Payback Period and NPV: Their Different Cash Flows

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Abstract

One of the major topics which is taught in the field of Finance is the rules of capital budgeting, including the Payback Period and the Net Present Value (NPV). The purpose of this paper is to show that for a given capital budgeting project the cash flows to which the Payback Period rule is applied are different from the cash flows to which the NPV rule is applied. This is in contrast to the way these two capital budgeting rules are customarily taught in the field of Finance.

Introduction

It is customary for Finance textbooks[2] and Finance professors to discuss the Payback Period and the Net Present Value (NPV) rules of capital budgeting, among other capital budgeting decision rules. For this purpose, they take a capital budgeting project and apply both the Payback Period and the NPV rules of capital budgeting to the project's identical sets of cash outflow and cash inflows. This paper argues that for a given capital budgeting project the cash flows to which the Payback Period rule is applied are different from the cash flows to which the NPV rule is applied. This is because the Payback Period does not involve discounting cash flows, whereas the NPV – together with most other capital budgeting decision rules – is based on discounting considerations. The paper illustrates the logic of its argument through a numerical example.

The paper is organized as follows. The following section demonstrates how the relevant cash flows for the Payback Period rule of capital budgeting are different from the relevant cash flows for the NPV rule of capital budgeting. Then, there is the concluding section.

Different Cash Flows for Payback Period and NPV Rules

This section demonstrates how the relevant cash flows for the Payback Period rule of capital budgeting are different from the relevant cash flows for the NPV rule of capital budgeting. It illustrates this argument by way of a numerical example.

Capital budgeting is the process of evaluating specific investment decisions. It is the whole process of analyzing projects and deciding which ones to include in the capital budget. It involves large expenditures. The results of capital budgeting decisions continue for many years. Capital budgeting decisions define the firm's strategic directions, which is very important to firm's future. Several capital budgeting decision rules have been created to reduce the probability that incorrect capital budgeting decisions will be made. These capital budgeting decision rules are applied to the cash flows of any project which comes under consideration. Whereas, the Payback Period rule does not involve discounting cash flows, the NPV rule is based on discounting considerations. Therefore, the relevant cash flows for the Payback Period rule are different from the relevant cash flows for the NPV rule. The logic of this argument is illustrated through a numerical example.

In the numerical example, first the relevant cash flows for the NPV rule are obtained and in the meantime the most important point for the argument of this paper is discussed. The discussion of more common and

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[2] See, for example, Berk, DeMarzo, and Harford (2012, Chapter 8, pp. 210-246), Brealey, Myers, and Marcus (2012, Chapter 8, pp. 226-260), Brigham and Ehrhadt (2011, Chapter 10, pp. 379-422), Brigham and Houston (2013, Chapter 11, pp. 367-398), Keown, Martin, and Petty (2011, Chapter 10, pp. 264-301), and Ross, Weterfield, and Jaffe (2010, Chapter 5, pp. 135-170).

standard steps which are presented in most introductory Finance textbooks are kept to a minimum in order to avoid occupying valuable pages of the journal. Secondly, the relevant cash flows for the Payback Period rule are discussed and reference is made to the most important point which would be discussed in connection with obtaining the relevant cash flows for the NPV rule in order to demonstrate the way in which the relevant cash flows for the Payback Period rule are different from the relevant cash flows for the NPV rule.

The numerical example starts with the information about a capital budgeting project:

Outlay:	Equipment	$200,000
	Shipping	$ 10,000
	Installation	$ 30,000
	Depreciable basis	$240,000

Economic life = 4 years
Inventories will rise by $25,000 and Accounts Payable will rise by $5,000
Sales: 100,000 units/year @ $2
Variable cost = 60% of sales
MACRS 3-year class
Tax rate = 40%
Salvage value = $25,000
Cost of capital (WACC) = 10%

For the NPV rule, a project's cash flows typically include the following:

1. *Initial Investment Outlay:* This includes the costs of fixed assets plus any increase in net working capital.

2. *Operating Cash Flows (OCF):* These are the cash inflows generated from the annual operation of the project.

3. *Terminal Cash Flows:* These include the return of net working capital and the net salvage value.

Slide number[3] 1 shows the typical time line and the relevant cash flows for the NPV rule of capital budgeting. The magnitudes for these relevant cash flows can be obtained as follows.

Fixed assets are required by almost all projects. The full cost of fixed assets includes any shipping and installation costs. The full cost of fixed assets is used as the *Depreciable Basis* when depreciation charges are calculated. For the numerical example, its magnitude is $240,000.

The Investment in Net Working Capital (NWC) is equal to the increased current assets resulting from a new project minus the spontaneous increase in accounts payable and accruals. Normally, additional inventories are required to support a new operation, and expanded sales tie additional funds up in accounts receivable. However, payables and accruals increase spontaneously as a result of the new operation, and this reduces the cash needed to finance inventories and receivables. The difference between the required increase in current assets and the spontaneous increase in current liabilities is the Investment in Net Working Capital. For the numerical example, its magnitude is: – $25,000 + $5,000 = – $20,000.

Operating Cash Flows (OCF) are the cash inflows generated from the annual operation of the project. Annual operating cash flows equal after-tax operating income plus depreciation. Note that depreciation is added to operating income because it is a non-cash expense. For the numerical example, the calculations of OCF are shown in Slide number 2. Note that Slide number 3 and Slide number 4 provide the MACRS table and the calculation of annual depreciation, respectively, which are used in the calculations of the operating cash flows in Slide number 2.

The most important point for the purpose of this paper is that financing costs (after-tax interest expense and dividend payments) are not deducted when calculating operating cash flows because these financing costs are accounted for in the after-tax cost of capital (WACC), which is used for discounting the future cash flows when calculating the NPV of a capital budgeting project. This is done because a project's cash flows are discounted by its after-tax cost of capital, and that the after-tax cost of capital (WACC) is a weighted average of the costs of debt (after taxes), preferred stock, and common equity. The discounting process reduces the value of future cash flows to account for the project's after-tax capital cost components. If interest payments (after taxes) to debt holders and dividend payments to shareholders were first deducted when calculating the cash flows and then the resulting cash flows were discounted at the after-tax cost of capital, then double counting of the cost of debt (after-taxes) and of the cost of equity is committed.

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[3] The slide number appears on the top-right-hand corner of the slide.

1

Time Line for the Project's Cash Flows

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        0         1         2         3         4
        |---------|---------|---------|---------|

Fixed Asset
  NWC

              OCF₁      OCF₂      OCF₃      OCF₄

                                        Return of NWC

                                        Net Salvage Value

        _____   _____   _____   _____   _____
         NCF₁      NCF₁      NCF₂      NCF₃      NCF₄
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2

Operating Cash Flows (OCF)

	1	2	3	4
Revenue	$200	$200	$200	$200
Op. Cost, 60%	-120	-120	-120	-120
Depreciation	-79	-108	-36	-17
Oper. inc. (BT)	1	-28	44	63
Tax, 40%	0.4	-11.2	17.6	25.2
Oper. inc. (AT)	0.6	-16.8	26.4	37.8
Add. Depr'n	79	108	36	17
Op. CF	79.6	91.2	62.4	54.8

3

MACRS

Year	3-Year	5-Year	7-Year	10-Year
1	0.33	0.20	0.14	0.10
2	0.45	0.32	0.25	0.18
3	0.15	0.19	0.17	0.14
4	0.07	0.12	0.13	0.12
5		0.11	0.09	0.09
6		0.06	0.09	0.07
7			0.09	0.07
8			0.04	0.07
9				0.07
10				0.06
11				0.03
	1.00	1.00	1.00	1.00

4

Annual Depreciation

Year	Rate	x	Basis	=	Depreciation
1	0.33		$240		$ 79
2	0.45		240		108
3	0.15		240		36
4	0.07		240		17
	1.00				$240

5

Net Salvage Value

Salvage Value	$25
Book Value	$ 0
Gain on Salvage	$25

Gain on Salvage	$25
Tax on Gain (40%)	-$10

Salvage Value	$25
Tax on Gain (40%)	-$10
Net Salvage Value	$15

6

Time Line for the Project's Cash Flows

0	1	2	3	4
-240				
-20				
	79.6	91.2	62.4	54.8
				20
				15
-260	79.6	91.2	62.4	89.8
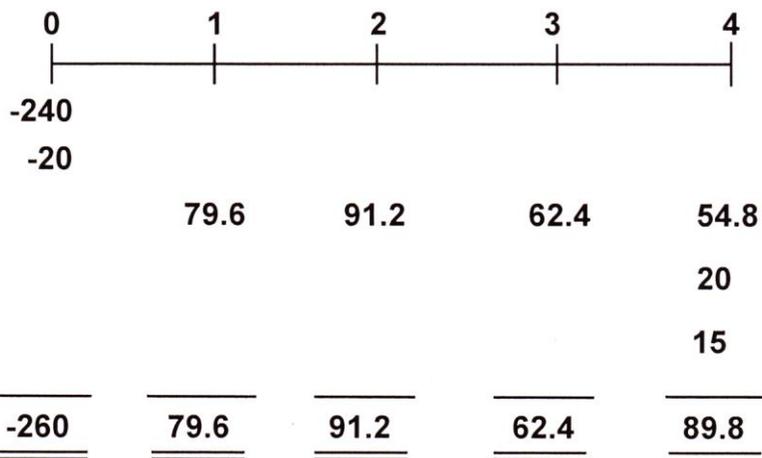
The return of net working capital takes place at the end of the project's life. This is because toward the end of a project's life, inventories will be used but not replaced and receivables will be collected without corresponding replacements. Furthermore, payables and accruals decrease spontaneously as a result of finishing the new project. As a result, the investment in net working capital (NWC) will be returned by the end of the project's life. For the numerical example, it is obtained in the following manner: + $25,000 – $5,000 = $20,000.

The net salvage value is the after-tax cash proceeds from the sale of fixed assets at the end of the project's life. That is, net salvage value is the salvage value of the fixed assets, adjusted for taxes if assets are not sold at their book value. Note that gains on salvage result in tax liabilities and losses on salvage produce tax credit, which are equal to the gain or loss times the corporate tax rate. For the numerical example, the calculations are shown on Slide number 5.

Slide number 6 summarizes the relevant cash flows for the NPV rule of capital budgeting. Given that the cost of capital is ten percent, the NPV can be calculated and the capital budgeting decision be made.

Except for the operating cash flows, all the cash flows for the Payback Period rule are obtained exactly in the same way that they are obtained for the NPV rule. The difference between their operating cash flows lies in the way they treat interest expense (after taxes) and dividend payments. The NPV rule does not require the deduction of interest expense (after taxes) and dividend payments when calculating operating cash flows. In contrast, the Payback Period rule needs to require the deduction of interest expense (after taxes) and dividend payments when calculating operating cash flows. This is because in the NPV rule of capital budgeting, when cash flows are discounted at the after-tax weighted average cost of capital, then, in effect, the interest expense (after taxes) and dividend payments are accounted for and there is no need to account for interest expense (after taxes) and dividend payments in the calculation of cash flows. However, in the Payback Period, there is no discounting involved and, therefore, the interest expense (after taxes) and dividend payments should be deducted from the operating cash flows when calculating the relevant cash flows for the Payback Period rule. That is, the operating cash flows calculated for the NPV rule should be reduced by the interest expense (after taxes) and dividend payments in order to arrive at the operating cash flows for the Payback Period rule of capital budgeting.

The logic of the argument of this paper can be further explained as follows. By definition, the Payback Period for a capital budgeting project is the length of time it takes for the initial investment to be recouped. And the initial investment is recouped from the net proceeds of the operations of the project. And these net proceeds are the proceeds net of costs, including interest expense (after taxes) and dividend payments. Therefore, interest expense (after taxes) and dividend payments should be deducted from those cash flows which are used in the NPV rule of capital budgeting. This explains how and why the cash flows to which the NPV rule of capital budgeting is applied are different from the cash flows to which the Payback Period rule of capital budgeting is applied.

Conclusion

This paper used a numerical example as a vehicle to show that the NPV rule of capital budgeting and the Payback Period rule of capital budgeting should not be applied to identical sets of cash flows for a given capital budgeting project. This is in contrast to the customary practice of teaching in the field of Finance. The cash flows used in the NPV rule of capital budgeting should be different from the cash flows used in the Payback Period rule of capital budgeting. This is because the NPV rule involves discounting whereby the cost of debt and equity are accounted for, however the Payback Period rule does not involve discounting and therefore the cost of debt and equity should be accounted for in the cash flows.

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