METHODS FOR INVESTMENT ANALYSIS: PRESENTATION
THEORETICAL AND PRACTICAL

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SUMMARY
This paper aims to present the most commonly accepted methods for investment analysis, namely Net Present Value (NPV)*Payback*–with simple cash flow and with discounted cash flow, Internal Rate of Return (IRR) and Modified Internal Rate of Return (MIRR). Conceptually, the work presents the MIRR as an evolution of the IRR, aiming to correct problems inherent to the IRR, such as, for example, the analysis of flows with sequential positive and negative peaks, in which case, the IRR method will generate several rates, and not just one rate for the project. This article also aims to present the concept of Average Rate of Attractiveness. The study method used is bibliographical research, in which the concept, theory and application of each method are presented, trying to differentiate them, and, at the end, a practical example with values is presented, in which a manager, to make or not the investment, considers the use of investment analysis methods to make a decision about the *trade-off*.
Keywords:investment analysis; IRR; NPV; MIRR.

1. INTRODUCTION

Investment analysis or evaluation methods are techniques used to help managers decide which investment to choose, in the case of two exclusive investments, or whether or not to invest, in the case of simple decision-making.

These techniques or methods serve as a source of information for the manager and should be used to avoid decisions based on immediacy or momentary impulses of the manager. Good analysis can determine, through technically justifiable factors, whether the investment should be considered or not. Information such as prices, profitability indexes and even risk rates should be considered to avoid uncertainty and perpetuate a good result for the company.

There are several methods for analysis, but the most commonly used methods for this analysis are the Internal Rate of Return (IRR), the Net Present Value (NPV) and the Payback - with its two variants, simple and discounted, and aim to demarcate the viability of a project, or in the case of comparing two projects, demonstrate which will have better viability.

This work aims to present the most traditional and used methods and also to present the Modified Internal Rate of Return (MIRR) as a more assertive method than the

TIR, in addition to carrying out a practical assessment of the sale of IP telephones. This article will use the bibliographic research methodology, since all the topics covered will be taken from works related to the proposed theme. This work is structured as follows: introduction, followed by a chapter on the importance of analysis methods. In the third section, we have the description of the main analysis methods and, in the fourth chapter, a practical example, contemplating the sale of IP telephones. The last section of this work contains the final considerations.

2. METHODS FOR INVESTMENT ANALYSIS: WHY USE THEM

Investment analysis methods are tools that allow us to compare investments to be made. Due to its characteristic of analyzing facts that have not yet happened, but for which we already have parameters to measure, it ends up being included within the theme of long-term financial management. According to Assaf Neto (1992, [np]):

The main intention of investment analysis methods is to give the decision maker information that allows decision-making on whether or not to make the investment. By using these methods, it should be possible to verify whether the investment will pay off, whether the return is what the partner expected, and whether we will have the return within a timeframe acceptable to the company's senior management. According to Veras (2001), investment analysis should not only be used to decide the best among several investment opportunities, but to assess the interest in implementing the chosen method.

For Casarotto Filho; Kopittke (1994), the decision to make an investment must consider economic criteria such as margins, profitability, and also financial criteria, such as cash availability. It must also take into account imponderable issues, such as the location of the investment and the existence or not of suppliers. Through the investment cash flow, we can ascertain financial issues, but it is through investment analysis methods that we will have the economic positioning of the business.

3 MAIN METHODS OF INVESTMENT ANALYSIS

According to Luehrman (1997), investment analysis methods that consider the use of discounted cash flows began to be used in the 1970s. Since then, several analysis methods have emerged, with different and often contradictory views. In this paper, we will evaluate the 4 most commonly used methods.

used, being the Internal Rate of Return (IRR), the PayBack (Return on investment), the Net Present Value (NPV) and the Modified Internal Rate of Return (M-IRR).

3.1 NPV

According to Damodaran (2004, p. 257). From this concept, it can be seen that the NPV method is simple to apply and can be used in the vast majority of projects or investments, simply by defining a Minimum Attractiveness Rate (MAR).

The TMA is the depreciation rate imposed on gains and expenses that will occur in the future, due to the fact that they are not available at the time of investment evaluation (CAMARGO, 2007).

Defining this rate is essential for using NPV, since it can be considered the rate at which the investor would accept keeping his money invested. According to Pilão (2003, p. 89):

The Average Attractiveness Rate is extremely important for analysis using NPV, because if a rate lower than the financial market yield is defined, it is better not to carry out the project and keep the money invested in the financial market.

A good feature of NPV is that the result is a monetary value, that is, any positive value already represents an increase in the company's value. The higher the NPV, the better it will be for the analyzed project (MELO, 2012).

$$VPL = \sum_{t=0}^{n} \frac{FC_t}{(1+i)^t}$$

Figure 1: NPV formula, adapted by the authors.

3.2 *PAYBACK*

Payback would be the period between the investment and the period in which the financial inflows cover this invested amount, in short, it would be the return on investment period. According to Damodaran (2004, p. 256).

Thinking from the perspective of a company partner, it is clear that projects that can bring returns in less time are better than those that take a long time to cover the cost.

investment. Also according to Damodaran (2004), projects that have a faster return have lower risk.

As the *PayBack* represents only the term for investment coverage, one might think that we should then avoid projects with a long coverage term, which could, in some situations, be a mistake. For this reason, it is recommended to always use another investment analysis method in parallel to the *PayBack*. According to Gitman (2006, p. 301): The method of *PayBack* unfolds into two submethods, called *PayBack* Simple and *PayBack* Discounted.

3.3 IRR

The Internal Rate of Return (IRR) is a discount rate that, when applied to a cash flow, causes the NPV to be zero. According to Pilão (2003, p. 125). We can define the IRR as the rate at which the investor would receive a return at the end of each year of the project. Again according to Pilão (2003, p. 125):

We should always compare it with the chosen TMA, so if the IRR is greater than the TMA, this means that the project has a return above the determined minimum. The IRR can be obtained using the following formula:

$$NPV = \frac{FC0}{(1+TIR).0} + \frac{FC1}{(1+TIR).1} + \frac{FC2}{(1+TIR).2} + \frac{FC3}{(1+TIR).3} + \frac{FC4}{(1+TIR).4} + \frac{FC5}{(!+TIR).5} + \frac{FCn}{(1+TIR).n}$$

Figure 2: IRR formula, adapted by the authors.

Where FC = the expected cash flow; NPV = 0.

Analyzing the formula, we see that all cash flows, negative and positive, are financed and reinvested by the IRR itself, which can be a problem if the IRR is very different from normal market rates. Damodaran (2004 p. 266) warns us about this situation:

This characteristic is recognized as a problem with the IRR method for investment analysis. Furthermore, in the case of unconventional cash flows, with the existence of several interspersed positive and negative flows, the method will not generate just one IRR, but several, making the method meaningless for business analysis. For this reason, the Modified Internal Rate of Return method was developed.

(TIRM), which considers that the cash flow will be reinvested at any rate to be defined by the analyst.

3.3 TIRM

The Modified IRR (MIRR or MTIR) is an improved version of the IRR, which seeks to solve the problems listed in the previous chapter of this article. Assaf Neto (2006, *apud* SAMPAIO, 2008, p. 28) is generally adopted to overcome these IRR deficiencies, Pereira (2012, p. 367) explains that:

> As we can see through the application of this methodology, we are able to obtain an Internal Rate of Return with greater fidelity, in which profits are remunerated at a rate consistent with the company's profile and history; and investments are financed at a rate adjusted to the market.

We can define the IRR-M formula:

$$TIRM = \left[\frac{\sum FC future}{In\ clothing} \right]^{\frac{1}{n}} the - 1 - 100$$

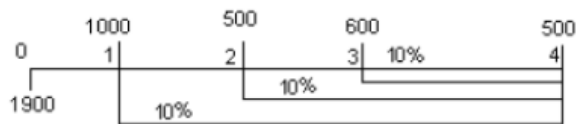Figure 3: MIRR formula. Extracted from Assaf Neto and Lima, 2009. p. 389-390.

Figure 4: example of IRR-M cash flow, taken from Assaf Neto and Lima, 2009, p.389 - 390.

4 PRACTICAL EXAMPLE OF INVESTMENT ANALYSIS – SALE OF IP PHONES

TIP is a company that resells telecommunications products, such as telephones, IP telephones and telephone exchanges. At a certain point in its operations, TIP receives an offer to sell a batch of 500 IP telephones for R$650.00 per unit. This amount will be paid in 6 equal installments of R$111.00 each, per device, with the first installment being paid 30 days after the order. The cost to acquire these devices for resale is R$350.00. It is up to the manager to decide whether or not to sell these devices. We will provide information to the manager so that he can decide whether or not it will be worth selling these devices, that is, we will use investment analysis methods to evaluate the implementation of a project, and not to compare it with another.

First, we must check a Minimum Attractiveness Rate (MAR) to be considered in the analyses. We found that if the company TIP were to finance the purchase of the devices through the bank with which it has a relationship, the bank considers an interest rate of 1.25% per month. On the other hand, if the company TIP chose not to make the purchase and invested the money in a Bank Deposit Certificate (CDB), also with the institution with which it has a relationship, it would have a monthly financial return of 0.89% per month.

Based on the data above, to facilitate calculations, we opted for a TMA of 1.1% per month, a value that would be between the cost and the remuneration of capital for the company TIP. Below is the proposed flow for the company TIP.

Months	0	1	2	3	4	5	6
Flow of box	- 175,000.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00

With the flow and TMA defined, let's start the analysis.

4.1 *Payback* Simple

THE *Payback* It simply defines, without the TMA discount on the installments, in what period the return on investment would occur, as follows:

Months	0	1	2	3	4	5	6
Cash flow	- 175,000.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00
Calculation of *Payback*		- 119,500.00	- 64,000.00	- 8,500.00	47,000.00	102,500.00	158,000.00

We see that, by *Payback* Simple, the investment would start to yield returns in the fourth month after the negotiation.

4.2 *PAYBACK* DISCOUNTED

Node *Payback* Once discounted, the value of the monthly payments is transferred to present value by applying an Average Attractiveness Rate. Then we will have:

Months	0	1	2	3	4	5	6
Cash flow	- 175,000.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00

Cash flow discounted		54,896.14	54,298.86	53,708.07	53,123.71	52,545.70	51,973.99
Calculation of *Payback*	- 175,000.00	- 120,103.86	- 65,805.00	- 12,096.94	41,026.77	93,572.47	145,546.46

Node *Payback* Discounted, for this specific business, the return will occur at the same time as *Payback* Simple, in this case, after the fourth month.

4.3 NPV

We will then calculate the Net Present Value using the formula below: NPV = -175,000 + 55,500/(1.011)^1 + 55,500/(1.011)^2 + 55,500/(1.011)^3 + 55,500/(1.011)^4 + 55,500/(1.011)^5 + 55,500/(1.011)^6

NPV = R$ 145,546.46

Following the NPV rule, we see that the project has a positive result for the NPV, so, also by analyzing this method, the manager should give a positive positioning to the sale of phones. *priori,* The calculation seems to be more laborious, but the NPV method can be calculated using Excel (NPV function) and also using the main financial calculators by activating the NPV function.

4.4 IRR

As previously stated, the IRR is the discount rate that equates the project's NPV to zero. Due to the complexity of manually calculating the IRR, we have entered the cash flow below into Excel and will use the IRR formula.

Months	0	1	2	3	4	5	6
Flow of box	- 175,000.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00

IRR Formula Format in Excel**:= IRR (cash flow)** Using

Excel, the IRR for this application is: 22.18%

4.5 TIRM

As stated previously, the Modified IRR reinvests positive cash flows, taking them to the end of the period and bringing the negative flows to present value, considering

for both operations the company's cost of capital. This cost of capital must be adjusted to the market so that the analysis is as realistic as possible. For this study, we considered the already defined MARR of 1.1% per month. By making the aforementioned adjustments, the new simplified cash flow will be as follows:

Months	0	1	2	3	4	5	6
Modified cash flow	- 175,000.00	0.00	0.00	0.00	0.00	0.00	342,292.92

With the new cash flow in hand, we calculate the MIRR using the Excel IRR formula and arrive at the following result: IRR-M = 11.83%

In addition to this calculation method, newer versions have a specific function for calculating the modified IRR. In this case, we can use the standard business flow, and then the formula will perform all the necessary calculations to determine the IRR. In short, we will have the table below, showing the result of each method:

	*Payback*Simple	*Payback*Discounted	NPV	TIR	TIR - Modified
Result the	return in the 4th month	return in the 4th month	R$145,546.46	22.18 %	11.83%

We see that selling IP phones at the values   proposed by the client is a good deal for the company TIP, since the return will be practically halfway through the contract, the NPV of the project is positive, proving that the investment will help increase the company's capital, and both the IRR and the MIRR present high rates, demonstrating to the company TIP that the investment in the sale is more profitable than keeping the money idle in financial institutions.

CONCLUSION

This work has made it possible to visualize the theory and practice of calculating the main methods used for investment analysis. During the preparation of this work, there was no intention to exhaust the subject, but only to present the methods addressed and present them not only as methods for comparing projects, but also as a tool for decision-making. *trade-off*to produce or not to produce. The applicability of the methods was demonstrated through the theoretical concept, and also in practice, with the example of the resale of IP telephones. The work considered only economic aspects, since the intention was to present and demonstrate the application of the methods. This theme

It may be continued by demonstrating the comparison of projects or improving cash flow, in order to achieve, in greater detail, situations that require more accurate mathematical treatment.

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