Deficiencies of IRRs and TWRs as Measures of Real Estate Investment and Manager Performance

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Internal rates of return are a useful measure of investment performance in many respects, particularly when analyzing the performance of private real estate investments and the managers of such investments, and particularly when compared and contrasted against an alternative measure of investment performance such as the time-weighted return. As the authors explain, however, IRRs should never be used, whether in evaluating the performance of an investment or an investment's manager, without an appropriate understanding of an investor's cost of capital and net present value goals.

Perhaps the most commonly used measure of investment performance in the real estate marketplace today is the internal rate of return (''IRR''). Despite this prevalence, IRRs can be misleading to investors who do not consider limitations inherent in IRR calculations that are best mitigated by carefully considering an investor's required cost of capital and net present value (''NPV'') investment goals.

A common alternative to the IRR as a measure of investment performance is the time-weighted return (''TWR''), a metric that does not weight investment returns by amount or by the timing of those amounts.[1] While useful, TWRs suffer from their own deficiencies, and are particularly problematic when applied to the performance of private real estate investments and the managers of such investments. As a result, IRRs are often appropriately preferred to TWRs in evaluating the performance of private real estate managers, including managers of private real estate joint ventures and pooled discretionary investment vehicles (or ''funds''). That is not the end of the story, however, as the lessons learned when analyzing the limitations of IRRs and TWRs as measures of investment performance illuminate potentially conflicting investor-manager incentives resulting from the unsophisticated use of IRRs in awarding manager compensation and suggest means for mitigating these conflicts.

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IRRs As A Measure Of Investment Returns

The IRR of an investment is formally defined as the rate of discount which makes the net present value of a

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series of investment cash flows equal 0. It is expressed by the following equation:
$0=\Sigma CFi/((1+IRR)^{i})$, where CFi is the cash flow in period i and i is the number of each period.

IRRs are calculated in Table 1 relative to two investments and resulting cash flows.

Table 1

Year-end cash flows	Investment 1	Investment 2
Cash flow year 1	(100)	(125)
Cash flow year 2	20	10
Cash flow year 3	40	15
Cash flow year 4	30	10
Cash flow year 5	150	125
IRR	32.25 percent	7.24 percent

Table 2

Year-end cash flows	Investment 1	Investment 2
Cash flow year 1	(100)	(200)
Cash flow year 2	175	300
IRR	75 percent	50 percent
NPV, using 10 percent discount rate	53.72	66.12

In addition to certain obscure mathematical limitations,[2] however, IRR calculations can be misleading when applied to investments of different sizes and to investments with different cash flow patterns over time. These limitations are best demonstrated by carefully comparing IRR results to NPV calculations of investment performance.

Investments Of Different Sizes

The misleading nature of IRR calculations when applied to two very simple investments of different sizes is illustrated by Table 2.[3]

As illustrated by the example in Table 2, a simple IRR investment rule (i.e., invest in whichever investment generates a higher IRR) will lead to a less than desirable result from an NPV perspective as the investor investing in Investment 1 will be substantially less well off than an investor investing in Investment 2. A slightly different IRR investment rule mandating any investment which generates an IRR equal to or higher than a specified target (e.g., 20 percent), however, can be salvaged by decomposing Investment 2 into two distinct investments (comprised of Investment 1 and the ''incremental'' investment of the additional 100 required for Investment 2), and then examining the IRR on the incremental cash flow generated by Investment 2 relative to Investment 1. This is illustrated by Table 3.

Table 3

Incremental year-end cashflows	Investment 2-first part	Investment 2-second part
Cash flow year 1	(100)	(100)
Cash flow year 2	175	125
IRR	75 percent	25 percent

As shown in Table 3, the cash flow on the incremental investment made in Investment 2 still exceeds the investor's desired IRR goal, and, since Investment 2 generates a cash flow not generated by Investment 1, Investment 2 is the superior investment under this analysis. It is important to note that this type of analysis does not take into account any consideration of the projected ''reinvestment rate'' of cashflows resulting from either investment.[4]

Investments With Different Cash Flow Patterns Over Time

IRR calculations can also be misleading when applied to investments which generate materially different cash flow patterns over time. These results are demonstrated in Table 4.

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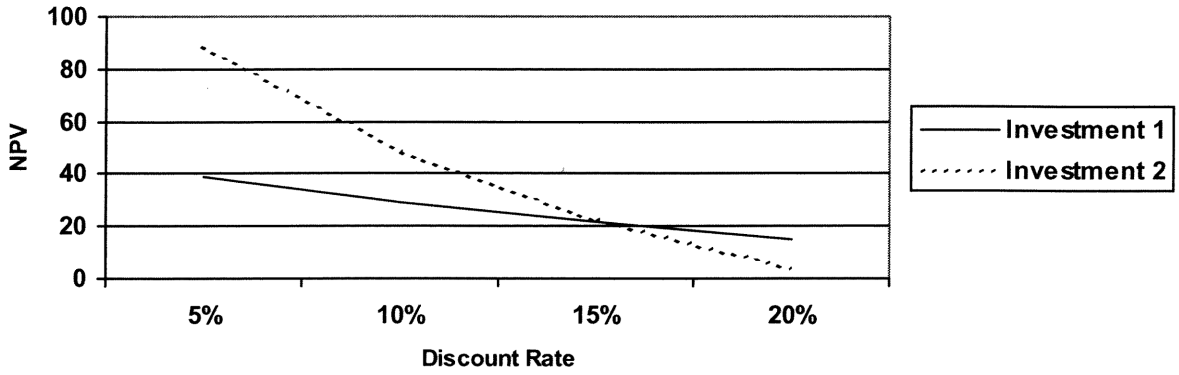
Table 4

Year-end cash flows	Investment 1	Investment 2
Cash flow year 1	(100)	(100)
Cash flow year 2	100	25
Cash flow year 3	50	25
Cash flow year 4	0	25
Cash flow year 5	0	25
Cash flow year 6	0	25
Cash flow year 7	0	25
Cash flow year 8	0	25
Cash flow year 9	0	25
Cash flow year 10	0	25
Cash flow year 11	0	25
IRR	36.6 percent	21.41 percent
NPV, using 10 percent discount rate	29.3	48.74

Once again, a simple IRR investment rule mandating whichever investment generates a higher IRR will produce discouraging results for investors concerned with maximizing NPV. The primary reason for these misleading results is best illustrated by analyzing the NPVs of the different investments at different assumed discount rates. These results are depicted in Chart 1.

Chart 1



As these results show, the attractiveness of each investment from an NPV perspective varies depending upon the discount rate that is utilized (which, in turn, will be driven by each investor's required cost of capital). For an investor facing a required cost of capital greater than 20 percent, Investment 1 will be more attractive from an NPV perspective. This investor sees Investment 2 as generating an insufficient return to justify investing, given the investor's capital constraints. For an investor facing a required cost of capital less than 15 percent, however, Investment 2 will be more attractive from an NPV perspective. This investor sees Investment 1 as generating high returns too quickly in sacrifice for the lower, more stable returns generated over a much longer period by Investment 2.

Again, a slightly modified IRR investment rule can be salvaged by examining the incremental cashflows generated by Investment 2 relative to Investment 1. It should now be clear, however, that such a modified IRR rule works for the same reason illustrated above with respect to our more detailed NPV analysis of these investments—the investor utilizing such a modified IRR rule has adopted a desired investment return goal based on the investor's anticipated capital constraints.

This point—that IRRs should only be employed by an investor in combination with a clear understanding of such investor's required cost of capital and NPV investment goals—is a critical investor lesson. In the absence of this understanding, investors may make certain unjustified assumptions about IRR results. For example, investors reviewing the IRR results generated by the investments in Table 4 may believe they prefer Investment 1 based on the unjustified assump-

tion that capital is highly constrained for them. Perhaps even more importantly, investors may fail to grasp the economic incentives of managers who receive incentive compensation based on IRR calculations.

TWRs As Alternative Measure Of Investment Returns

As a result of these deficiencies, investors may be tempted to use an investment return metric, like the TWR, which does not accord any ''weight'' to investment returns by amount or by the timing of those amounts. While useful to certain types of investors, however, TWRs suffer from their own deficiencies and often do not make sense when analyzing the performance of private real estate investments or the performance of the managers of such investments.

In technical terms, a TWR is a method of computing a rate of return for an investment based on the investment's period-by-period performance over a series of periods. Unlike an IRR, a TWR will usually require the calculation of ''interim'' valuations, even though the investment in question may not have actually generated any cash, because the performance of the investment (based on both cash flows and unrealized appreciation) must always be measured for each period.

A basic TWR calculation is illustrated in Table 5 and contrasted against the IRR calculation generated by the same investment cash flows used in Table 1. Beginning and ending ''interim'' values have been arbitrarily chosen.

Table 5

Year-end cash flows	Investment 1	Investment 2	Period-by-period returns	Investment 1	Investment 2
Cash flow year 1	(100)	(125)	Period 1-2	Beginning value: 100 Ending value: 112.5 Cash flow: 20 Return: 32.5 percent	Beginning value: 125 Ending value: 125 Cash flow: 10 Return: 8 percent
Cash flow year 2	20	10	Period 2-3	Beginning value: 112.5 Ending value: 125 Cash flow: 40 Return: 46.66 percent	Beginning value: 125 Ending value: 125 Cash flow: 15 Return: 12 percent
Cash flow year 3	40	15	Period 3-4	Beginning value: 125 Ending value: 137.5 Cash flow: 30 Return: 34 percent	Beginning value: 125 Ending value: 125 Cash flow: 10 Return: 8 percent
Cash flow year 4	30	10	Period 4-5	Beginning value: 137.5 Cash flow: 150 (all value realized) Return: 9.1 percent	Beginning value: 125 Cash flow: 125 (all value realized) Return: 0 percent
Cash flow year 5	150	125			
IRR	32.25 percent	7.24 percent	TWR	30.57 percent	7 percent

The TWR calculation used in this example is the arithmetic average of the investment's returns over each applicable period. A TWR could also be calculated for this investment by taking the geometric average of the investment's returns over each applicable period. Such a geometric TWR for Investment 1 would equal 29.81 percent and for Investment 2 would equal 6.91 percent.[5] This type of geometric calculation takes

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into account the principal of compounding and is therefore generally viewed as a better measure of an investment's past performance.[6]

The fundamental difference between an IRR calculation and a TWR calculation is that the former, by solving for a single rate that fully discounts a series of cash flows over future periods to 0, takes into account the timing and amount of such cash flows where the latter, by solving for an average period-by-period return, does not. Because TWR calculations generate period-by-period returns unaffected by the timing of investment cash inflows or outflows, they are often employed to evaluate the period-by-period performance of investment managers who are unable to control the timing or amount of cash inflows or outflows of the investments they manage, such as pension fund managers. The performance of many pension fund managers, in fact, is evaluated against an index—the ''NCREIF Index''—which is itself calculated on a TWR basis.

As mentioned, TWR calculations also require hypothetical interim valuations in order to determine the period-by-period returns necessary to generate them in the first instance, whereas such interim valuations are not required for IRR calculations. For this reason, TWRs are also appropriately used to evaluate the performance of relatively liquid investments (e.g., publicly traded REIT shares) where investment inflows and outflows can be realized fairly rapidly and effortlessly, and where accurate interim valuations are easy to calculate.

Like IRRs, TWR calculations must be carefully evaluated relative to an investor's required cost of capital and NPV goals.[7] TWR calculations are particularly problematic when applied to the performance of private real estate investments and to the performance of the managers of such investments, where the timing and amounts of investment inflows and outflows are some of the most critical elements of managerial skill, and where liquidity is usually the exception rather than the rule. The spread between a private real estate investment's TWR and IRR performance, in fact, can rightly be viewed as an important measure of the performance of the manager of that investment as it demonstrates the relative success of that manager in investing and realizing cash flows at ''the right time.'' Other specific problems with the use of TWRs in evaluating the performance of private real estate investments include the following:

- The beginning and ending period valuations required by TWR calculations are often speculative and difficult to calculate in relation to private real estate investments;
- During the early phases of most real estate investments, cash flow performance is often very uninspiring relative to the level of invested capital (or even negative in the event managers are entitled to fees or expense reimbursements which must be satisfied out of additional capital contributions instead of investment cashflows). On the other hand, the cash flow performance of these investments during later phases is often phenomenal relative to the level of invested capital. TWRs, by weighting the performance of such investments equally over all periods, essentially overweight earlier periods when a relatively small amount of capital has been invested and a relatively small number of investments have been realized and underweight later periods when a larger amount of capital has been invested and larger numbers of investments have been realized. In contrast, IRRs, by according less weight to smaller amounts of invested capital and investment returns, appropriately take into account these systematic return characteristics of most real estate investments; and
- Similarly, during both early and later phases of most multi-asset real estate portfolio investments, portfolios are more concentrated by property-type and/or geographic location because, during the early phases, capital has not been fully invested (and many assets have yet to be purchased), and, during the later phases, many assets have already been liquidated. The performance of such investments during such phases may accordingly be biased in a manner that is not reflective of the performance of the entire portfolio over the life of investment. Again, by weighting the performance of such portfolio investments equally over all periods, TWRs are more likely to produce return results that are unduly influenced by such unrepresentative periods. And again, since these periods are less likely to involve the same levels of invested capital or investment returns as other periods, IRR calculations will, in general, appropriately discount them.

Use Of IRRs In Incentive Compensation Calculations For Real Estate Joint Venture And Fund Managers

As a result of the relative quality of IRRs as measures of private real estate investment performance, IRRs are frequently used in some form by investors in real estate joint ventures and funds to evaluate the performance of the managers of such vehicles. However, for the same reasons IRRs are potentially misleading as a measure of investment performance, IRRs are also potentially misleading when evaluating manager performance. Investors should accordingly think carefully about implementing certain methods to mitigate the technical deficiencies of such calculations when documenting manager compensation driven by them.

Let's revisit the two investments addressed in Table 4. As discussed in more detail below, a manager who is entitled to incentive compensation based on a speci-

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fied IRR target may view Investment 1 as more attractive than Investment 2 (depending on the exact amount and timing of such compensation), even if the manager would otherwise prefer Investment 2 based on a straight equity investment (i.e., if the manager were required to invest its own money without the benefit of any IRR-driven incentive compensation). For example, let's assume that a real estate fund manager is entitled to a 20 percent ''carried interest'' in all investment profits, commencing after an investment has returned cash flows to investors sufficient to achieve a 25 percent IRR. In this situation, the manager has an unequivocal incentive to make Investment 1 over Investment 2 as the manager earns $3.758 if it makes Investment 1 and nothing if it makes Investment 2! On the other hand, most investors (including the manager if it made a straight equity investment) will prefer Investment 2 unless facing an anticipated cost of capital in excess of 20 percent. These potential conflicts between manager and investor goals are only exacerbated to the extent IRR-driven compensation is earned over a series of investments.[9]

Such investor-manager conflicts resulting from the use of IRR-driven compensation can be mitigated by requiring a ''total dollar'' return (calculated on the basis of the investor's desired NPV goal for this type of investment) before the manager is entitled to receive any such compensation.[10] Specifically, an investor could calculate its required cost of capital, utilize a discount rate in the same percentage, and calculate an NPV goal for a ''hypothetical'' investment based on a series of cash flows that the investor believes such an investment should generate. This investor could then carefully analyze the time horizon over which the investor believes such cash flows should be generated and calculate a total return amount which, if earned over that period, would permit the investor to achieve its desired NPV goal. If an investor were to require a $200 total return in the example from Table 4 addressed immediately above, for example, the manager's incentive to choose Investment 1 over Investment 2 would be completely eliminated.[11] This method, if implemented properly, would also eliminate the manager's IRR-driven incentive to choose smaller over larger investments, as the total dollar threshold would always need to be satisfied in any event.

Conclusion

IRRs are a useful measure of investment performance in many respects, particularly when analyzing the performance of private real estate investments and the managers of such investments, and particularly when compared and contrasted against an alternative measure of investment performance such as the TWR. But IRRs should never be used, whether in evaluating the performance of an investment or an investment's manager, without an appropriate understanding of an investor's cost of capital and NPV goals. Only by understanding such goals and setting appropriate investment or manager performance targets will an investor be in a position to truly evaluate, and utilize, IRRs.

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[1] The term ''time-weighted return'' is a bit of a misnomer as it implies other investment return measurements do not take time-weighting into account when calculating returns. This is clearly not the case relative to IRRs (or other measures of investment returns). As this article illustrates, a better name might therefore be ''non-dollar weighted return.''

[2] The first obscure mathematical limitation results from a problem with any general solution to a polynomial equation, discovered by the famous French philosopher and mathematician Renes Descartes—Descartes' so called ''Rule of Signs.'' Specifically, this rule entails that multiple rates of return will be generated by the standard IRR formula to the extent there is more than one change in cash flows from negative to positive (or vice-versa). Such cash flow patterns, however, are fairly unusual, and sophisticated solutions (far beyond the scope of this article) are available to salvage IRR calculations in these circumstances.

The second obscure mathematical limitation is generated if an investor desires to utilize an IRR calculation as a simple investment rule (i.e., invest if the IRR of investment x exceeds y percent) but faces different costs of capital over the relevant investment period (perhaps as a result of anticipated fluctuations in the term structure of interest rates). In this situation, since the standard IRR calculation generates only 1 discrete result (barring the issue noted above), an IRR calculation will not adequately address the investor's desired investment goals as and when the investor's anticipated cost of capital changes. As will be seen, however, IRR calculations should almost never be used in such a simple-minded way. In addition, other (more straight-forward) examples are available to illustrate some conceptually similar deficiencies with IRR calculations.

For a more detailed discussion of these issues, as well as many of the other problems with IRR calculations discussed in this article, see Brealy and Myers, Principles of Corporate Finance, Chapter 5 (McGraw-Hill 2003).

[3] All NPV results throughout this article are calculated based on the following standard NPV equation:

$NPV=\Sigma CFi/((1+DR)^{i})$, where CFi is the cash flow in period i, i is the number of each period and DR is the applicable discount rate.

[4] Perhaps the most common objection to IRR calculations in these situations—that such calculations fail to take into account the ''reinvestment rate'' of resulting investment cash flows (or, stated slightly differently, that such calculations improperly only assume reinvestment at the IRR rate)—is misplaced. Although it is true that IRRs, as the name implies, are measures of an investment's internal return and do not take into account how an investment's cash flows might be reinvested after the investment's liquidation, the inclusion of potential ''reinvestment rates'' in any calculation of an investment's return automatically combines the prospective return resulting from another independent investment with the return resulting from the investment in question. Investment return calculations incorporating any notion of a ''reinvestment rate'' thus permit the return characteristics of other investments to influence decisions which should be

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based upon the return characteristics of the investment in question, considered in isolation.

[5] $1+X=(1.325*1.466*1.34*1.091)^{1/4}$, X=29.81 percent; and $1+X=(1.08*1.12*1.08*1)^{1/4}$, X=6.91 percent.

[6] TWR arithmetic calculations, however, continue to have their uses. In fact, for complicated statistical reasons, TWR arithmetic calculations are better unbiased predictors of an investment's future performance than TWR geometric calculations.

[7] In fact, ignoring practical differences (such as the need to use ''interim'' valuations), the only mathematical difference between a TWR calculation and an IRR calculation is that the former represents the unweighted average of an investment's performance over a series of subperiods, whereas an IRR always reflects the dollar/time-weighted average of an investment's performance over the same subperiods. See, e.g., NCREIF White Paper: Recommendation to Amend the AIMR Performance Presentation Standards to include the Internal Rate of Return for Real Estate Discretionary Closed-End Funds and Discretionary Separate Accounts (October 1998). Given these similarities, TWR calculations suffer most (if not all) of the mathematical limitations addressed earlier in this article relative to NPV calculations.

[8] 20 percent of 18.75, which represents the excess cash flow over the cash flow required to achieve a 25 percent IRR (131.25).

[9] Such conflicts are exacerbated to the extent a fund manager has the right to utilize bank financing instead of investor capital contributions to make investments. As partially demonstrated by the examples in this article, there is an inverse relationship between the magnitude of IRR returns and the size of an investor's capital contributions. To the extent managers are able to obtain bank financing at effective interest rates lower than the IRR targets utilized to calculate their incentive compensation (which is almost always the case), such managers are incentivized to fund investments with such financing in lieu of investor capital contributions for as long as permitted.

[10] Note: One seemingly plausible alternative to mitigating these conflicts—requiring a minimum hold period for an investment (without more)—fails in that the manager earning incentive compensation in excess of the referenced IRR target would still be incentivized to make Investment 1 and hold it until permitted to dispose of it (unless the manager is required to hold Investment 1 beyond the point that the 25 percent IRR target is no longer achieved, in which case the manager is indifferent between Investment 1 and 2—also not an ideal result). In this sense, a minimum holding period requirement is neither necessary nor sufficient for purposes of encouraging appropriate manager decision-making as it always requires an analysis of manager-investor NPV results in any event.

Likewise, a so-called ''claw-back'' requirement implemented in a fund or other multi-asset investment situation—whereby a manager is required to pay back incentive compensation paid as a result of earlier successful assets (or on the basis of less than fully-drawn capital commitments) if later assets are sufficiently less successful to drive the overall performance of all assets below the manager's IRR target (or if the IRR target calculated on the basis of the later fully-drawn capital commitments mandates the same result)—also does not mitigate these conflicts as the manager could simply choose multiple investments akin to Investment 1 over Investment 2 and never be required to pay back any of its compensation.

However, the countervailing incentive effects of any non-IRR-driven manager compensation must also be taken into account before utilizing any particular return target. For example, if a significant component of a manager's compensation takes the form of management fees calculated on the basis of committed or invested capital (as is often the case), the manager will already be incentivized (unless such incentive is outweighed by other incentives) to hold on to the investment for as long as possible (even beyond the point that makes sense from an NPV perspective). The use of a total dollar return threshold in such a situation could exacerbate these potentially negative incentives (whereas the use of pure IRR-driven compensation could alleviate them). Accordingly, each manager compensation program should be carefully evaluated to determine the overall effect of implementing a total dollar return threshold.

[11] The ultimate amount of any total dollar threshold, of course, will only be agreed after negotiation between the manager and investors involved with the underlying investment, and a manager can rightfully object that any total dollar threshold requiring the full payback of an investor's anticipated NPV is overreaching. The important point is that, whatever amount is agreed, some specific total return will be required which will reflect the investor's anticipated NPV goals (at least in part), thereby mitigating the IRR-driven incentive conflicts referenced in this article.