IRR – A Blunder –What Next?
But it is Still Popular –Why?

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BACKGROUND – IRR – ABLUNDER (PROBLEM WITH IRR)

May be finance managers just enjoy living on the edge. What else would explain their weakness for using the internal rate of return (IRR) to assess capital projects? For decades, Finance textbooks and academics have warned that typical IRR calculations build in reinvestment assumptions that make bad projects look better and good ones look great. Yet, as recently as 2004, academic research found that three quarters of CFOs always or almost always use IRR when evaluating Capital projects (Anand,2002; Dedi & Orsag,2007 & Graham & Harvey, 2001).

In an informal survey done by Kelleher & MacCormach, 2004, out of 30 executives at Corporations, Hedge funds, and Venture Capital firms, they found only 6 were fully aware of IRR's most critical deficiencies. They re-analyzed 2 dozen actual investments that one company made on the basis of attractive internal rates of return. If the IRR calculated to justify these investment decisions had been corrected for the measure's natural flaws, management's prioritization of its projects as well as its view of their overall attractiveness would have changed considerably.

However, IRR does offer what seems to be a straight forward comparison of, say, the 30% annual return of a specific project with the 12% or 36% rate that most people pay on their car loans or credit cards. That ease of comparison seems to outweigh the technical deficiencies that create immaterial distortions in relatively isolated circumstances.

Admittedly, some of the measure's deficiencies are technical, even arcane, (as a result of an arcane mathematical problem, IRR can generate 2 very different values for the same project when future cash flows switch from negative to positive or vice versa. Also, since IRR is expressed as a percentage, it can make small project appear more attractive than large ones, even though large projects with lower IRRs can be more attractive on an NPV basis than smaller projects with higher IRRs) but the most dangerous problems with IRR are neither isolated nor immaterial, and they can have serious implications for capital budget managers. When managers decide to finance only the projects with the highest IRRs, they may be looking at the most distorted calculations and thereby destroying shareholder value by selecting the wrong projects altogether. Companies also risk creating unrealistic expectations for themselves and for shareholders. The most dangerous assumption in IRR is that interim cash flows will be reinvested at the same high rates of return.

Practitioners often interpret internal rate of return as an annual equivalent return on a given investment; this easy analogy is the source of its intuitive appeal. But in fact, IRR is the true indication of a project's annual return on investment only when the project generates no interim cash flows or when those interim cash flows really can be invested at the actual IRR.

When the calculated IRR is higher than the true reinvestment rate for interim cash flows, the measure will overestimate-sometimes very significantly-the annual equivalent return from the project. The formula assumes that the company has additional projects, with equally attractive prospects, in which to invest the interim cash flows. In this case, the calculation implicitly takes credit for these additional projects. Calculations of net present value (NPV) by contrast, generally assume only that a company can earn its cost of capital on interim cash flows, leaving any future incremental project value with those future values.

IRR's assumptions above reinvestment can lead to major Capital budget distortions. Consider a hypothetical example of 2 different, mutually exclusive projects A and B, with identical cash flows, risk levels and durations as well as identical IRR values of 41%. Using IRR as the decision yardstick, an executive would feel confident in being indifferent towards choosing between the 2 projects. However, it would be a mistake to select either project without examining the relevant reinvestment rate for interim cash flows. Suppose that Project B's interim cash flows could be redeployed only at a typical 8% cost of capital, while Project A's cash flows could be invested in an attractive follow-on project expected to generate a 41% annual return. In that case, Project A is unambiguously preferable. Most practitioners would agree that a company's cost of capital by definition, the return available elsewhere to its shareholders on a similarly risky investment is a clearer and more logical rate to assume for reinvestments for interim project cash flows (Exhibit I).

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Exhibit I (Identical IRR, but very different Annual returns)

Project A							**IRR**	**Project B**							**IRR**
Year	0	1	2	3	4	5		Year	0	1	2	3	4	5	
CF in Rs Million	-10	5	5	5	5	5	41%	CF in Rs Million	-10	5	5	5	5	5	41%

However, Interim cash flows are reinvested at different rates.

Key assumption : Reinvestment rate = IRR								**Key assumption : Reinvestment rate = Cost of Capital**							
Project A							**CAGR**	**Project B**							**CAGR**
Year	0	1	2	3	4	5		Year	0	1	2	3	4	5	
CF at Year 5 if		5				20	41%	CF at Year 5 if		5				7	8%
Reinvested			5			14	41%	Reinvested at			5			6	8%
at 41%				5		10	41%	at 8%				5		6	8%
					5	7	41%						5	5	8%
						5	41%							5	8%
Year 5 value of Rs 10 million investment						56	41%	Year 5 value of Rs 10 million investment						29	24%

CAGR = Compound Annual Growth Rate.

However due to lower reinvestment rate, true return is nearly 50% less. Since this amplification is not felt evenly across all projects (The amplification effect grows as a project's fundamental health improves, as measured by NPV, and it varies depending on the unique timing of a project cash flows.), managers can't simply correct for it by adjusting every IRR by a standard amount. Most striking, the company's highest rated projects--- showing IRRs of 800,150,130% -dropped to just 15, 23 & 22%, respectively, once a realistic decision had already been made (Kelleher&MacCormack,2004).

Unless the interim reinvestment rate is correct, the IRR distortion will be greater when interim cash flows occur sooner. This concept may seem counterintuitive, since typically we would prefer to have cash sooner rather than later. The simple reason for the problem is that the gap between the actual reinvestment rate & the assumed IRR exists for a longer period of time, so the impact of the distortion accumulates.

Interestingly, given two projects with identical IRRs, a project with single bullet cash flow at the end of the investment period would be preferable to a project with interim cash flows.

Instead of major distortion in IRR method of analysis and findings, if we look at the reality, it will reveal completely a different picture. Here, I want to produce two survey evidences for the proof of above statement.

Evidence-1: (% of CFO, who always, or almost always, uses a particular technique for evaluating investment projects.)

Evidence-1

Technique	**% of CFO**
Profitability Index	12
Book Rate of Return	20
Payback	57
IRR	76
NPV	75

(Source: Graham & Harvey, 2001).

Evidence-2

Technique	**% of CFO**
Profitability Index	35.1
Book Rate of Return	34.6
Payback	67.5
IRR	**85**
NPV	65
Break-even Analysis	58.2

(Source: Anand, 2002).

Hence though IRR is having major shortcomings, it is still very much popular in India and other countries throughout the years (Ryan & Ryan,2002; Block,2005; Dedi & Orsag,2007). What are the reasons behind its popularity? It's having demerits, other better alternatives are available, still IRR is maintaining its record of popularity? Why this type contradiction is there between the concept and actual practice?

LITERATURE REVIEW

The evaluation of NPV and IRR is well developed and documented in many publications, some representative ones of which are Muro's(1998) and Lang & Merino's(1993). IRR and NPV are the most common and important

indicators in investment decisions. Although ARR (Accounting Rate of Return), as reported by Lefley (1996), is also a common indicator, whose role as fully discussed by Brief & Lawson (1992), both Muro (1998) and Lefley & Morgan (1998) opined that ARR has shortcomings and that the discounted cash flow methods, such as IRR & NPV, the so-called 'sophisticated' and 'scientific' methods, should be preferred in Capital investment appraisals.

Although IRR and NPV both are discounted cash flow methods, they have intrinsic differences from one another. Tang (1991, 2003) and Robinson & Cook (1996) illustrated that the ranking of investment alternatives is not necessarily the same obtained by the two methods. Differences in rankings between NPV and IRR are further exhibited in Asquith & Bethel (1995), who reported that IRR might be preferred to NPV under certain circumstances. Evans and Forbes (1993) also reckoned that IRR is more cognitively efficient than NPV because IRR is expressed as a % or a rate of return, while NPV was just a monetary value cognitively inefficient to decision makers, and hence, the use of IRR should be promoted. Other researchers, such as Lefley and Morgan (1998) and particularly the academicians, however took the view that NPV is more conceptually correct despite the fact that the IRR is more popular than the NPV, and that NPV is more theoretically sound as the IRR may be too capricious or fickle and may not rank some projects in the same order as the NPV. It has been pointed out in the paper by Battaglio et.al. (1996) that IRR is meant for a consumer's point of view, and NPV, for a banker's point of view. This is close to the true definition as the consumers usually have relatively limited money and the banks usually have relatively unlimited money. As Tang & Tang (2003) had correctly defined that IRR gives the private investor's point of view and NPV, the society's point of view. In other words, the IRR is financial indicator and NPV, an economic indicator.

In their paper, Tang & Tang (2003) joined the decades- long discussion on their merits & validity of the IRR as a variable alternative to the NPV. They argue that, notwithstanding the persistent criticism of the IRR, which has been voiced primarily in academia (Brigham et al.1994; Hirshleifer,1958; Rapp,1980; Solomon,1963), this criterion is still sound & useful, provided that it is properly interpreted. To remedy the perceived problem of the IRR and the NPV being inadequately defined, Tang & Tang offer their own definitions of these two criteria.

However, regardless of the point of view, the mathematics of the NPV/IRR relationships remains the same, and so the well-documented problems resulting from this relationship (Fisher, 1930; Fleischer, 1966; Hirshleifer, 1958; Mao, 1996). In what follows, it is demonstrated, using Tang & Tang and other numerical examples, that direct comparison of the IRRs of various project-financing alternatives for the purpose of ranking is not a recommended approach. The proper approach will be revisited, and the limitations of the IRR applicability will again be emphasized.

WHAT NEXT?

In this area, we will discuss that what can be other alternatives we have for project evaluation, as we have already discussed the limitations of our widely accepted traditional approach of NPV & IRR.

Most traditional investment decisions are characterized by irreversibility and uncertainty about their future rewards. Once money is spent, it cannot be recovered if the payoffs hoped for do not materialize. These decisions make implicit assumptions concerning an expected scenario of cash flows and presume management's passive commitment to a certain operating strategy. In the real world of uncertainty and competitive interactions, the realizations of cash flows will probably differ from what management originally expected. As new information becomes available and uncertainty about market conditions and future cash flows is gradually resolved, management may revise the operating strategy it originally anticipated. This flexibility to adapt in response to new information enhances the investment opportunity's value by improving its upside potential while limiting downside losses relative to the initial expectations under passive management.

REAL OPTION ANALYSIS:

Using the analogy with options on financial assets, investment flexibility is often called a real option (Dixit & Pindyck, 1994; Trigeorgis, 1996; Huchzermeier & Loch, 2001). Real options are options on real assets that can be defined simply as opportunities to change consisting of rights but obligations to take some action in the future (Dixit & Pindyck, 1995). Many of these real options occur naturally, while others may be planned and built-in at some extra cost. The role of real options analysis is to quantify how much future opportunities are worth today. Using option pricing models, it is possible to quantify these opportunities and to indicate when these options should be optimally exercised (Botteron, 2001).

Like financial options, we can divide real options into call options and put options. A call options gives the holder the right for some specified amount of time to pay an exercise price/investment price and in return receive an asset

/project that has some value. Consequently, the profit of the option at the time of exercise is the difference between the value of the underlying asset and the exercise price. An example of such a call option is the deferral option, which refers to the possibility to delay the start of the project until more information has become available. A put option is the opposite, i.e. the right to sell the underlying asset/project to receive the exercise price. An example of a put option is the opportunity to abandon an uncertain project for a fixed salvage value.

This section discusses consecutively the NPV method, Decision Tree Analysis (DTA), real options analysis and Adjusted Present Value (APV) method. To have a good understanding of the different valuation techniques, a simple deferral option will be used as an example. Copeland & Antikarov.2001 describe a situation where one has the possibility to invest in a project that will cost $115 next year with absolute certainty, but will produce uncertain cash flows $c=(c_1, c_2)$ of either $170 million or $65 million, each with a probability of 50%. The risk free rate is 85 and the project specific cost of capital is 17.5%.

NPV ANALYSIS:

Consider first the case without flexibility: we can only use the information that is available today and we have to decide now whether or not to invest. The current gross project value is obtained by discounting the project's end-of-period values at the appropriate discount rate, i.e.

P(c) = (0.5*$170 + 0.5*$65)/1.175 = $100

After subtracting the current investment costs, the project's NPV is finally given by:

NPV= $100 -- $115/1.08 = --$6.48

In the absence of managerial flexibility, we would decide not to invest in this project, based on negative NPV.

NPV-based approaches provide an easy and instructive way to analyze the decision whether or not to commit resources to a new investment in a stable environment. They implicitly assume that a project will be undertaken now and operated continuously until the end of its expected useful life, even though the future is uncertain. Interventions during the life of the project according to changes in market conditions over time provide companies with a better chance to reap higher returns or minimize losses in a volatile marketplace (Yeo & Qiu,2003).

This does not mean that traditional NPV calculations should be scrapped, but rather seen as a crucial and necessary input to an expanded, option-based analysis. The value of the project with the option consists of 2 components; the traditional (static or passive) NPV of direct cash flows, and the option value of operating and strategic flexibility (Trigeoris, 1993).

DECISION TREE ANALYSIS (DTA):

Suppose we allow for flexibility in our example. Instead of the now-or-never investment, we have the unrealistic option to wait until the end of the period and choose whether to spend $115 million based on the knowledge of the state of the nature. Only in the case of cash flows are $170 million, we decide to invest. When cash flows turn out to be only $65 million, we rather decide not to invest, instead of incurring a loss of $50 million. To this right to defer the decision, we have to pay a certain price, since we eliminate the uncertainty and thus the risk of our investment. A frequently used method to capture the value of flexibility is DTA. Here flexibility is modeled through decision nodes allowing future managerial decisions to be made and altered after some uncertainty has been resolved and more information has been obtained:

$170--$115= $55 (invest)

$65--$115= --$50 (do not invest)

The expected return is estimated by discounting the expected cash flows of the project given the right to defer at the cost of capital of 17.5%. The NPV of the project with this option now becomes:

NPV= (0.5*$55 + 0.5*$0)/1.175 = $23.40

Since the flexibility to defer increases the NPV of the project from --$6.48 million to $23.40 million, the deferral option would be $23.40(--$6.48)= $29.89 million

At first glance, this seems to be a good approach. However, in this case we may not simply use the DTA method since the presence of flexibility embedded in future decision nodes changes the payoff structure and thus the risk characteristics in a way that invalidates the use of the same constant discount rate. Since the project profile has changed due to the changes in the cash flow pattern of the project, adjustment for risk should be done appropriately. Here is where the real options analysis comes in. The option approach can be interpreted in the decision tree context as modifying the discount rate to reflect the actual risk of cash flows (Copeland & Keenan,1998).

ADJUSTED PRESENT VALUE (APV)

All discounted cash flow methodology involves forecasting future cash flows and then discounting them to their present value at a rate that reflects their riskiness. But the methodology differ in the details of their execution, most particularly in how they account for the value created or destroyed by financial maneuvers, as opposed to operations. APVs approach is to analyze financial maneuvers separately and then add their value to that of the business (Luehrman,1997). Weighted average cost of capital or WACC's approach is to adjust the discount rate to reflect financial enhancements. Analysts apply the adjusted discount rate directly to the business cash flows, WACC is supposed to handle financial side effects automatically, without requiring any addition after the fact.

In reality, WACC has never been that good at handling financial side effects. In its most common formulations, it addresses tax effects only and not very convincingly except for simple capital structures. However, its compelling virtue is that it requires only one discounting operation, a boon in the past to users of calculators and slide rules. Today that advantage is irrelevant. High speed spreadsheets make light work of the extra discounting required by APV. More than 20 years after APV was first proposed, its unbundling of the components of value, always very informative, is now also very inexpensive.

APV is flexible. A skilled analyst can configure a valuation in whatever way makes most sense for the people involved in managing its separate parts. Why choose APV over WACC? For one reason, APV always works when WACC does, and sometimes when WACC doesn't, because it requires fewer restrictive assumptions. For another, APV is less prone to serious errors than WACC but most important, managers will find that APV's power lies in the added managerially relevant information it can provide. APV can help managers analyze not only how much an asset is worth but also where the value comes from. APV un-bundles components of value and analyzes each one separately. In contrast, WACC bundles all financing side effects into the discount rate. APV works on value additivity principle and separates cash flows into different segments with different discounting factors.

APV = BASE-CASE NPV + VALUE OF ALL FINANCING SIDE EFECTS

Value of the project	Interest tax shield, subsidies,
as if it were financed	Cost of financial distress, hedges
entirely with equity	Issue cost and other costs

APV is a step-by-step project evaluation approach. Steps are as follows :

Prepare performance forecast for the target business

Step 1: Prepare performance forecasts (income statements and balance sheet) and base case incremental cash flows for the business.
(Here the components of values are bundled together)
Prepare a valuation spread sheet for each component of value.

Step 2 : Discount base-case cash flows and terminal value to present value.

Step 3 : Evaluate financing side effects.
For example Interest tax shield.
Prepare present value of estimated interest tax shields from borrowing.
(Here they are un-bundled)
Add the components of value.

Step 4 : Add the pieces together to get an initial APV.
APV = Base-case value + Value of financing side effects

Step 5 : Tailor the analysis to fit managers' needs.
(Finally they are re-bundled)

THEORY BUILDING/ RESEARCH QUESTIONS OF THE STUDY

Hence academicians have already proved that IRR had flaws (Kelleher & MacCormack, 2004) in Project Evaluation and furthermore we have updated and error-free techniques like APV (Luehrman, 1997) and Real Option (Dixit & Pindyck, 1994 &1995; Trigeorgis, 1993 &1996; Luehrman, 1997& 1998) methods. But still we are using IRR methods in almost $3/4^{th}$ of the cases in Capital budgeting decision (Dedi & Orsag, 2007). Now why? What are the inherent causes or reasons that make IRR so popular throughout the periods? What will be the intuitive appeal of IRR for Corporate Managers? The study is a maiden attempt to address these issues by posing the following research questions.

(1) Is there any significant impact for Corporates in selecting capital intensive project by IRR technique?

(2) Whether managers are not fully aware of its limitation?

(3) Whether managers are psychologically biased towards IRR?
(4) Whether IRR is better for investor's point of view?
(5) Whether managers are not adequately comfortable with other updated and advanced methodologies?

PREMISES OF HYPOTHESES

Although different researchers have chosen different variables to measure the reasons behind the popularity of IRR, in the present study the term reasons of popularity is defined to include simplicity, lack of knowledge & Psychological. These are the commonly identified resource variables by the researchers and the corporate manager's relative contribution in respect of each of these reasons is likely to motivate his or her role in capital budgeting decision-making situation.

HYPOTHESES

I. SIMPLICITY AS A REASON (Knowledge of required rate of return is not required):

In case of NPV or other above-said methods, it is necessary to project future cash flows along with estimation of the required rate of return namely the cost of capital, which is applied as the discounting factor in NPV computation. It is needless to say that cost of capital estimation is a very complicated and tedious exercise and none of the accepted techniques for the same are free from assumptions. Alternatively in IRR computation, only the future cash flow projections are required and there is no need to compute the cost of capital or in other words there is no need to quantify the expectation of the investors (Brigham,1994; Hirshleifer,1958; Rapp,1980). The IRR as computed is simply vetted against a pre-specified cut off rate and the final decision is taken (Mao,1996).

H 1: The projects, where finding out exact discounting factor is difficult, are using IRR method in project appraisal more than the projects where it is not so difficult.

II. LACK OF KNOWLEDGE AS A REASON:

Some of the managers may not be fully aware or familiar with the inherent limitations (Described above mainly reinvestment rate assumption, Source: Kelleher & MacCormach,2004) of the IRR method and may be of the opinion that ranking can be accurately done with the aid of this method (Asquith & Bethel,1995; Lefley & Morgan,1998).

H 2: The projects where decision makers/managers are not aware of deficiency of IRR, are using IRR technique more rather than the projects where concerned managers are fully aware of distorted outcome of IRR method.

III. BIASEDNESS AS A REASON:

Evans and Forbes (1993) reckoned that IRR is more cognitively efficient than NPV because IRR is expressed as a percentage or a rate of return while NPV was just a monetary value cognitively inefficient to decision makers, and hence the use of IRR should be promoted. Usually managers are psychologically comfortable in expressing financial data in the form of percentage. Moreover, IRR is meant for consumer's or individual point of view and NPV for a Banker's or Societal point of view (Battaglio et.al., 1996). Hajdasinski (2004) defined as IRR as a financial indicator and the NPV as an economic indicator.

H 3: More managers are using IRR because they are biased as it is expressed in percentage and it talks about the firm's point of view.

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