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# Aggregate Return on Investment and Investment Decisions: A Cash-Flow Perspective

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## Abstract

The recent notion of average internal rate of return (AIRR; Magni 2010a, The Engineering Economist, 55(2), 150–180) completely solves the long-standing problem of the internal rate of return (IRR). Though the AIRR is a return measure, this article presents a cash-flow measure, namely, the ratio of net cash flow (i.e., cash inflows minus cash outflows) to capital invested, which we call aggregate return on investment (AROI). It is a purely internal measure because, unlike the AIRR, it does not depend on the market rate and is a return measure, because it is a mean of one-period return rates, weighed by the outstanding capitals. The AROI is reliable in both accept/reject decisions and project ranking, in association with an appropriate, economically significant hurdle rate: the comprehensive cost of capital (CCOC), which takes into

account not only the interest foregone on the capital actually employed but also the interest foregone on the capital that is given up by the investor. This perspective enables one to decompose the project net present value (NPV) into an excess-rate share and an excess-capital share. The traditional IRR is just a particular case of both AIRR and AROI, but the latter approach has the advantage that the IRR's nature (rate of return versus rate of cost) does not depend on the market rate and is unambiguously determined by the capital invested.

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# Notes

Hazen (2003, 2009) and Magni (2010a) used the expression investment stream. In this article we prefer to use the expression capital stream, to avoid any misunderstanding.

The terminal value $c^*_T$ of the capital stream $c^*$ is univocally determined by cash flow stream and market rate, which means, in general, that $c^*_T \neq 0$.

This definition is essential in correctly interpreting the financial nature of the IRR. Until Hazen (2003), the notion of investment and borrowing was connected to the sign of the outstanding capital $c_t$ (see Teichroew et al. 1965a, 1965b); but this perspective brings about unfavorable cases where the sign of $c_t$ changes over time, which implies that neither the IRR's financial nature (lending rate versus borrowing rate) nor the project's financial interpretation (investment versus borrowing) is univocal. Hazen's (2003) definition (and Magni's [2010a], generalization) is important because it sweeps away such mixed cases and gives the opportunity of establishing the exact nature of any project and any rate of return.

Note that PV ( c | r) (not c) is in a biunivocal correspondence with $\bar{k}_r$. Therefore, an AIRR does not change under changes in the capital stream, as long as PV( c | r) does not change.

If 0 < C* < C, the greater capital invested in the project tends to offset the rate component, so the CCOC turns out to be smaller than the market rate.

The symbol v(t) in Kay (1976) denotes book value.

PV-equivalence in this paper is not PV-equivalence as defined in Magni (2010a). In the latter, two or more capital streams are PV-equivalent if they share an equal PV( c | r).

The analyst does not even need fix the capital streams if the NCFC or the market-investment AROI is employed.

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