

Full Length Research Paper

Functional correlations between the efficiency indicators of investments

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In the methodology for evaluating the validity of investments (without portfolio investments), recommended by the World Bank, three methods are usually used: payback period, net present value and internal rate of return. Functional correlation can be set up between these indicators and this paper presents an interdependence research, based on the five projects form of different industrial branches.

Key words: Investments, efficiency, net present value, payback period, internal rate of return.

INTRODUCTION

The process of investing implies making some economic outflows at the present time, in order to make some economic benefits and yields in the future. Investment decisions tend to be of crucial importance to business, because large amounts of resources are often involved and it is often difficult and expensive to “bail out” of an investment once it has been undertaken (Atrill and McLaney, 2006). The investment program is an expert document and a basis for investment decisions, which marks the closing stage of planning as part of the investment management process (Maric, 2008). Investors screen different investment proposals in order to make decisions and for that process, it is essential to apply appropriate methods of projects evaluation.

This paper studies the functional correlations between the main efficiency indicators of investments in order to help them make proper decisions about the validity of the investment proposal. For this particular research, data were collected from former researches. As such, a database was created, which will be used in this paper.

The main purpose of this paper is to point out the functional correlation between two of the three most applied methods in investment project justification. Those two methods are payback period and internal rate of return. The authors, through this research, seek the level of their interdependence. The expected result of this research will confirm the hypothesis of existing high level of functional correlation between payback period and internal rate of return.

The paper is organized as follows. First, the theoretical background explains the importance of applying the generally accepted methods of project evaluation, that are also given in the “Common Methodology for Investments”, used in all former Yugoslavian republics. Subsequently, the data used for the research are explained by the data sample and methodology, after which the results and relation between the observed efficiency parameters are presented. Finally, concluding remarks and suggestions for future research are made.

THEORETICAL BACKGROUND

Planning of implementation of investment facilities is regulated in each country by a special law. Moreover, in the former Socialist Federal Republic of Yugoslavia, since 1987, Common Methodology for investments was

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used. The methodology was recommended by the International Finance Corporation and World Bank and it harmonized the investment process with actual methodology at the global level. Accordingly, as a result of accepting the world tendencies in this area, all former Yugoslavian republics (now independent states) incorporated the planning procedure into its legal elements. In this procedure, one of the most important steps is to make an investment program, whose purpose is to make a decision about the validity of the project. Therefore, the investment program is a projection of future business within the defined-conventional rules of its development, that is use to predict future efficiency of the project and validity of its implementation.

The investor should have information about the expected return and cash flow of some proposals in order to make a decision about the validity of that project. One major problem, according to Demir and Bostanci (2010), is that return of some projects cannot be calculated without timing of future cash inflows and outflows. Thus, comparison of different investment proposals in order to accept or reject them needs information about the time distribution of cash inflows and outflows, as well as an amount of investment.

DATA SAMPLE AND METHODOLOGY

The data collected from former researches, headed by Maric (2010), were used to create a database that was partially used in this paper. One part of these researches is presented in the following papers: "Researching the dependence between the dynamic indicators of investment profitability" (Maric et al., 2010a), Afr. J. Bus. Management (forthcoming) and "Observing the dependence between dynamic indicators of investment profitability – Relative net present value and Internal rate of return" (Maric et al., 2010b), Afr. J. Bus. Management (forthcoming).

Methods of investment proposals evaluation

Amongst the earliest methods of firm or project evaluation were the non-discounted cash flow methods and the discounted cash flow techniques. The nondiscounted cash flow methods are a form of capital budgeting techniques used in evaluating the uncertainty and risk of the value of a firm without considering the time value of money (Olawale et al., 2010). Those methods and techniques help investors to make the best allocation of resources. Traditional payback period (PP) and accounting rate of return do not consider cash flows in investment decisions.

Understanding of various project evaluation techniques provides the investor with valuable tools for determining which projects, if any, should be accepted or rejected (Olawale et al., 2010). Methods for dynamic evaluation of project efficiency, due to their advantages and disadvantages, are defined in the aforementioned methodology as follows (Maric, 2000):

1. Payback period (PP),
2. The net present value (NPV),
3. The internal rate of return (IRR).

Each of these methods is based on the economic course of the project, and they should satisfy some theoretical requirements to justify the further project realization.

Applying the method of payback period in the project evaluation

The net cash flow of the project has to be greater than the amount of initial investment. This method is usually the first and the simplest to be applied in project evaluation. It answers the question of how many years will be necessary to pay back the initial amount of investment and will it be within the lifetime of the project. Therefore, the project with the shortest payback period should be accepted, but this method does not consider timing of cash flows. According to Atrill and McLaney (2006), payback period is the length of time taken for an initial investment to be repaid out of the net cash inflows from a project.

Applying the method of net present value in the project evaluation

Discounted future net cash inflows should be greater than the amount of investment, that is, the net present value should be positive (the boundary is equal to 0).

The net present value is a popular technique for investment decision, because it is a financial measure that ascertains the time value of money invested in a business (Peel and Bridge, 1998). This method is superior than others because it considers timing and the entire sum of relevant future cash flows, as well as the objective of the business or project (Atrill and McLaney, 2006).

A relative indicator of this method is the relative net present value (RNPV), calculated as the ratio of net present value and amount of initial investments, which also needs to be greater than 0, in order for a project to be accepted.

Applying the method of internal rate of return in the project evaluation

The internal rate of return of the project is the rate at which the project returns the amount of investment and it should be higher than the weighted value of the project's financial sources. All financial sources have their costs, where financial funds have a cost of 8% (by convention), which is the opportunity cost of investment in alternative projects. Costs of each loan are calculated according to the real agreement with the creditor. In other words, IRR should be greater than opportunity cost of finance, usually known as a *hurdle rate* of the project. IRR also takes into consideration, timing and the entire amount of the future cash flows (Atrill and McLaney, 2006).

In order to appraise an investment program all three methods should be applied, but there is always a specific level of risk and uncertainty, if the data for these calculations are imprecise. Some techniques have been developed to reduce such an uncertainty (probabilistic analysis, sensitivity analysis and scenario analysis). However, when used alone, any of these techniques can only provide the decision maker with limited data (Demir and Bostanci, 2010). By making investment decision, the investor should be aware that slight changes in discount rate can result in significant shift of NPV and IRR. According to Lin and Lee (2010), decision-makers should assess and evaluate investment alternatives, on the base of their knowledge, experience and subjective judgment.

The basis for the application of all three methods for dynamic evaluation of the project is the economic course of the project that presents projection of future techno-economic events in the lifetime of the project. Table 1 shows the structure of the economic course.

RESULTS AND DISCUSSION

In the aforementioned papers, the authors, headed by

Table 1. Structure of economic course.

No.	Course structure	Project lifetime (Years)					
		0	1	2	3	...	n
I	Inflows						
1.	Total revenue						
2.	After depreciation value						
II	Outflows						
3.	Long-term assets						
4.	Short-term assets						
5.	Material expenses						
6.	Non-material expenses						
7.	Employees' paychecks						
8.	Corporate profit tax						
I - II	Net Inflows ΣNI						

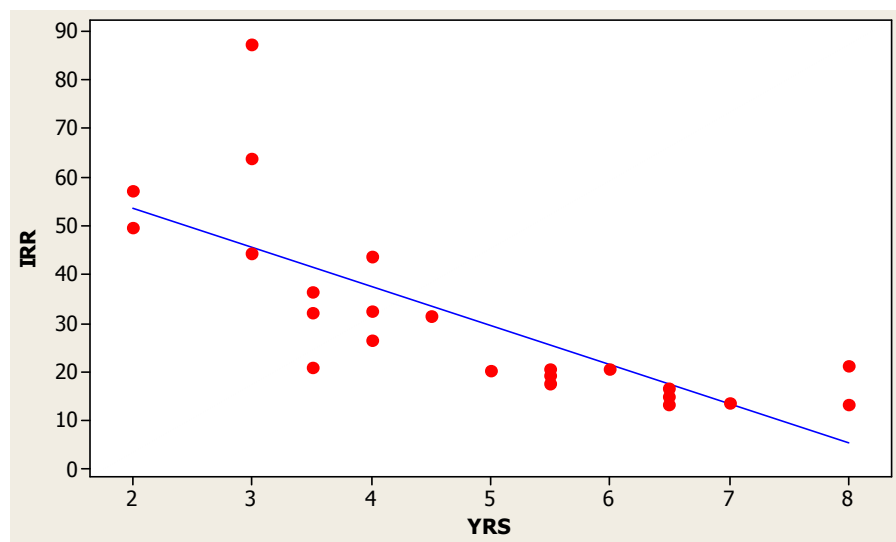


Figure 1. The model of linear shape dependence (Scatter plot of IRR vs. YRS).

Marić (2010), show that between the payback period (PP) and internal rate of return (IRR), for the 23 investment proposals, the following links and correlations exist (Figures 1, 2 and 3).

The correlation factor value (Cor=0.753) indicates high level of correlation between payback period and internal rate of return and it is described by the linear shape dependence of the following form: $IRR = 68.8 - 7.96 PP$.

The correlation factor value (Cor=0.850) indicates high level of correlation between payback period and the internal rate of return and it is described by the curved exponential shape dependence of the following form: $IRR = 89.9 \times 1.29 PP$.

The correlation factor value (Cor=0.865) indicates high

level of correlation between payback period and the internal rate of return and it is described by the curved exponential shape dependence of the following form: $IRR = 148.7 \times 1.29 PP^{-1.15}$. In the paper titled "Observing the dependence between the dynamic indicators of investment profitability - Relative net present value and Internal rate of return" (Maric et al., 2010b), Afr. J. Bus. Management (forthcoming), it was shown that there was a correlation and relationship between the relative net present value and internal rate of return (Figure 4).

The correlation factor value (Cor=0.753) indicates high level of correlation between internal rate of return (IRR) and relative net present value (RNPV), and it is described by the linear shape dependence of the following form:

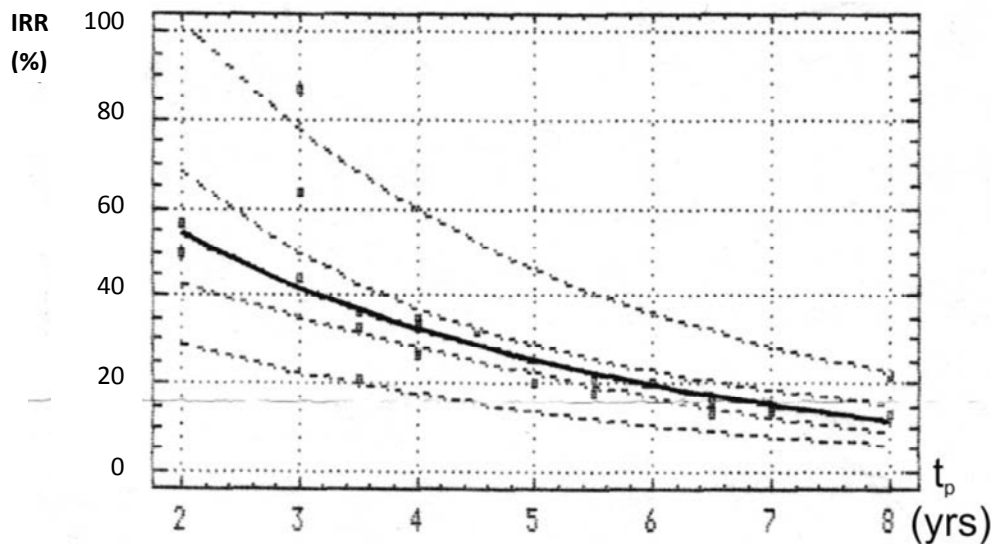


Figure 2. The curve of exponential shape dependence.

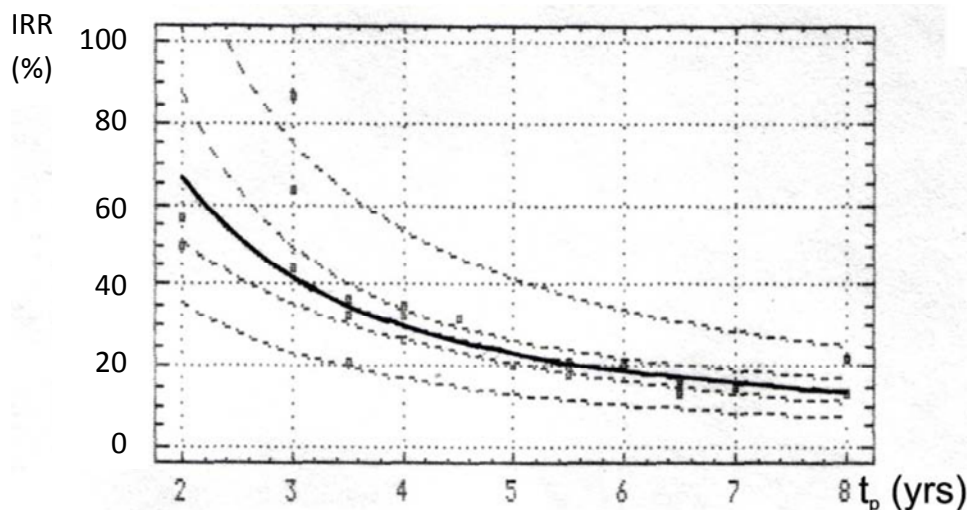


Figure 3. The curve of exponential shape dependence.

$$IRR = 18.16 + 15.51 \text{ RNPV}.$$

Figure 5 aggregates all the aforementioned dependences shown in Figures 1, 2, 3 and 4. The review and the established relation can serve as a tool in making investment programs for quick and relatively accurate understanding of these relationships. In order to consider the justification of new investments, the simplest method to apply on the base of economic course of the project is the payback period (PP). According to this method, by cumulating the yearly net inflows within the project's lifetime and comparing the amount of investment in "0" year, we find out that the year of the project's lifetime is the return of investment. In other words, the cumulated net inflows are higher than the amount of initial investment.

This method is the easiest to apply, considering the fact that it has only addition and subtraction as its mathematical operations. The functional connection between the aforementioned methods and the two other methods are established and shown. So, by the graphical method, it is very easy to determine the relative net present value (RNPV), as well as the IRR, whose calculation is used for the iterative process.

As an evidence of the different statements, Table 2 shows results for the five tested projects (A, B, C, D and E), applying the graphical linear model $IRR = f(PP)$ with a correlation of 0.753, and a curvilinear model $IRR = f(PP)$ with a correlation of 0.865. Those five projects are from the following branches: Agricultural complex - Food production, Metal industry - Tractor spare parts, Graphical

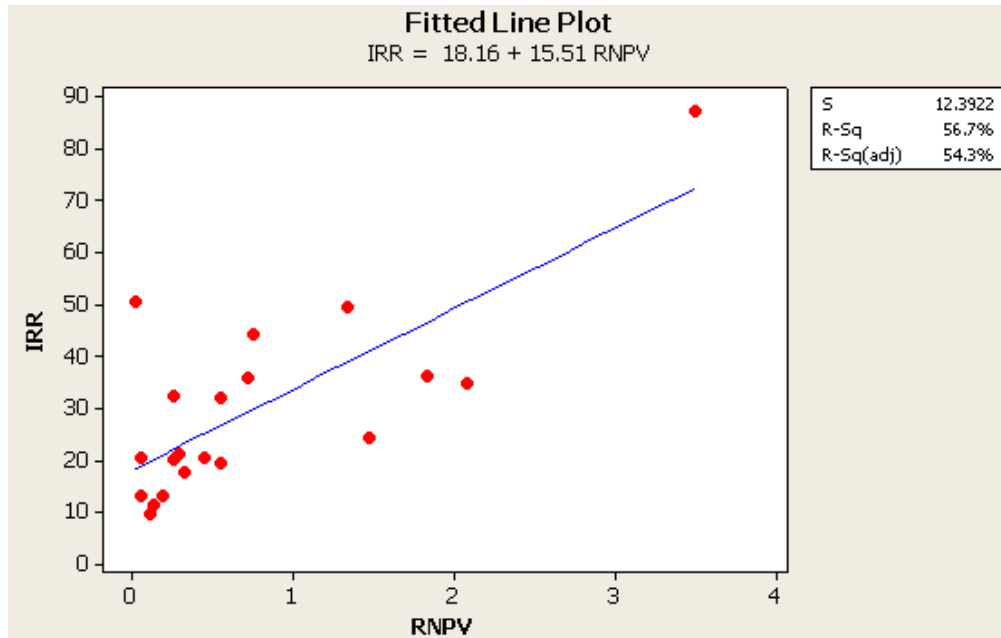


Figure 4. The model of linear shape dependence between IRR and RNPV.

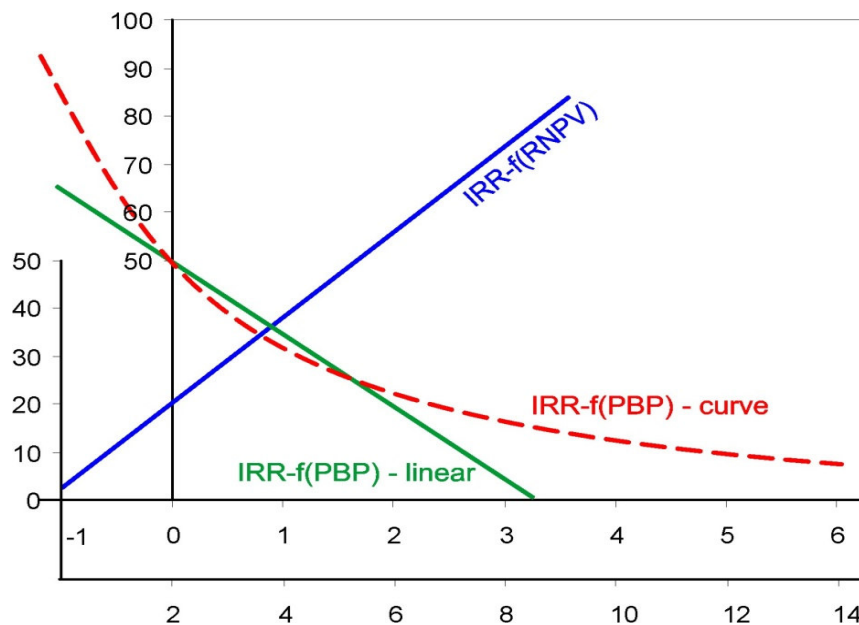


Figure 5. Aggregate model of interdependences between PP, IRR and RNPV.

Graphical industry - Stationery production, Timber industry - Furniture production, and Services - Beauty salon.

The data in Table 2 show that the linear model points out less deviations on the IRR from the real-calculated data than the curvilinear model in the practical area of functional dependence of variables PP and IRR. Considering that similar researches have not been done

yet, a special note is given to this paper.

Conclusions

This paper is as a result of the research conducted and the data collected for several years, which yielded good results in the fields of observation of investments

Table 2. Interdependence between payback period (PP) and internal rate of return (IRR).

Number	Project	Calculated		Graphical	
		PP	IRR (in %)	IRR (lin.) (in %)	IRR (curvlin.) (in %)
1.	A	1.8	48.8	50	72
2.	B	2.5	37.6	47	50
3.	C	4.2	21.5	32	28
4.	D	4.8	31.8	30	23
5.	E	7.5	10.5	8	13

efficiency. Based on real patterns of projected investments in the autonomous province of Vojvodina, derived relationships between efficiency parameters of the project and rightness in their behaviour are explicitly found.

This theoretic research also has practical benefit that results in quick conclusion about the validity of the project through the IRR and PP parameters. Payback period (PP) can be immediately calculated if the amount of investment, as well as revenues, expenditures and their difference for each year of the project's lifetime are known. The presented method of quick IRR in determining the PP data is essential in making a pre-feasibility study too. At the lower level of data elaboration, this study helps in concluding whether or not the project is justified to realize which level of the IRR can be approximately expected.

The authors intend to continue the research of other interdependences between factors and indicators that are relevant for the process of planning and decision making by investors, and to present the results in further papers.

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