



MULTIPLE FACTORS FOR A NEW INTERNAL RATE OF RETURN ANALYSIS METHOD. THE CASE OF ACQUISITION OF PRODUCTIVE FIXED ASSETS.

García-Piña Rosete, Juan Carlos¹

*Universidad Autónoma de Nuevo León, México
Juancarlos.gpr@gmail.com, Calle Madera, 51, Madrid, España, +34 692 178 119*

Fecha de envío: 9/Mayo2016

Fecha de aceptación: 16/Mayo/2016

Resumen / Abstract:

Compilación de trabajos previos, e introducción a trabajo actual explorando la obsolescencia del método de análisis de la Tasa Interna de Retorno para Decisiones Corporativas de Inversión. Trabajos previos de autores distintos han investigado los beneficios de adaptar la fórmula de la Tasa Interna de Retorno para obtener resultados eficientes correspondientes a los diferentes procesos de toma de decisión en los sectores financieros y de bienes raíces. Sin embargo, hay un vacío de análisis relativo a los sectores de manufactura y productivos. El propósito es explorar la adición de factores al método actual como objetivo de eficiencia del proceso de Toma de Decisiones. Los factores sujetos al análisis son los siguientes: inflación, ingresos marginales y eficiencia relativa a maquinaria productiva. La adición de dichos factores en una formula combinada agregaría valor y certeza al análisis; de este modo, proveerá decisiones eficientes a los corporativos que intentan engrandecer o expandirse internacionalmente.

Compilation of previous work, and an introduction to current research exploring the obsolescence of the analysis method for the Internal Rate of Return for Corporate Investment Decisions. Previous work from distinct authors have researched the benefits of adapting the Internal Rate of Return formula to obtain improved results correspondent to different investment decision processes in financial, and real estate sectors. Nonetheless, there is lack of further analysis towards the manufacturing, and productive sectors. Our aim is to explore the addition of factors to the current method as a principle for the improvement of investment decision making process. The factors subject to analysis within this paper are the following: inflation, marginal returns, and efficiency relative to productive fixed assets. The addition of the aforementioned factors in a combined formula will add value and certainty to the analysis; thereof, providing improved decisions to corporations attempting to enlarge or further expand operations internationally.

Palabras Clave / Key Terms: Tasa Interna de Retorno; Toma de Decisiones de Inversión; Inflación; Ingresos Marginales; Eficiencia. Internal Rate of Return; Investment Decision Making; Inflation; Marginal Returns; Project Efficiency.

Introduction

One of the most widely accepted as theoretically accurate analysis method for Investment Decision Making Processes has been for over eight decades the Net Present Value (NPV). This method provides a monetary value for prospective Investments' possible future cash flow for the present time of the analysis. A derivative of this method assigns a percentage value to the NPV, whereas the investment amount being depicted as a negative outflow of cash, must equal the possible inflows of cash in the monetary value as to equal the NPV to zero, this method has been deemed as the Internal Rate of Return (IRR). Each method is preferred in different analysis depending on what the financial analyst prefers to seek for, whether is the monetary value or the percentage of return; therefore, it offers certain conflicting results. Due to this fact, it is required to take a further comparison to ascertain the correspondent results derived from each method.

For the most part, the percentage value rendered by the IRR is quite appropriate for most decisions, since its result depicts the return that is expected to obtain by the project being analyzed. This method has strong value for several industries; specifically in the financial, real estate, and other productive industries. Unfortunately, this method has been analyzed by several researchers as being limited at its present form. The concurrent research by authors like Magni, and Trifonov have opted for the addition of factors to the IRR model; thereof, the proposal of alternative methods such as the Modified Internal Rate of Return, Incremental Internal Rate of Return, and the Average Internal Rate of Return as more effective methods. (Magni, Aggregate Return on Investment and Investment Decisions: A new Perspective, 2010) (Trifonov, Yashin, Koshelev, & Makarov, 2011)

The above mentioned proposals have advocated for the inclusion of marginal returns within the Internal Rate of Return Method, whereas has been proven that its inclusion does provide different results, which are deemed as relatively more accurate to the real expectancy of net returns throughout the project's prospective future years of operations.

The present paper will attempt to circumscribe its effort in establishing a background allocation for missing factors such as Inflation, Marginal Returns, and Productive Equipment Efficiency. For this purpose, a projected purchase of new machinery from a metallurgical corporation shall be analyzed empirically from its projection and the obtained results.

Theoretical Framework

The Internal Rate of Return (IRR) and the Net Present Value (NPV) models are the most widely used set of analysis for investment decisions in corporations. Both methods were introduced by Irving Fisher, an American neoclassical economist, on its 1930's book entitled "The Theory of Interest". Fisher explained the role that interests play in long-term investments, where time is the leading factor to assign the profit value in the present moment of the analysis. (Fisher, 1930) The reason for its widespread usage is due to its practical applications, and offer relative measures of worth, also commonly required by investors. The reasons for a relative measure of worth is often researched is that a percentage return is easily understood and is felt as an intuitive measure by most investors (Evans & Forbes, 1993)

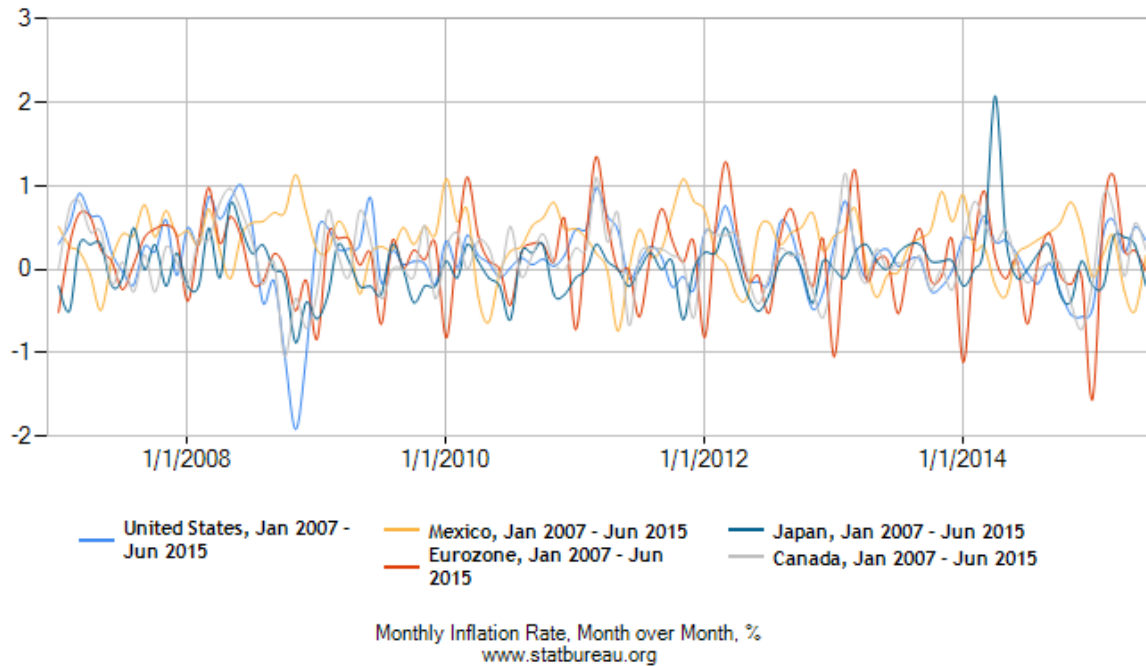
As stated, the Internal Rate of Return offers a relative measure of worth expressed in present monetary value, deemed as the Net Present Value, expressed in percentage terms to evaluate an investment plan being considered for its near future deployment and development. The Internal Rate of Return model has been defined by Fisher as the moment where the Net Present Value of a specific project's cash flow equals zero. (Fisher, 1930) For an investor to select an evaluated option, the selected choice must be equal or exceed a desired return, which must be superior to the corporation's cost of capital funding, in order for such corporation to report profits.

This method has prevailed applicable for over 86 years, now seen as to possess several flaws, which are going to be discussed in this paper. Friedrich A. Lutz has stated that Fisher's method did not consider the existence of variable interest rates, but fixed interest rates. (Lutz, 1968) This consideration occurs for the majority of the developed nations, while in some under developed or developing nations, variable interest rates abound. Other considerations relate to the existence of present factors such as inflation, marginal returns, and in specific cases of productive fixed assets' efficiency has not being considered.

Inflation has concurrent relevance, due to the fact that currently prices do change, in the past it was not relevant for any study. (Wofford, 2013) Inflation has profound implications in most economies, whereas for an international corporation with several locations in different regions of the world, this factor nowadays is a key player for investment decision making.

Developed nations' economies, unless an unforeseen event occurs such as political instability, wars, external economic issues, possess a stable economic situation. For the most part, corporations from developed nations expand and seek international operations in countries where economic conditions are not similar to their country of origin.

As an example the following chart depicts dissimilarities in terms of inflation.



Source: Author's Creation.

Bearing this in mind, the constant fluctuation of inflation, and dissimilar economic circumstances act as a force upon Investment Decisions. Inflation is a key player in terms of competitiveness, whereas if a corporation seeks to reach for a further expansion, such expansion will be deterred in unstable economic nations, due to the fact that high inflation is a signal of economic instability.

In terms of the Internal Rate of Return Analysis, Inflation has not been considered as a factor in any previous literature. This situation must be adapted, since even in developed nations, price suffer variations; therefore, cash flows must be subjected to these fluctuations. Such fluctuations can have a positive or negative effect directly linked to the cash flow. Positive effects would occur in terms of proper adjustments in the expectancy of the cash flow. Negative effects would be a decrease in the real inflow of cash.

The following chart depicts both positive and negative effect of Inflation in the cash flow, considering an Inflation rate of 3%:

POSITIVE EFFECT		NEGATIVE EFFECT	
YEAR	NEUTRAL CASH FLOW	YEAR	NEUTRAL CASH FLOW
0	(1,000,000.00)	0	(1,000,000.00)
1	300,000.00	1	300,000.00
2	309,000.00	2	291,000.00
3	318,270.00	3	282,270.00
4	327,818.10	4	273,801.90
5	337,652.64	5	265,587.84
NPV	592,740.74	NPV	412,659.74

Source: Author's Creation.

As it can be seen the positive adjustment will sustain the present value of money, while a negative effect will consider that Inflation affected customers' purchasing power turning the expected plan less profitable by 30%.

Another factor that has been analyzed has been the presence of Marginal Returns, being defined as additional income derived from the reinvestment of yearly income. There have been two major analyses done regarding this factor, one in Russia by a group of four researchers led by Trifonov, and another commanded by Carlo Magni, an Italian economist. Both analyses propose the inclusion of marginal returns on investments, and even propose formulas for this purpose to be fulfilled. The mentioned researchers provide sufficient evidence to prove that Investment Decisions have been lacking the existence of marginal returns. (Trifonov, Yashin, Koshelev, & Makarov, 2011) (Magni, 2010)

Another study provided by Dean Altshuler, in conjunction with Carlo Magni was designed for the Real Estate industry in the United States. This study demonstrate to the readers that all the previous knowledge regarding the Internal Rate of Return model does not depict the present circumstances, due to the lack of marginal returns factor into the determination of profit values relative to the projects being analyzed. (Altshuler & Magni, 2012) As seen Dr. Magni has specialized in the research of the topic, and has comprised himself to develop further analysis regarding this topic.

A different perspective from Dr. Magni, he has proposed the Average Rate of Return, which according to him, it's a model that serves multiple purposes of different sectors. This proposed method provides a class of rates of return. A specific rate of return is found by specifying the capital base on which the rate is applied. (Magni, Average Internal Rate of Return and Investment Decisions: A new perspective, 2007) As stated under this proposal, analysts will obtain several classes of rates of return, when all the required data is accessed, the final result will be assessed and valued under the capital base specific to each corporation, and their availability of funds.

A different proposal comes from Dr. Salamon, where on its research paper proposes an examination for the methodology of the Internal Rate of Return model in terms of Accounting Disciplines, due to the fact that it lacks a relationship to fiscal accountancy. (Salamon, 2010) Although it is important to consider this important aspect, it needs to be treated with respect, since the analysis is for projects that if accepted as an Investment Decision, will conform an entirety of cash inflows and outflows of the entire corporation's activities, and its effect on the fiscal side will vary upon the size and further deployment of such projects.

Another relevant factor that must undergo an appraisal is the efficiency of the productive machinery on an investment project. This factor has limited or null bibliographical framework for analysis, due to the fact that corporations restrict its access to corporate outsiders. The proposed analysis depicts the need to undergo an empirical study from real projections and the actual development of the project. This factor is highly variable, and faces outside entities such as quality, maintenance, performance. Nonetheless, the actual deployment of the project certainly affects the performance of the monetary inflows deemed proprietorship for each project.

A project's actual performance varies and different deployment result in more profitable than others. Under this assumption, it is entailed that machinery with good quality, and well-designed equipment with a proper fit for each specific project result in better monetary results. On the other hand, underachieving productive equipment will result in worsen results. There's a stochastic study that has proven that through technology, performance results are improved by reducing human errors, and the maximum utilization of raw materials input and reduction of defects and waste. (Adkins & Paxson, 2014) Hence attempting to evidence the need of outstanding productive equipment.

As stated through obvious assumptions, and the lack of presence of bold bibliographical references, this paper attempts to prove through empirical analysis that the actual performance of productive equipment has a sound impact affecting monetary results.

Methodology

This paper studies a real case from a metallurgical sector corporation that has undergone a recent investment in Salinas Victoria, Nuevo León, México for the epoxy bond fusion covering for the production of Steel Pipes deemed exclusive for the Oil Industry. This move has been deemed as a backward vertical integration, since it was previously outsourced to a specialist corporation, the idea behind this investment was to reduce costs and improve delivery times for their customers; therefore, achieving better monetary results from two sources. The investment was the acquisition of land, and equipment for developing a manufacturing plant valued in the 9 million euros range, that will perform the epoxy bond fusion covering on the Steel Pipes being manufactured in their other plants located in the metropolitan area of Monterrey, Nuevo León, México. The corporation at hand has had improved results surpassing their expectations of performance.

To better assess the present analysis, a comparison of Internal Rate of Return and a relative method the modified, IRR will be performed with the empirical results been seen as actual performance from the described Investment. Subsequently, under t-Test for paired two samples for means as a test to prove which method converges more with the performance results obtained from the actual operation of this manufacturing plant.

This specific case has surpassed the projected estimations by huge margins, this situation which is a desired outcome, is not a normal outcome. For this analysis, it represents a limitation, instead of properly assessing the actual performance of the deemed methods under normal circumstances, it's done under exceptional circumstances. That is the reason why the t-Test for paired two samples is the most appropriate comparison method, since it provides the pertinent information deemed specific for this analysis.

The results section will portray the tables and graphs obtained from the present analysis.

Results

The analysis that was performed analyzed the Capital Budgeting from this corporation performed previously to the acquisition of the Salinas Victoria Plant. The corporation provided 5 years of cash flows, since it is the amount of time that the plant has been in operations. The cash flows provided were in the form of estimated savings in cost vs. the actual performance of such savings.

The data gave the opportunity to perform an overall analysis, by obtaining the Net Present Value at 5%, which according to this corporation is their regular Market Value Rate of Return with their regular banking institutions. At this Rate of Return such corporation budgeted a Return of roughly 5.6 million euros; while the actual performance is surpassing so far the 12.5 million euros, with a Variance Coefficient of 53.6%. The budgeted IRR was 24.5%, while the performance rate so far is over 43%, with a Variance Coefficient of 39.1%. The modified IRR under its budgeting stage was 15.2%, under its performance the result was 23.4%, with a Variance Coefficient of 33.8%. Subsequently, the t-Test for paired two samples for means was performed. On this analysis, the investment outflow was removed from the equation, since it was an atypical value for the equation. On both cases, budget and actual performance, the value will have been the same; therefore, disregarded from this equation.

VALUE	BUDGET	ACTUAL	VAR. COEFF.
NPV	5.6 M €	12.5 M €	53.6%
IRR	24.5%	43%	39.1%
MIRR	15.2%	23.4%	33.8%

Source: Author's Creation.

The t-Test was based on the following hypothesis:

H₀: There is no Significant Difference between the Budgeted and the Actual Performance Results.

$$\mu_1 = \mu_2$$

H₁: There is a Significant Difference between the Budgeted and the Actual Performance Results.

$$\mu_1 \neq \mu_2$$

The level of significance was 1%, from which we obtained a critical t-value of ± 4.60409 , since it is a two tailed test, seeking for a difference not for a specific direction whether it would be greater or lesser than each other.

The resulting t-value was -7.77525; thereof, the H₁ is accepted, there is a Significant Difference between results.

The following table provides the results obtained:

t-Test: Paired Two Sample for Means		
	<i>BUDGET</i>	<i>ACTUAL</i>
Mean	2,961,201.70	4,341,923.18
Standard Deviation	397,078.36	
Observations	5	
Pearson Correlation	-0.357335866	
t-Value	-7.775258939	
t-Critical Value	± 4.604094871	

Source: Author's Creation.

The depicted results provide that there is enough evidence to support the acceptance of the alternative hypothesis, due to the fact that the specific t-value deemed proper of this specific case is significantly outside the critical t-value of -4.60409 being allocated at -7.77525.

Conclusions

The conclusions that arise from this analysis is that according to the theoretical framework, there is an ample background for depicting the overall actualization of the Capital Budgeting Methods, deemed outdated by several authors, and for over three decades there has been discussions about the adaptability of such methods. This discussion is current, due to the availability of concurrent analysis undergoing for such methods, and the fact that entities require to suffice the need for more accurate Capital Budgeting procedures.

International Corporations attempting to expand to newer markets struggle with global economic factors such as different inflation rates, different interest rates, and monetary exchange rates, among others. The presence of such factors must be taken into consideration in the different processes of Capital Budgeting with the option to improve its turnout of results.

Most situations depict the overall presence of Marginal Returns during performance cash flows. There are current methods or modified methods that have adapted the presence of both Returns, the financing of the project and the marginal returns. Modified IRR uses this inclusion of factors, which was proven to have a lesser Variance Coefficient, but still had a significant difference between the results obtained under both processes of nearly 34%.

The factor that has the lesser degree of bibliographical research is the efficiency of the productive equipment, due to the fact that there is minor accessibility for empirical research from corporations. The conclusions relative to this factor are obvious that through accessing more technologically sound equipment, and reducing the presence of human error, meaning that equipment that require limited or null human intervention tend to be more efficient. Nonetheless, without proper maintenance, and strict controls machinery will tend to reduce its efficiency.

According to the corporation that served the present research, the cause for such outstanding results was the fact that the equipment provided a higher efficiency than the expected initially, allowing them to increase their cost's savings. Therefore, this factor addition must be considered in the Capital Budgeting as a correction method for a better allocation of the financial results.

The present research has shown through empirical analysis of results that Capital Budgeting Methods deviate substantially from the actual performance of the Investment Project at hand. Since, results were obtained at a level of confidence of 99%, reassures the need for an improved method of analysis. Regardless the fact that the results were overwhelmingly better than the expectancy provides a special situation for further research, centering in controlling such variable that needs several years of empirical research, and the observance of different equipment under different industries and different circumstances. Thereof, future research will prevail to seek for results within the same metallurgical industry; subsequently will be extrapolated to other industries.

As a final conclusion, the addition of factors will attempt to improve results seeking for the reduction of deviations. Future research would be performed seeking how to form a relationship between the proposed factors and the currently accepted methods. A quite rather important situation to consider is the integration of all factors into a single model that shall provide enough data for corporate usage.

Bibliography

- Adkins, R., & Paxson, D. (2014). Stochastic Equipment Capital Budgeting with Technological Progress. *European Financial Management*, 1031-1049.
- Altshuler, D., & Magni, C. (2012). Why IRR is Not the Rate of Return for Your Investment: Introducing AIRR to the Real Estate Community. *Journal of Real Estate Portfolio Management*, 219-230.
- Arshad, A. (2012). Net Present Value is better than Internal Rate of Return. *Interdisciplinary Journal of Contemporary Research in Business*, 212-219.
- Dudley, C. L. (1998). A Note on Reinvestment Assumptions in choosing between Net Present Value and Internal Rate of Return. *The Journal of Finance*, 907-915.
- Evans, D., & Forbes, S. m. (1993). Decision making and display methods: the case of prescription and practice in capital budgeting. *Eng. Econ.* 39, 87–92. *Eng. Economics*, 39, 87–92.
- Fisher, I. (1930). *The Theory of Interest*. New York: Macmillan.
- Lutz, F. A. (1968). *The Theory of Interest*. New Brunswick: Transaction Publishers.
- Magni, C. A. (2005). On decomposing net final values: EVA, SVA, and shadow project. *Munich Personal RePEc Archive*, 1-29.
- Magni, C. A. (2007). Addendum to "Average Internal Rate of Return and Investment Decisions: A new perspective.". *The Engineering Economist*, 181-182.
- Magni, C. A. (2007). Average Internal Rate of Return and Investment Decisions: A new perspective. *The Engineering Economist*, 140-169.
- Magni, C. A. (2009). Investment decisions, net present value and bounded rationality. *Quantitative Finance*, 967-979.

- Magni, C. A. (2010). Aggregate Return on Investment and Investment Decisions: A new Perspective. *The Engineering Economist*, 140-169.
- Magni, C. A. (2011). In search of the "Lost Capital". A Theory for Valuation, Investment Decisions, Performance Measurement. *Frontiers in Finance and Economy*, 87-147.
- Pae, J., & Yoon, S.-S. (2012). Determinants of Analysts' Cash Flow Forecast Accuracy. *Journal of Accounting, Auditing & Finance.*, 123-144.
- Salamon, G. L. (2010). Models of the Relationship between the Accounting and Internal Rate of Return: An Examination of the Methodology. *Journal of Accounting Research*, 296-303.
- Sarnat, M., & Levy, H. (1990). The relationship of Rules of thumb to the Internal Rate of Return: A Restatement and Generalization. *The Journal of Finance*, 479-490.
- Trifonov, Y. V., Yashin, S. N., Koshelev, E. V., & Makarov, S. A. (2011). Planning an Investment Program of a company in view of Reinvestment Opportunities. *International Journal of Business and Social Science*, 307-314.
- Wofford, R. (2013, April 12). Economics Lecture during University of the Ozarks Alumni Weekend.