

A USEFUL TOOL FOR BOLSTERING INVESTMENT DECISIONS – MODIFIED IRR (MIRR)

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Abstract

The need of firms of all sizes to compute rate of return of an investment project is addressed by corporate finance, which provides firms' management everywhere – at least, everywhere there is a market economy – with such a tool as internal rate of return (IRR) index, which, as well as its several variations (EIRR, FIRR), is useful as far as simply determining rate of return size.

On the other hand, IRR does not address the problem of linking quantitative approach of ascertaining (internal) rate of return to that essential quantitative approach of defining cost of long-term financing sources, namely weighted average cost of capital (WACC); built around WACC, the IRR model which solves this problem is known as modified IRR (MIRR).

Keywords: investment decisions, modified internal rate of return, weighted average cost of capital

JEL classification: D81, E22, G31, L25

Introduction

The need to determine, with sufficient precision, value of an investment project yielded IRR (Internal Rate of Return) index, which can be employed alongside of NPV index, and – optimally – in some cases, instead of NPV.

Central concept of IRR index – exactly, of its *prototype* – is the necessity of determining level of discount rate for which ***future benefits equal initial costs***¹(e.g. *future costs*, from a strict chronologic perspective) – in other words, for which $NPV = 0$ – , as *minimal* benchmark needed for implementing, in every firm, an effective management; basically, and *financially*, this benchmark is nothing *less* than required (firm) effectiveness for $NPV \geq 0$.

Computing required effectiveness for condition $NPV \geq 0$ to be fulfilled requires, in effect, nothing more than computing present value – in these conditions – of project's return rate, namely *internal* rate of return. IRR formula, in the logic of this rationale, is (where CF stands for cash-flows recorded by firm – CF_0 being costs and $CF_1, \dots, CF_N$ benefits received by firm)²:

$$NPV = 0 = CF_0 + \frac{CF_1}{(1 + IRR)^1} + \dots + \frac{CF_N}{(1 + IRR)^N} \Leftrightarrow$$

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¹Ehrhardt, M.C., Brigham, E.F. (2011), p. 387.

²Ibid.

$$CF_0 + \frac{CF_1}{(1 + IRR)^1} + \dots + \frac{CF_N}{(1 + IRR)^N} = 0$$

Formula above should not, and we can state *cannot* constitute a distraction; namely, internal rate of return *is* not opportunity cost of capital in disguise, because these two notions are individuated, to the effect that³:

- I. internal rate of return is a measure of the *effectiveness* of an investment project;
- II. opportunity cost of capital is, on the other hand, only an effectiveness *standard* for an investment project, which is included in the formula given it is used to compute (financial) *value* of investment project.

Content

The basic picture of modeling investment decisions comprises this fact: these two indexes – internal rate of return and opportunity cost of capital –, although distinct, are used simultaneously for process of decision taking; this implies that firm's management *will* make use of typical instruments needed for a comparative analysis of its own planning, on one side, and economic and financial projections (i.e. for its *future* planning), on the other side.

From this point of view, decision of investment of a certain amount of financial funds, in order to build up a certain investment project, will be *adopted* only if it can be verified opportunity cost of capital is smaller than internal rate of return⁴.

In other words, using notations used above, *investment*, and not *saving*, financial funds is decided only when financial measurements attest that:

$$r < IRR$$

Having underlined this, IRR index is a better instrument – from a mathematical point of view – than NPV, but it is, itself, less than perfect; because, in first place, the imperfections that 'plague' IRR are structural rather than (merely) operational, being generated by the very theory this index is build upon – according to which internal rate of return *exist* – and, therefore, is *useful* – only if NPV index is used under certain conditions (e.g., NPV = 0).

In second place, though, firm's management will confront itself with a bit of a (potential) crisis if its investment decision(s) will depend on IRR value *only*, if the firm deals with an atypical dynamics, one which, for more clarity, can be quantitatively appraised only in improper circumstances, IRR value being able, as a result, to supply firm's management with (only):

- a. unsure or practically useless quantitative data;
- b. intelligence valid only in short term – more precisely, valid during a period shorter than:

³Brealey, R.A., Myers, S.C., Allen, F. (2014), p. 116.

⁴Ibid., p. 117.

- i. period in which firm must support costs of investment project, respectively
- ii. period in which firm receives, or, eventually, amortizes firm's benefits (positive – that is, profit, or negative – that is, loss).

As for the query of analysis of dynamics of financial structure (main) factors, the circumstances in which IRR index *prototype* is not adequate for determining *quality* of investment projects are the following⁵:

1. when *output* of investment project is not yielded on a continuous basis – in long term –, as far as obtaining/recording profits, given for *a* specific project IRR quantification provides management with – sometimes – *several* values of IRR, or even with *no value* at all;
2. if firm, insofar as its investment policy goes, has to choose between mutually exclusive projects, whose (financial) perspectives, on one hand, and (financial) requirements (e.g., costs), on the other hand, are not comparable proper, or are simply divergent (e.g. do *not* relate to *similar* levels – of output, cash-flows, etc.), IRR index is unable to prove useful, due to fact no matter what the computed IRR value is for *any* two or more investment projects, any project can prove, in the long run, more profitable than any other;
3. situations in which *cost of capital* of cash-flows recorded in near future is different from that computed for cash-flows to be recorded in long-term perspective;
4. situations in which *opportunity cost of capital* of cash-flows recorded in near future is different from that computed for cash-flows to be recorded in long-term perspective.

These perspectives and conditions are not always easily identified, respectively taken into account – not all in the same time, or, at best, not with maximum efficiency. This is main reason which determined theorists to further their researches *starting* from IRR model – e.g. *the* prototype –, so as to give firms the chance to quantify (internal) rates of return more suitable to firms'/projects' specifics than IRR.

As for this analysis, we observe in relevant literature one correction is considered most needed among all (possible) corrections for improving IRR *model*, namely an overhaul proper of IRR model's premises regarding efficiency of benefits' use – benefits generated by investment project – or, in other words, the profitability of financing source *it* (i.e., the investment project) stands for.

A firm's management that uses IRR will face real and not quite negligible difficulties whenever it must take a decision as to investment of financial funds for building up of an investment project, as result of the fact *mechanism* of decision-making process – i.e. once it is assumed to be build around IRR model – is inherently instable, as its structure routinely acts in two distinct – and divergent – tendencies:

- A) IRR *theory*' pledges' benefits yielded by *new* investment *can* be used for financing new investments, this operation generating for firm a profitability

⁵Brealey, R.A., Myers, S.C., Allen, F. (2014), pp. 130-131.

rate equivalent not to an (average) interest rate, but to an interest rate *equal to IRR*;

- B) *In practical terms*, however, financial market behaves to the extent that value of IRR, computed for investment projects *approved* for financing – e.g., implementation – is, in general, of larger size than *true* value of rate of return for *financing* investment projects.

The least one can hold about pledge described above is that it is (extremely) difficult to meet in real (economic and financial) terms; as for real economy firms work – and, eventually, develop/grow – in, it affects firms' decision-making process, mainly, through the upward bias on corporate projections; this evolution is, directly or indirectly, instrumented through quantification of IRR value – or, either EIRR (Economic IR) or FIRR (Financial IRR).

For this to ever be actually rectified, economist perceived the need to overhaul premises of IRR *model*, the goal being to enhance *reflecting* capability of (computed values of) *internal rate* of return as to *profitability* rate of investment projects in general; the results of this *demarche* is – arguably – index which goes by the name of **modified internal rate of return** (Modified IRR – MIRR).

MIRR is unlike any other variations of internal rate of return – e.g., EIRR and FIRR –, its defining characteristic being fact discount rate, in this case – applicable in process of reinvesting benefits yielded by the *functional*(completed) investment project –, is (equal to) weighted average cost of capital (WACC)⁶.

Thus, MIRR formula is (where C_0 stand for *initial* costs of investment project, $C_1, \dots, C_T$ costs of maintaining the (accomplished) investment project, B benefits yielded by investment project and T life of project – i.e., number of periods)⁷:

$$\sum_{t=0}^{t=T} \frac{C_t}{(1+WACC)^t} = \frac{\sum_{t=0}^{t=T} B_t \cdot (1+WACC)^{T-t}}{(1+MIRR)^T} \Leftrightarrow$$

$$\Leftrightarrow MIRR = \sqrt[T]{\frac{\sum_{t=0}^{t=T} B_t \cdot (1+WACC)^{T-t}}{\sum_{t=0}^{t=T} \frac{C_t}{(1+WACC)^t}}} - 1.$$

In this point, we must observe index known as weighted average cost of capital (WACC), designed for computing cost of financing sources acquired and/or used by a firm in the long run – i.e. by a *listed* company – is based on a concept developed – not in

⁶Ehrhardt, M.C., Brigham, E.F. (2011), p. 393.

⁷Ehrhardt, M.C. and Brigham, E.F. (2011), p. 395.

the least, for analysis of decisions taken as to *capital budgeting* – as a *resultant* of following premises⁸:

- 1) different types of long-term financing sources constitute, in fact, different *types of capital* – that make up, together, firm's capital –, more or less fraught with risk;
- 2) as a result, for each type of capital exists a certain (size of) *rate of (expected) return*;
- 3) the expected return of various types of capital *must* record a dynamics to the effect that it will, eventually but decisively, contribute to *maximization of stock (i.e., share/equity) price*, which requires, in its turn, designing of a certain (or optimal) *capital structure*—considering *typical*⁹ elements of firm's capital being the following¹⁰:
 - i. (long-term) debt (D – in WACC formula)
 - ii. common equity (AO)
 - iii. preferred stock (AP), and WACC formula is (where *w* stands for *target weights* for different types of capital, *r* for cost of owing and using these types of capital and *T* for marginal tax rate as to tax levied on firm's interest revenues):
 - iv. $WACC = w_D \cdot r_D \cdot (1 - T) + w_{AO} \cdot r_{AO} + w_{AP} \cdot r_{AP}$.

On this basis, cost of long-term financing sources owned and used by firm is the weighted *average of costs* generated by ownership and use of different components of firm's capital.

Conclusions

From this perspective, financial technique needed to forge (optimal) financial structure of a firm, *the basis* – at least, in theory – of diminishing costs of long-term financial sources contracted/owned and used by firm comprises following levers and procedures¹¹:

1. Using long-term debt to benefit from *tax advantage of debt* – which has a positive impact as long as firms do *not* record the so called ***financial distress cost***¹²;
2. Advancing on the path of accessing long-term financial sources in form of long-term (bank) loans, up to the moment WACC value reaches its minimum – viz. the moment firm's *value* increase reached its *maximum*.

What is more, it must be observed MIRR model yields, for an investment project, a *single* value, that is *it cannot* yield two (distinct) values – or more; this is, certainly, a highly valuable trait of MIRR model, for any firm's management.

⁸Ehrhardt, M.C., Brigham, E.F. (2011), p. 337.

⁹Ehrhardt, M.C., Brigham, E.F. (2011), pp. 368; 399.

¹⁰Ehrhardt, M.C., Brigham, E.F. (2011), pp. 358-359.

¹¹Ross, S.A., Westerfield, R.W., Jordan, B.D. (2013), pp. 541-542.

¹²Op. cit., p. 543. This type of cost is within average firm's realm of (economic and especially financial) endurance *if* it can muster, in a similar proportion, its *tangible assets* – i.e. the type of assets than can be sold to *(be able to) settle firm's debt* in absence of firm's value's deteriorating.

Finally, last but not least, through its use of WACC, MIRR yield values of internal *rate* of return *comparable* to cost of capital, feature of no little importance for any managerial team and even more so for any management *strategy*, both badly needing a sound tool, in order to take financial and investment decisions aware of all economic intricacies, both inside firm and outside it.

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