Research on the Ways to Appraise the Investment Based on NPV, Payback Period and IRR

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Abstract: Recently, the economy of each country and nation are becoming increasingly influenced by the existence of the coviod-19. As the trend of the economic decline, a large number of manufacturing industries are facing the dilemma as to seize the opportunities of investment aggressively or stay in the situation where they are to keep the market share safely. As a result, it attaches great significance to choosing one investment wisely and cautiously. This paper focuses on the different types of appraisal techniques directly. By giving a specific example of different cash flows of a project, make calculations of various appraisal techniques and make comparisons between each of them. And then make a list of different advantages and shortcomings of investment criteria. The main findings of this paper are that among several appraisal techniques, the method of NPV can be the best one to apply when the project managers or investors have gained a large amount of experience and have a more aggressive mind and with the differences of the investment criteria, investors have to consider both the liquidity and profitability. At the end of this paper, the study makes slight advice on choosing the investment projects, making the investment decision more effective and acceptable.

Keywords: appraisal techniques, investment decisions, net present value, payback period, internal rate of return

1.   Introduction

There are two ways to pay for the investment. Fix investments, such as property, plant, or equipment, as well as financial investments, including options and futures, are also examples of investments. Whatever the type of investment is, each of them can promote the growth of an enterprise and maximize the shareholders' wealth to the extent that expectations beyond our minds. From a different perspective, investments might be net investments when the latest assets are added to the existing ones, or replacement investments when a physical item is replaced [1].

Avram et al. make a definition that the general investment as an outlay undertaken to generate future profits [2]. Almost all the company choose to flourish and survive in the cutthroat market by investing in a variety of projects. To decide on investing wisely and efficiently, all corporations have their own making-decision rule to appraise and analyse and even the project managers of the company have a basic understanding of project appraisal. Whether to invest or not relies on the investor's expected return, the asset's cost, the amount of funding available for the investment, and how to fund

that investment [3]. Nowadays, with the introduction of basic appraisal techniques, shareholders, investors, investment institutions and individuals can pick up the project of investment by comparing various measurements. There are an increasing number of appraisal techniques, for instance, payback period, net present value, and internal rate of return. The financier must fully comprehend and accurately assess all available options before making any investment decisions, which should not be rushed [4]. Thus, this paper makes focuses on the approaches of five kinds of appraisal techniques and by making the application of them to a specific project, this paper investigates the suitable way to spend the investment expenditure more useful and efficiently.

2. Different Types of Appraisal Techniques

2.1. Net Present Value

According to Paul D. Gardiner and Kenneth Stewart, when future returns are discounted at the marginal cost of capital, net present value is the gap between those two values [5]. An example below will show the importance of considering NPV in valuing the project. What makes NPV more essential than other appraisal techniques like payback period or return on capital employed is that NPV places emphasis on the time effect on cash which means that money that is presently available is not equal to and much more worth than the same amount of money in the future as time goes by. Intending to choose the most appropriate project, the calculation of the NPV is necessary. Project managers or investment firms should predict the project's cash streams over a longer time frame when calculating the NPV of the projects. And then the cost of capital should be chosen appropriately. It is of great significance for this rate to reflect both the time value of money and the inherent risk that involves in investing. Additionally, utilize this rate to discount the various financial flows of the project to figure out the present value of the various periods of the revenue streams after calculating the prediction of the money created and the opportunity cost of financing. Consequently, after calculating the total discounted financial flows, subtract the project's starting funding to arrive at the net present value. What is more, the formula of NPV is presented in the following ways.

$$\text{NPV} = \text{CFO} + \frac{CF1}{(1+i1)} + \frac{CF2}{(1+i2)} + \frac{CF3}{(1+i3)} + \cdots \tag{1}$$

By comparing the NPV of the project with the number of zero and the project's NPV is equal to and more than zero, project managers or investment institutions can make a large investment in this project to earn gains and growth of the corporation.

2.2. Payback Period

The payback period has gained large popularity as the project evaluation criteria among investors or investment institutions. Under the circumstance that the companies have a problem with capital rationing, the payback period is widely used in the capital budget. Measured by the time it will take for expected cash earnings from an investment to equal the cash expenditure needed to invest, this period is known as the payback period [6]. For instance, when the latest machinery costs ￡10,000 and the machine is expected to contribute ￡2,000 each year, then the payback period of the machine is 5 years. If the cash inflows generated each year are different on a yearly basis, then the payback period is defined by adding the anticipated cash flows to the initial expense until the sum of the cash inflows gathered equals the original cash outflow. Based on the agency problem, the shareholders of the company may more concentrate on long-term profit. However, the managers of the board pay more attention to the short-term profit. And it is not uncommon for individuals to choose a project that has a shorter payback period. Simply put, the shorter the payback period is, the more attractive the project is. Otherwise, payback period analysis fails to distinguish between the current and future value of

money because it ignores variations in the timing of cash flows [6]. As a result of neglecting the financial flows following the repayment term and the timing of money, the payback period has received a lot of criticism. Nevertheless, determining how long it will take to recoup the initial expenditure makes a minimal contribution to determining the earning potential of a project [6].

2.3. Discounted Payback Period

The time worth of money is not taken into account by the conventional payback period. To modify this problem, the discount rate has been introduced into the calculation. By adding the generated discounted cash flows to the investment expense rather than the raw cash flows, the discounted payback time is identical to the standard payback duration. The discounted payback duration, in contrast to the typical payback period, is more precautionary, disregards the cash streams after the repayment term, and is unable to reflect the project's profitability.

2.4. Internal Rate of Return

The investor's prior success and his assumptions about potential future profit chances both have an impact on the demand to plan an investment [7]. Additionally, the risk appetite of the investor also attaches importance to the decision of the project. The cost of funding, expected rates of return, and the level of uncertainty associated with the numerous investing possibilities that may be accessible to him must all be taken into account by a businessman [8]. The internal rate of return, or discount rate, reduces the NPV to zero. In other words, when the internal return rate surpasses the opportunity cost of funding, which means that the project's NPV is negative, the project ought to be abandoned since that is the greatest opportunity expense of capital that investors or investment institutions may allow. And the internal rate of return computation is presented in the manner shown above.

$$\text{NPV} = \text{CFO} + \frac{CF1}{(1+IRR)} + \frac{CF2}{(1+IRR)} + \frac{CF3}{(1+IRR)} + \cdots = 0 \qquad (2)$$

2.5. Modified Internal Rate of Return

Using the conventional internal return rate has some drawbacks. Firstly, finance textbooks and academics have warned for years that the reinvestment assumptions used in traditional IRR calculations make good initiatives look terrific while making bad projects look better [9]. The fundamental presumption behind the IRR is that all earnings will be reinvested to produce revenues equivalent to the project's initial IRR. Otherwise, the IRR indicates the highest rate of return, and reinvesting money at the IRR is difficult. The following is a depiction of the modified internal rate of return equation.

$$MIRR = \sqrt[n]{\frac{Terminal\ value\ of\ return\ phase}{Present\ value\ of\ investment\ phase}} - 1 \qquad (3)$$

3. The Calculations of the Five Appraisal Techniques

All the calculations are based on the same example and data that is taken from Paul D. Gardiner and Kenneth Stewart's work [10] and very slightly modified. The data is shown in a table along with the various cash streams that took place during the investing stages. Additionally, a 10% discount rate is presumptive.

Table 1: The project's cash flow.

	Year 0 £	Year 1 £	Year 2 £	Year 3 £	Year 4 £	Year 5 £
Return			0.8m	0.46m	0.78m	1.4m
Outlays	(1.02m)	(1.3m)				
Money flow	(1.02m)	(1.3m)	0.8m	0.46m	0.78m	1.4m

3.1. The Result of the NPV

This study calculates the NPV by setting the interest rate as 10% and the calculation is as shown in formula (4).

$$\text{NPV} = (-1.02\text{m}) + (-1.18\text{m}) + 0.66\text{m} + 0.35\text{m} + 0.53\text{m} + 0.87\text{m} = 0.21\text{m} \qquad (4)$$

As a result, the NPV is 0.25 million, which is greater than zero and indicates that the project could be approved (referring to table 2)

Table 2: NPV computation.

	Year 0 £	Year 1 £	Year 2 £	Year 3 £	Year 4 £	Year 5 £
Profits			0.8m	0.46m	0.78m	1.4m
Expenses	(1.02m)	(1.3m)				
Cash streams	(1.02m)	(1.3m)	0.8m	0.46m	0.78m	1.4m
Discounted factor	1	0.9091	0.8264	0.7513	0.6830	0.6209
Discounted financial flows	(1.02m)	(1.18m)	0.66m	0.35m	0.53m	0.87m

3.2. The Result of the Payback Period

The recovery period is established by accumulating the working capital collectively until the whole can fully cover the upfront outlay.

Considering the number of money streams in table 3, the payback period is 4.20 years as formula (5) shows.

$$Payback\ period = 4 years + \frac{0.28\text{m}}{1.4\text{m}} = 4.20\ years \qquad (5)$$

Table 3: The payback period's calculation.

	Year 0 £	Year 1 £	Year 2 £	Year 3 £	Year 4 £	Year 5 £
Earnings			0.8m	0.46m	0.78m	1.4m
Expenditures	(1.02m)	(1.3m)				
Money streams	(1.02m)	(1.3m)	0.8m	0.46m	0.78m	1.4m
Cumulated money streams	(1.02m)	(2.32m)	(1.52m)	(1.06m)	(0.28m)	1.12m

3.3. The Result of Discounted Payback Period

Firstly, the rate of the discount applied to all cash flows is 10%. Secondly, the discounted payback time is calculated using the same method as the payback period, which is to add the cash flows until the total can fully cover the investment outlays.

The data presented in Table 4 demonstrates that the discounted payback time is 4.76 years, as evidenced by formula (6).

$$Discounted\ payback\ period = 4\ years + \frac{0.66m}{0.87m} = 4.76\ years \qquad (6)$$

Table 4: Discounted payback time estimation.

	Year 0 £	Year 1 £	Year 2 £	Year 3 £	Year 4 £	Year 5 £
Financial gains			0.8m	0.46m	0.78m	1.4m
Spending	(1.02m)	(1.3m)				
Money streams	(1.02m)	(1.3m)	0.8m	0.46m	0.78m	1.4m
Discounted factor	1	0.9091	0.8264	0.7513	0.6830	0.6209
Discounted cash streams	(1.02m)	(1.18m)	0.66m	0.35m	0.53m	0.87m
Cumulated financial flows	(1.02m)	(2.20m)	(1.54m)	(1.20m)	(0.66m)	0.21m

3.4. The Result of IRR

$$IRR = \frac{-1.02m}{(1+IRR)^0} + \frac{-1.3m}{(1+IRR)^1} + \frac{0.8m}{(1+IRR)^2} + \frac{0.46m}{(1+IRR)^3} + \frac{0.78m}{(1+IRR)^4} + \frac{1.4m}{(1+IRR)^5} = 0 \qquad (7)$$

Consequently, the project's IRR is 13.22%.

3.5. The Result of MIRR

Based on the hypothesis that the finance rate is 8% and the reinvestment rate is 10%, this estimate has been made.

$$MIRR = \sqrt[5]{\frac{3.88m}{2.022m}} - 1 = 11.77\% \qquad (8)$$

And the outcome is 11.77% and also shown in formula (8).

Table 5: The calculation of the modified internal rate of return.

Year	Cash streams	Current value	Terminal value
0	(1.02m)	$\frac{1.02m}{(1+8\%)^0}$	
1	(1.30m)	$\frac{1.3m}{(1+8\%)^1}$	
2	0.80m		$0.8m*(1+10\%)^3$
3	0.46m		$0.46m*(1+10\%)^2$
4	0.78m		$0.78m*(1+10\%)^1$
5	1.40m		$1.4m*(1+10\%)^0$
Sum		2.02m	3.61m

4. Comparisons Between Investment Criteria

Above the calculations of different investment criteria, the decision of the investor to invest now are be quantified and just follows each decision-making rule of different appraisal techniques. As we can see, on the one hand, NPV is 0.21m which is more than zero and it reveals a signal that the project can be accepted by the investors. However, the IRR and the MIRR are also greater than the projected 10% cost of capital, coming in at 13.22% and 11.77%, respectively. What is more, it also makes investors know that investing in this project can make benefits and earn gains.

However, when the payback duration and discounted payback time are analyzed, it becomes clear that the project generates greater money streams as it gets closer to completion. If the investors are more likely to desire to see a return right away and are impatient, the project is not the optimal one to choose. The choice of investment is arbitrary. The investment decision is based totally on the investor's subjective risk perception, his understanding of the newer procedures, and the anticipated costs [11]. And with the same analysis, someone who favors high returns and risk tolerance may choose a project with high risk to earn more gains.

5. Advantages and Disadvantages of the Five Appraisal Techniques

5.1. Advantages and Disadvantages of NPV

NPV has been widely used in the world because it takes all the costs that investors spend and all the benefits that investors gain. Unlike the payback period, it is a long-term indicator which means this project can directly maximize the shareholders' wealth, and then the company can have a chance to grow rapidly. Also, it takes the timing of money into account. The last point that needs to mention is that NPV can directly make comparisons between projects of different sizes, and its link to the changes in shareholders' wealth straightforwardly.

Firstly, due to risk and uncertainty, it is problematic for the project management and investors to predict every cash flow over the course of the project. Expected outcomes are unclear since the financial and economic conditions have an impact on investments [12]. There are some changes in cash flows relying on the stages of the economic and financial environments. Secondly, the discount rate is ambiguous and it depends on the prediction of the future interest rate, but nobody knows whether the interest will increase or not. NPV is more sensitive to the discount rate. To make a more accurate NPV, the investors need plenty of experience and knowledge of the market.

5.2. Advantages and Disadvantages of Traditional Payback Period and Discounted Payback Period

There are a bunch of reasons for the popularity of the payback period. On the one hand, it is easy to calculate and understand. Individuals who have no idea about financial marketing can make it quite simple to understand the meaning of the payback period. On the other hand, businessmen who are risk-averse likely have more favorable liquidity preferences than economists commonly recognize [12]. And payback period does emphasize the liquidity aspect of the investment decision. Despite being required to sacrifice some of the project's profitability, merchants are more concerned with the project's liquidity for they prioritize an early return on investment. Both the payback duration and the discounted payback time focus on the liquidity of the project and do not measure profitability. It does not account for the potential benefits of a project which has a prolonged economic life since it over-looks all earnings after the payback life [13].

5.3. Benefits and Drawbacks of IRR and MIRR

The timing of cash flows has indeed been the main emphasis of both IRR and MIRR. Furthermore, an enterprise can have a better understanding of the structure of capital and also have a chance to justify it to make the cost of capital less than before.

There are some reasons for modifying the internal rate of return. What is more, these rates are probably going to vary in real life, making the IRR inaccurate. Unconventional projects with diverse cash flow patterns may have no IRR, several IRRs, or a signal IRR, which is another issue with IRR. The decision maker may feel troublesome to make the right decision just depends on the IRR. Finally, when deciding between projects that are mutually exclusive, a project with a high IRR is not always the one delivering the maximum return in NPV terms, making it an unreliable tool. The modified internal rate of return has countered these problems by reinvesting at cost of capital instead of IRR. And based on this assumption, the result of the MIRR will be unique and can be consistent with the NPV ranking decision.

6. Conclusion

This paper implies that in the process of investment decision, firstly, it needs to use the method of the payback period to filter some bad investments with relatively extended payback periods. The rationale behind this is that we should always have access to liquid cash in case of an emergency. The next step is that if the investment expenditure is too large for us to invest and we can borrow money from the bank or someone who is an acquaintance. Also, there are a lot of ways for a large company to fund the money by issuing shares of the company or issuing the debt of the company. At this time, the interest rate borrowed or the cost of capital for the company should be taken into consideration seriously. Thus, the IRR or MIRR can help us understand the project more deeply. If choosing to use the IRR as a technique of appraisal, it's better to calculate the NPV because the project with a higher IRR may not the one which offers the high NPV. And it is acceptable to make an investment decision by considering every aspect of the project.

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