the sole criterion of an investment decision.

## Internal rate of return

The *internal rate of return method*, a process of dynamic investment appraisal, determines the interest rate  $r$  of the invested capital. The *internal rate of return method* can be used to assess the absolute advantages of an investment. When comparing different investments, the alternative with the highest internal rate of return is the most advantageous solution. The rate to look for is the one where the NPV will be zero.

$$NPV = C_0 + \frac{C_1}{1 + \text{discount rate}} = 0$$

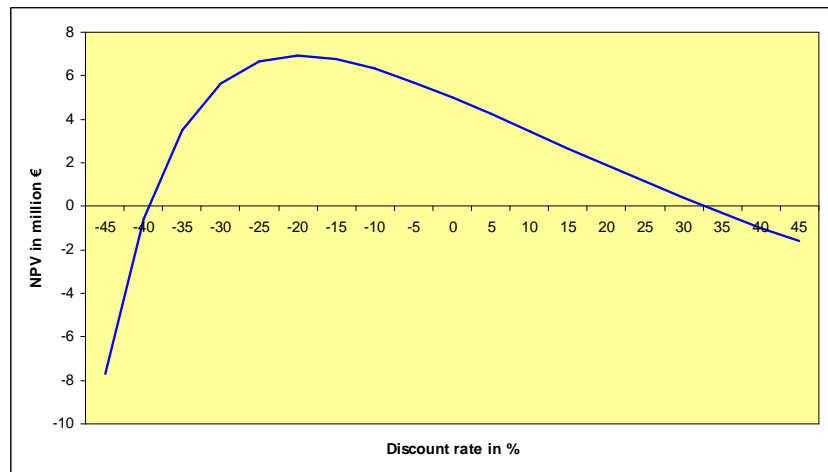
After re-arranging the equation:

$$\frac{C_1}{-C_0} - 1 = \text{discount rate} = \text{rate of return}$$

Obviously, this formula only works for a one-time payment in one period. The formula, however, is the right approach to obtain the outcome of several payments in different periods. Once again, the discount rate to look for is the one where the NPV will be zero. Therefore, the following formula:

$$NPV = C_0 + \frac{C_1}{1+IRR} + \frac{C_2}{(1+IRR)^2} + \dots + \frac{C_T}{(1+IRR)^T} = 0$$

The easiest way to solve this formula is done using a special calculator or a computer. If both fail, trial interest rates must be generated. This procedure is cumbersome. The remedy? Create a chart in which three or four trial interest rates associated with the NPV are registered and then the individual points are connected. The discount rate where NPV is zero can now be read off the resulting graph.



*Diagram 1*

But the *IRR method* also, as the next example shows, is not sufficient for making an investment decision.

Project	Investment Cash Flow		IRR
	C <sub>0</sub>	C <sub>1</sub>	
A	-20	20	0%
B	-35	70	100%
C	40	-80	100%

*Example 5*

As can be seen in the example below, two different investment options may have an equal IRR, but very different NPVs. Fact is, that Project C is like a loan.

Project	Investment Cash Flow		IRR	NPV	Interest Rate
	Co	C1			
A	-20	20	0%	-1,82	10%
B	-35	70	100%	28,64	10%
C	40	-80	100%	-32,73	10%

*Example 6*

Another problem is accidental change in cash flows. When the accidental of the cash flow changes, then there is a separate IRR for each exchange.

Project	Investment Cash Flows (million €)				IRR	NPV	Interest Rate	
	Co	C1	C2	C3				
A	-20	20	20	-15	33%	-39%	3,44	10%

*Example 7*

Even applying the *IRR rule* to alternative investments may lead to wrong decisions. This case is illustrated by the next example:

Project	Investment Cash Flow		IRR	NPV	Interest Rate
	Co	C1			
A	-20	45	125%	20,91	10%
B	-35	70	100%	28,64	10%

*Example 8*

The first variant has a higher IRR, but with regard to the NPV, the decision would tend towards to the second variant. To verify that the second variant is justified, the higher investment is once again expected – with the difference amounts from both investments.

Project	Investment Cash Flow		IRR	NPV	Interest Rate
	Co	C1			
B - A	-15	25	66%	7,73	10%

*Example 9*

Conclusion: The *method of internal rate of return* is not suitable for comparing several investment projects of varying amount, length and timing. It is quite possible that an investment with a higher internal rate of return has a lower net present value than another investment with a lower internal rate of return.

## Conclusion

The examination of the three different investment appraisals presented here has clearly shown that the various methods entail the risk of misinterpretation. It is possible to get three different choices using three different methods. And this may not always match the company's strategy. Adopting the *payback rule*, for example, only the cash flows to the amortization period are observed. All subsequently incurred cash flows are ignored. In addition, all predominant cash flows are on equal footing, regardless of whether an investment has a faster return or not. Even the *method of internal rate of return* viewed on its own provides no reliable results for an investment decision. If, as shown in the above examples, this method is slightly modified, it can also provide useful results. With regard to the reliability and mathematical simplicity of the *net present value method*, there is a question as to whether this modification is absolutely necessary. The opportunities identified for rendering the other methods practically useful, indicate that application of the *net present value method* is advantageous. The actual investment can be directly compared with a reference interest rate without making any modifications. Because the capital value is expressed in monetary units, it is simple to interpret the results. Moreover, it is possible to adjust the discount rate for different periods.