The hazards of using IRR to measure performance: The case of private equity

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Most of the investments in asset classes such as real estate and private equity (include buyout, mezzanine and venture capital) are made via private partnerships. Measuring performance in these partnerships is important for investment allocation decision as well as for compensation.

The main performance measure that is used in practice is the Internal Rate of Return (IRR).[1] However, it is known that the effective Rate of Return (RoR) experienced by investors differs from IRR.[2] This difference means that the incentives of the asset managers partly differ from the objective of the investors.

This article makes two main contributions to the literature on performance evaluation. First, it shows the problems that arise when IRR is used as a performance measure in the context of private partnership investments. It shows that in addition to the well-known pitfalls, IRR leads to a number of issues. First, it provides severely distorted incentives for the timing of cash flows and grouping of funds. Second, it biases upward volatility estimates. Third, at least for venture capital and buyout investments, simple average performance measures are significantly upward biased. Fourth, in a situation where 'kick-backs' can happen, the use of IRR provides incentives to alter significantly cash flow amounts.

The second contribution is that it describes in details a solution. While it is known that using Modified IRR (labeled MIRR), or, equivalently, Net Present Value, (labeled NPV) largely tackles the well-known pitfalls of IRR, its practical implementation in a private partnership context is not obvious. I show how MIRR can be implemented at the investment level and at the fund level in order to not only tackle the well-known pitfalls of IRR but also provide the right incentives to the fund managers.

In practice, there are two main reasons why investors do not use MIRR. First is the belief that the current performance metric (IRR) is good enough but the evidence provided in the first part of this paper should tackle this objection. Second is that the implementation is not obvious and the second part of this paper should tackle this objection.

This article relates to the large literature on performance measurement pioneered by Sharpe (1966) and Jensen (1968). It is most related to the recent study of Goetzmann, Ingersoll,

[1] In practice, a multiple (sum cash distribution plus estimated value of on-going investments divided by cash invested) is also shown in performance report but play a secondary role (see section 2 for a discussion and evidence).

[2] In theory, they could be equal but the conditions under which this happens are rarely fulfilled in practice simply because IRR is used when a rate of return cannot be easily computed. They are equal if one can re-invest intermediary distributions at the IRR rate and borrow at the IRR rate to finance intermediary payments. This is virtually impossible. A special case is when there are no intermediary cash flows, then IRR and rate of return are the same but when there are no intermediary cash flows in an asset class, people do not use IRR.

Spiegel and Welch (2007) who show that traditional performance measures (e.g. Sharpe ratio) can be "gamed". They describe a manipulation-proof measure. For the asset class I consider here, however, their solution cannot be implemented.

The rest of the article reads as follows. Section 1 describes the problems with IRR and section 2 describes how Modified IRR works and section 3 shows how to effectively implement Modified IRR for private partnerships. Section 4 briefly concludes.

1. IRR pitfalls

IRR is the most common way of measuring performance for both private equity investments and corporate projects.[3] IRR is defined as the discount rate which makes the Net Present Value (NPV) of a series of cash flows equal to zero. Investment textbooks hardly talk about IRRs and never about its shortcomings or alternatives (e.g., see Bodie Kane and Markus, 2005, Levy and Post, 2005, Francis and Ibbotson, 2002).[4] Paradoxically, investors in such assets have to turn to Corporate Finance textbooks to read about performance measurement. This is because their problem is closest to that of CFOs evaluating the profitability of corporate investments. In this paper, I take private equity funds as an example, but the results apply to other asset classes (e.g. real estate).

A. Working example

To illustrate the different problems and solutions, Table 1 shows hypothetical cash flows from 4 funds. For an investment of $100 million, fund X returns 1.5 the capital invested after one year and then $50 million in the third year. Overall, it doubles the money and boosts an IRR of 68%. For the same amount invested, funds Y1 and Y2 return $100 million after five years and another $100 in year eight. They also double the amount invested, but the IRR is 11%. Fund Z returns $50 million in the fifth year and $10 million in year twelve, corresponding to an IRR of -8%. These figures correspond to the average IRR of private equity funds that are in the bottom quartile (-8%), inter-quartile (10%) and top quartile (65%) according to Thomson Venture

[3] For example, the EVCA (European Venture Capital Association) and the BVCA (British Venture Capital Association) use IRR as their standard performance measure. For corporate projects, Graham and Harvey (2001) report that 75% of CFOs use IRR.

[4] Bodie, Kane, and Markus (2005) mention IRR but do not say anything about shortcomings. It does not say what to do to measure performance of a stream of cash flows despite a whole chapter dedicated to performance measurement (chap 24)

Economics. Finally, I assume the stock market returns 12% each year and take this 12% as the hurdle rate.

B. *A major pitfall: Reinvestment assumption*

IRR equals the effective rate of return if and only if intermediary dividends are reinvested at the IRR rate. This means that when IRR is high, the spread between IRR (the performance measure) and the effective rate of return (what is of interest to investors) is positive and large and when IRR is low, the spread between IRR (the performance measure) and the effective rate of return (what is of interest to investors) is negative and large.

The above fact is well-known, but its direct consequences for private partnership performance evaluation are less known if at all. The first consequence is that using IRR as a proxy for performance level is misleading for an asset class that is volatile and has intermediary cash flows. Table 1 shows the cash flows for our working example. Investors in fund X get a 68% rate of return only if they can invest the $150 million dividend at work for two years at a rate of return of 68% per year. In this case, the $150 million dividend will be worth $420 million at the end of year 3, which added to the $50 million dividend provides the ($470/$100)^(1/3)-1 = 68% per annum rate of return. The question is whether getting $420 million out of a $150 million dividend in only two years is feasible in practice or not. If the answer is no then this IRR is an exaggeration of the rate of return experienced by investors.

The second consequence is that performance appears more dispersed than it really is. There is a lot of talk about private equity fund performance being widely dispersed. This claim is mainly based on the spread between the IRR of the top quartile and that of the bottom quartile fund. It is 76% in our working example, a large spread indeed. This spread is then compared to the spread in rate of returns between top and bottom quartile mutual funds. This is comparing IRRs with rate of returns or, to put it simply, “apples with oranges”. The re-investment assumption means that funds with high IRR have a higher IRR than effective rate of return and funds with low IRR (below re-investment rate) have a lower IRR than effective rate of return. It is thus mechanical: volatility is exaggerated. The true spread depends on the re-investment rate. If we assume that it is 12% per annum for the full 12 years, then the spread in rate of return between the two extreme funds shrinks from 76% to as low as 15% (Table 1, using Modified IRR – see section 2 for definition).

C. Aggregation issues

An important pitfall for IRR when used as a performance measure is that the average IRR is different than the IRR of the aggregated cash flows. It is possible that an average IRR is above a benchmark and yet, if an investor would have invested in each fund, she would have underperformed the benchmark. The bias can be upward or downward and in general relatively small. That may be why this fact is mostly uncovered by the literature.

In private equity, however, aggregation is a dramatic issue because performance is negatively related to duration. This fact, pointed out by Phalippou and Gottschalg (2008), is strong in the data and has important consequences. The large negative correlation implies that average performance is always substantially biased upward. In the example shown in Table 1, the IRR of the aggregated cash flows is 12%. The average IRR is, however, almost twice as much (21%). Hence if an investor had invested an equal amount in the four funds, she would not have earned the average IRR of 21% but half that amount, which is just the hurdle rate.

As another example, consider an equal investment in Fund X and in Fund Z. Fund X posts an IRR of 68% over 3 years and fund Z posts an IRR of -8% over 12 years. Even though the same amount was invested, it is obvious that the average IRR (30%) is meaningless. As mentioned above, the problem is severe in private equity because funds with longer duration underperform dramatically, just like in this example.

Phalippou and Gottschalg (2008) suggest weighting each IRR by duration as a consequence. This is an intuitive albeit imperfect correction. In Table 1, durations are respectively 1.4 years, 6.2 years and 5.6 years.[5] The duration weighted IRR is 10%, which is more reasonable than the plain average IRR but, again, this is only a rough correction.

A related issue is that of the strategic grouping of funds to artificially display a high IRR. Table 2 (case 1) shows hypothetical cash-flows from firm XYZ if it had raised first fund X, then (in year 4) raised fund Y1 and lastly (in year 13) raised fund Z. These three funds are the same as above. If the firm would show such a track record to investors, this sharp decrease in performance over the years would probably raise concerns among investors. The first fund had

[5] Duration has to be computed like in the fixed income literature. The answer consists in computing the weighted average payment time using the present value of the payments as weights. Compared to the fixed income setup, in some practical situations like in private equity, an extra difficulty is that capital contributions also vary over time. It is therefore necessary to compute the average time of capital contributions as well. The difference between average time of dividends and average time of capital contributions is the duration of the investment. Duration can be negative. Note also that funds Y1 and Y2 terminate before fund Z, but have a longer duration.

68% IRR, but after that, the second one had 11% and the last one had -8%. A firm in such a situation can group together all the funds and presents its overall track record. It would then compute the IRR of its track record and, has shown in Table 2, display an IRR of 47%. This IRR is very high and makes a very different impression. Again, this shows the hazard of treating IRR as a rate of return. Doing so leads to very misleading impressions.

D. Endogenous cash flows

The most important issue with IRR as a measure of performance for private partnerships is the incentives it provides to managers to strategically time their cash flows. Irrespective of whether this is done in practice or not, it is important to know the incentive a performance measure provides. In practice, one cannot rule out that some fund managers can play on IRR flaws to artificially improve performance. It is thus important for investors to know these incentives.

An example is shown in Table 3. Consider first a high performance fund. This fund invests 100 at date 0. Assuming that the rate of return over the first year is 50%, the market value of the fund has increased to 150 at date 1. The fund can sell the investments now or keep them and earn 20% per year for 4 more years. Assuming the investments are as risky as the S&P 500, the hurdle rate is 12% and investors would prefer the fund to keep the investments until the fifth year. If fund A does so, then the IRR would be 25%. However, if fund A exits the investments after one year, the IRR will be 50% - twice as much. This provides strong incentives for fund managers to terminate good investments early. Hence, if fund managers are strategic with their cash flow timing, we should observe that good investments are shorter. As mentioned above, this is precisely what is found in the data. However, this is not a proof that managers are strategic because other explanations exist for a negative correlation between duration and performance. It is nonetheless a fact that the data are consistent with this behavior and that judging someone on IRR induces this type of incentive.

Consider now the case of intermediary dividends. Buyout funds have recently been criticized for buying a company, borrowing large amounts with company's assets as collateral and using the borrowed money to pay large dividends. This phenomenon is also consistent with an attempt to inflate IRRs (although still not a proof). For instance, consider the last case in Table 2. The investments made by the fund have a value of 150 at date 1. Assume that distributing a large dividend at this stage (say 100) would halve future performance to 10% yearly (instead of

20%). The idea is that distributing a dividend early is not optimal economically (this is an assumption). If a dividend is distributed early anyway, IRR is 28%. If not, IRR is lower (25%) and not higher. This is despite the sizeable destruction of value that I assumed. Hence a manager's incentive in this example is clearly to destroy value to pay an early dividend in order to inflate IRR.

Another such example is with fund X of firm XYZ in Table 1. If this fund has as much as $50 million to distribute in year 10 and does so, the IRR stays at 68%. A fund manager in this situation is thus indifferent between distributing $50 million (half of what has been invested!) to investors or nothing. A manager acting strategically could then do the following. Sell the investment in year 10 for $10 million instead of $50 million to another private equity firm called A. Then firm A could return the favor by selling an investment at a discount to another fund of the XYZ firm. Hence so-called secondary buyout transactions (transactions between two private equity firms) can help gaming the IRR.

Interestingly, other exit channels are also affected by this incentive. For example, in the case of an IPO, fund X manager would not mind leaving some money on the table (via large underpricing) in exchange of subsequent favors, because the underpricing will not change its IRR. One of the reasons behind the large IPO underpricing of venture-backed internet companies that are (informally) given by some prominent venture capitalists is that the exact pricing of the IPO had little impact on their funds' IRR because the IRR was already very high. Some venture capitalists thus did not mind too much their IPO to be underpriced as long as they get some kind of kick-backs (which could be making it to the front page of the Wall Street journal for exceptional first day return of their IPO).

An obvious force against the behavior described above is that the manager earns a carried interest. Hence he/she loses 20 cents of each dollar wasted. This may be enough to discourage the above behavior in many cases but probably not in all. The question is to know how large a distortion this incentive creates in practice. While such research is beyond the scope of this article, some recent research provides results that are consistent with this (again, this is not a proof, simply consistent evidence). Lee and Wahal (2004) shows that venture capital backed IPOs are more underpriced and Nahata and Masulis (2007) show that M&As in which a venture capital firm is the seller is more underpriced

A similar issue is seen in Table 2 when successively raised funds are grouped together. The difference between the 3 cases is the final cash flow of fund Z. Irrespective of what fund Z pays as a final dividend, the IRR is exactly the same. That is, whether fund Z returns at the end $1 billion, $10 million or nothing, the IRR stays at 47%!

To correct for the problem discussed above and to measure its importance in practice, one needs to know the exact cash flow amounts and timing of funds (see next section). Nonetheless, even without this information, one can get a sense of the distortions by comparing IRR and multiples – two performance measures that are typically provided. For example, Table 4 shows the performance report of Calpers for its private equity investments in all mature funds (12 years old and older). Two funds are among the top performers with an impressive IRR of 39% (Media com partners) and of 46% (Doughty Hanson). However, the multiples are very different. Media com partners have a 4.5 multiple while Doughty Hanson has only returned a multiple of 2. To generate a multiple of 4.5 and a rate of return of 39% with only one dividend, one should hold the investment for 4.5 years. This is close to the average duration of private equity investments and thus this high return may be close to the (true) rate of return, which would make this fund indeed exceptional. To generate a multiple of 2 and a rate of return of 46% with only one dividend, however, one should have liquidated all the investments in less than 2 years. Such a quick exit is rare but also unlikely here because this fund seems to be still running after 12 years (it reports a value for on-going investments of 10% the total amount invested). Hence, this IRR and multiple combination indicates that the rate of return experienced by investors is likely to be much lower than 46%. Note that Blackstone II is in a similar situation with an IRR at 38% and a multiple at 2.2. Again, this does not mean that fund managers do something wrong or game IRR on purpose. But this means that judging funds – and these two in particular – on their IRR is misleading.

2. Towards a solution: MIRR

A. Modified IRR (MIRR)

The textbook solution is to use NPV for choosing among projects/funds. Practitioners use this rule more now than in the past for corporate projects (see Damodaran p. 312) but still use IRR and other rules of thumb. In private equity, all fund raising performance reports I have seen use multiple and IRR, never NPV. A typical report reads like Calpers report (see Table 4). Only multiple and IRR are reported.

There are two main reasons why NPV is not used in practice. First, practitioners do not want to *assume* a cost of capital, as its value is somewhat subjective. In a corporate finance situation, this is not really a valid excuse because the IRR needs to be compared to a benchmark to decide what to do and this benchmark is in fact the corporation (or division) cost of capital. In an investment context, the case is more difficult. It would clearly be unpractical if each fund chose its discount rate (cost-of-capital) and then reported the NPV given that cost of capital to its investors. Nonetheless, most funds charge carried interest (incentive fees) with a 8% hurdle rate. This suggests that there is a quasi consensus that 8% is a good hurdle rate. All funds could then use this 8% as a constant discount rate, making performance comparable across funds. Another solution would be for all funds to use a broad and fairly universal market index such as the S&P 500. Hence, we can overcome the first obstacle to the use of NPV in these two fashions.

The second obstacle is that NPV is an abstract value and scale dependent. In fact NPV is very tangible as it is a cash amount; it is the size of the 'free lunch' (and if negative, how much money was burnt). The best solution for this obstacle is probably to use a modified IRR. To compute a modified IRR, one assumes that the capital committed to a fund is put on an 'account' that earns the hurdle rate (e.g. 8% per year). The capital called by a fund is taken out of this account and capital distributed goes to this 'account'. When the fund liquidates, the MIRR is computed as the amount on the account at liquidation divided by capital committed to the power one over duration. This basically boils down to calculating NPV but give a per annum number.

In Table 1, I show the MIRR of the four funds. Fund X has an MIRR of 17% compared to a 68% IRR and, also of interest, MIRR improves the performance of fund Z from -8% to 2%. As I mentioned above, fund Z was unfairly penalized by the IRR assumption that the $50 million distributed half way was invested at -8% per year. The average MIRR is now 11%, which is about half of the average IRR and approximately equal to the stock-market return. It is also close to the IRR of the aggregated cash-flows; hence, the IRR that an investor who would have invested in all funds would have experienced.

But most practitioners object using MIRR because they say they over-commit to private equity funds and know which funds are good ex-ante, hence can re-invest the dividend in such top funds. First of all, if this claim is true, the MIRR computed on the entire track record of the investor will show this ability. Second, for high IRRs, the above claim is simply unrealistic. If true, it would mean that because of their over-commitment strategy and abilities, investors can obtain a 68% rate of return for example. A simple reality check is whether anyone investing $100 million in private equity ended up with $18 billion 10 years down the road (multiple of 180). This is what a 68% rate of return means. Even on a three year period, 68% p.a. means that the money would be multiplied almost five times! I do not think that there are as many investors experiencing this type of multiple as funds boosting this level of performance.[6]

In addition, it may be helpful to see what is necessary to make the 68% rate of return come true even with perfect insight. Our investor has $100 million and got her full $100 million in fund X. The following year, our investor receives $150 million. She now needs: i) that a type X fund is available that year, ii) that she spots a type X fund, i.e. knows which fund is top, and iii) manage to invest $150 million in it (a steep 50% increase in the allocation to private equity in only one year). And every year goes like this. After 10 years, it is a whopping $18 billion that needs to invest in a type X fund. Clearly, this is not feasible and thus 68% is not a return that will be achieved. It is simply an illusion in practice and this type of objection does not resist common sense.

B. Issues with MIRR

Fund X has a MIRR of 17%. To compute this number, I assume that all the proceeds received by the investor (year 1 and 3) went to a 12% rate of return account until year 12. This may be unfair. An alternative solution is to stop when the fund is done, i.e. at year 3. In this case the MIRR is 34%, which I label IMIRR (Isolated Modified IRR).

Why are they so different and what do they mean? IMIRR assumes implicitly that once the fund is liquidated, a similar fund is available for investment. So intermediate dividends get

[6] The top 50 buyout funds whose PPM I have display on average a 59% (gross) IRR. In Calpers report, 20% of the funds have an IRR above 30% but only 5% of the funds have a multiple above 3.7 (which is what an investor earning 30% per year for 5 years would obtain).

invested at a pre-determined rate and once the fund is liquidated, the money can be fully invested into a similar fund. Let's continue the example with fund X. The investor invests $150 million for two years at 12%. When the fund liquidates, in year three, the investor can invest the $238 million into fund X again. She then receives $357 million one year later. Continuing like this forever, the rate of return obtained will be 34% per annum.

With the plain MIRR, it is assumed that distributions earn the pre-determined re-investment rate for a pre-determined time period.

To gain further intuition, let's go back to the example shown in Table 2 when we saw the perverse incentives provided by IRR. IMIRR ranks the second option (hold the investment) higher than the third one (pay intermediary dividend), which is what investors want, but ranks the first option (liquidate all immediately) the most valuable. This is because IMIRR assumes that if everything is liquidated another project that asks for 100 and pays 150 a year later will come along immediately. Obviously, in such a scenario, liquidating everything is the preferred option. IMIRR thus always solves the issue with unwanted intermediate dividend payments, but still faces a challenge for strategic final liquidation. From the above example, it seems reasonable for most practical situations to work with MIRR rather than with IMIRR.

C. Intermediary investments

The question of how to discount intermediary investments is rarely discussed in textbooks and is actually even trickier than the question of intermediary dividends.

Let us start with an example shown in Table 5. Project A consists of a $100 million investment at date 0 and a second investment of $100 million at date 1, generates a dividend of $600 million at date 2 and an IRR of 100%. IRR assumes that $100/(1+IRR) million is put on an account at date 0 and this account has a rate of return equal to IRR. Hence, project B with cash flows equal to -$150 million at date 0 and returning $600 million at date 2 has the same IRR as project A. It is obvious, however, that most investors would prefer project B rather than project A, even though they have the same IRR. So again, IRR fails. But here, calculating the NPV for project A may be tricky. How to discount the $100 million? Should it be discounted (from year 1 to year 0) at the risk-free rate on the basis that we know the fund will call an extra $100 million (only the timing is unknown but likely independent of the stock-market return, hence with a zero beta)? Does it change anything if the $600 million dividend is generated equally from the first investment and the second investment or if $400 million dividend comes from the first investment and $200 million dividend from the second one?

The easiest and also what seems most fair is to discount the $100 million at the hurdle rate on the basis that, in practice, we know the fund will call an extra $100 million, but we do not know whether it will do so this year or next year. We want the fund to call it as soon as it can generate at least the hurdle rate on the investment. To give that incentive, we need to use the hurdle rate for discounting. Hence, to compute MIRR, we consider that 100/(1+h) is put on an account that earns the hurdle rate (e.g. h=12%).[7]

To illustrate, I show in Table 5 that MIRR and NPV say that project A and C are equivalent and dominate projects B and D. If we had discounted the $100 million at the risk free rate, then project D would have dominated project A.

3. Towards a better Private Equity industry standard for performance reporting

Given the above discussion and the particularities of the private equity industry, it seems best to report IMIRR for each investment and an MIRR for the whole fund.

Let us start with the whole fund performance measure. We first need to choose a starting date and a final date. It seems most natural to start at the time of fund inception and terminate at the contracted termination date of the fund.[8] Next, I suggest to assume that the full amount of capital committed is put on a separate and fictitious account at inception and earn the hurdle rate. This assumption has several advantages. First, it gives the right incentives. A fund will decrease performance if it calls capital but cannot put it at work at the hurdle rate. Second, it penalizes good funds for not calling capital. If two funds have the same performance on their investments and outperformed the hurdle rate, then the fund with the lower amount of capital committed (or the fund who has invested more rapidly) will show better performance. This seems fair from an investor perspective. Third, this assumption makes calculations simple and somewhat more transparent.

Thus, when the fund calls money (including fees), it is as if it drew from this account. Similarly, when there is a divestment, the money goes to the S&P account. At the end of fund's

[7] When using the hurdle rate for discounting, the split between the proceeds from the first and second investment in the $600 million dividend does not matter. Otherwise, it would.

[8] The possibility of extension makes matters more difficult and can also lead to gaming. A possibility is to make the final date the latest possible closing date (e.g. 13 years for most private equity partnerships).

life, both the MIRR and incentive fees can be calculated. MIRR is simply the amount of money on the fictitious account at liquidation divided by the amount of capital committed to the power one over fund duration. For incentive fees, the following rule appears simple and fair:

i) x%*(Capital Committed)*(MIRR *minus* hurdle rate [e.g. S&P 500 index fund geometric average return over the same period]) if MIRR > hurdle rate

ii) zero otherwise

In Table 6 – Panel A, I show hypothetical cash flows realized on *N* investments and their aggregation at the fund level. For the sake of the example, I ignore fees. In Table 6 – Panel B, I show the usual performance measures. IRR is 43% and multiple is 2. This is a fairly usual outcome for private equity funds and typically seen as an excellent one as the IRR is compared to average S&P 500 over the same period (18%). The MIRR of this fund is, however, 19% when using the S&P 500 (MIRR_S&P) and 13% when using the 8% hurdle rate (MIRR_8%).[9] The verdict about this fund is that it outperformed the S&P 500 slightly and outperformed by 5% p.a. the 8% flat benchmark. So the answer naturally depends to a certain extent on what investors think the right benchmark is but the conclusion does not change dramatically despite a large difference between the S&P rate of return and 8%.

The multiple of two could be converted into a rate of return taking 10 years as the duration of the fund. This is actually simply an MIRR_0%. We then obtain 7%. Thus investors using the usual measures (IRR, multiple and the duration of the fund) would get two returns, one of 43%, which looks very good and one of 7% which looks bad. This again illustrates that current performance reporting standards are not useful.

At the project level, IMIRR seems most appropriate. There is no capital committed per project and projects should be treated the same irrespective of the time at which they were started in fund's life. As we saw above, with IMIRR, fund managers have an incentive to fully liquidate good projects too early and delay too much the final liquidation of poor projects (as long as an intermediary dividend was paid). However, if they do so, the fund level performance will be negatively affected because it is computed with MIRR. So this should not be a concern. We show

[9] The logic is that the hurdle rate for incentive fees should be the cost of capital. If investors agree that the level of risk requires a flat 8% hurdle rate then this is the hurdle rate.

the results for investment 1 and *N* in Table 6 – Panel C. As observed above, the IMIRR provides more reasonable performance numbers. The IRR of investment 1 is above 400% while IMIRR is between 46% and 56% depending on the hurdle and the IRR of investment *N* is a low -25% while IMIRR is between -17% and -20%.

IMIRR and MIRR are serious improvements on IRR. They align incentives between manager and investors and provide a more accurate picture of performance. In addition, MIRR, unlike IRR, is always uniquely defined and does not require any optimization algorithm. It is trivial to compute. One of the issues with MIRR is that it is a geometric return. It is therefore not a number that can be used for optimal portfolio allocation. To get an arithmetic return, one needs to observe a large cross-section of projects to estimate the expected return (over a given period). Methods such as those designed by Cochrane (2005), Driessen, Lin and Phalippou (2007) and Korteweg and Sorensen (2007) achieve this. For the portfolio allocation decision, one needs also to determine alpha, volatility and correlation. However, in practice, it is investor dependent (David Swensen would use different estimates than the average investor). In addition, it is often unwise to perform such an analysis for non-traded alternative investments such as real estate funds and private equity funds. Not only the Mean-Variance solution is bound to be noisy, but investment opportunities vary significantly over time. It then seems better to allocate as a function of the number of spotted positive NPV funds. The rule is to invest in any positive NPV fund.[10]

The use of MIRR would prevent some additional potential games. First, some funds report investment duration but sometimes calculate it as date of first divestment minus date of first investment. Hence an investment may last for 10 years, but as long as it pays a dividend after 1 year, the reported duration is one year. A multiple of 3 then looks good given the 1 year holding period, but it is obviously misleading. Second, some fund computes different IRRs. The main alternative is time-zero IRR. Funds may then report the IRR that looks better. With MIRR these issues become irrelevant.

Finally, it seems fair to have performance of the overall fund reported net of fees and all cash flows to be reported at the date they were actually paid to investors (not always the case –

[10] The principle is simple but, in practice, this is a difficult exercise that will probably addressed by future research. NPV should be computed with a discount rate that takes into account the correlation with the rest of the portfolio. Also, in practice, an upper bound may be defined for the allocation.

sometimes announcement dates are used). Performance should be shown separately for all funds (no pooling, nor insertion of investments done when working for another firm). It also seems important to enforce a fixed duration window for funds (e.g. 8-10 years). It prevents some potential gaming at the cost of less flexibility. However, with the development of a secondary private equity investment market, the cost of forcing liquidation may be minimal.

4. Conclusion

One of the most central question that Finance theory answers is whether a project should be undertaken or not. For investment professionals, this question reads “should a given project have been undertaken or not.” This is performance measurement; an often overlooked field and yet central to the success of asset managers. In this article, a challenging aspect of it is presented. Namely, how to measure performance when all we have is a stream of cash flows generated by an asset or a manager.

Academics advise NPV while practitioners prefer IRR. Survey evidence shows that decision makers prefer to use rules such as IRR or cash multiples to decide whether they should invest in a project or not. Graham and Harvey (2001) report that 75% of surveyed CFOs use NPV (always or almost always) but an equal fraction use IRR (always or almost always). The situation is very similar for private equity funds. When raising capital, funds provide track records expressed in terms of IRR and cash multiples exclusively. This state of the world often puzzles academics but to be fair, implementing NPV is actually trickier than it seems from textbooks. In this article, it is first shown that IRR is probably the worst performance metric one may use in an investment context. It exaggerates the variation across funds, exaggerate the performance of the best funds, can be readily inflated and provide perverse incentives to fund managers. Next, a way to implement NPV in practice via the use of MIRR is put forward. A framework is proposed for performance reporting based on MIRR for private partnerships. The objective is to open a debate and to invite more work towards a more acceptable performance reporting standard.

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Appendix: *Other known pitfalls of IRR*

IRR also has some other known pitfalls. The first one is the computational difficulties. Computation of the IRR involves an iterative search procedure that may not converge and can lead to multiple solutions. The computational difficulties are presented in almost all the finance textbooks. It also happens that Excel cannot find a solution, while a more advanced software does. In private equity, not finding a solution happens frequently, especially at the individual investment performance level. Multiple solutions are, however, rare despite the fact that private equity fund cash flows alternate positive and negative signs.

The second pitfall often mentioned is that of the 'Lending versus Borrowing Problem.' If a project start with a small investments, then returns quickly a large amount of capital and then takes on a number of additional investments that do not lead to any distribution, then the IRR may be high even though more capital is invested than is returned. It is as if the computer thinks that you are the one receiving the money for the project and not the one paying (see Brealey and Myers, 2000, p. 101). Hence, receiving less than you paid becomes good news. In our example, if fund X pays 400 in dividends instead of 150 at date 1 and then invests 400 at date 2, the IRR is 40%, while the NPV is negative and the fund has invested more than it distributed.

The third known pitfall is that it does not rank projects correctly in many situations. Corporate Finance textbooks show extensive example when this happens due to difference in project scale. In private equity, as each fund has many investments and divestments this issue is always present and IRR-based ranking always differ from what the optimal ranking would be according to the solution that is proposed in textbooks and worked out in details below.

The fourth known pitfall is that IRR cannot be compared to a time-series average of the hurdle rate when the later is time varying. The IRR of private equity funds is frequently compared to the average rate of return of stock market indices over the same time period but this comparison is not proper (see Damodaran, 2001, p. 301). Not only one cannot compare IRR to an average hurdle rate, but also the amount invested at any point in time is different for private equity compared to the stock-market index. The private equity industry had much larger amounts invested in the late 1990s and early 2000s than in the 1980s, it is therefore unfair to compare private equity performance to something that gives the same weight to each time period like the average S&P 500 rate of return from say 1980 to 2005.

Table 1: The working example – 4 funds

This table shows hypothetical cash flows from four funds. On the right hand side, their aggregated cash flows (firm XYZ) are shown both gross of fees and net of fees. Fees are assumed to be 4% per year. The stock market index is set to a constant 12% per year. NPV is computed using 12% as a hurdle rate. Modified IRR (MIRR) is computed assuming dividends are re-invested at 12% until the end of the period (date 12).

Year	Fund X	Fund Y1	Fund Y1	Fund Z	Firm XYZ (gross)	Firm XYZ (net)
0	-100	-100	-100	-100	-400	-416
1	150	0	0	0	150	134
2	0	0	0	0	0	-16
3	50	0	0	0	50	34
4	0	0	0	0	0	-12
5	0	100	100	50	250	238
6	0	0	0	0	0	-12
7	0	0	0	0	0	-12
8	0	100	100	0	200	188
9	0	0	0	0	0	-4
10	0	0	0	0	0	-4
11	0	0	0	0	0	-4
12	0	0	0	10	10	6
IRR	68%	11%	11%	-8%	12%	5%
MIRR	17%	12%	12%	2%	12%	10%
IMIRR	34%	12%	12%	2%	12%	10%
NPV	69.52	-2.87	-2.87	-69.06	-5.28	-95.41
Duration	1.42	6.25	6.25	5.58		

Table 2: Grouping successively raised funds

This table shows hypothetical cash-flows from firm XYZ if it had raised first fund X, then (year 4) raised fund Y1 and lastly (year 13) raised fund Z. These three funds are like those shown in Table 1. Three cases are shown. In case 1, fund Z has the same cash flows as in Table 1 while in case 2 and 3 fund Z has a different final cash flow (high in case 2 and low in case 3).

Year	Case 1	Case 2	Case 3
0	-100	-100	-100
1	150	150	150
2	0	0	0
3	50	50	50
4	-100	-100	-100
5	0	0	0
6	0	0	0
7	0	0	0
8	0	0	0
9	100	100	100
10	0	0	0
11	0	0	0
12	100	100	100
13	-100	-100	-100
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	50	50	50
19	0	0	0
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	10	1,000	0
IRR	47%	47%	47%

Table 3: Timing exits

This table shows hypothetical cash-flows from one fund. The stock market index is set to a constant 12% per year. NPV is computed using 12% as a hurdle rate. The rate of return of the fund for the first year is 50%. In the first case, the fund liquidates at date 1, while in the second case it continues until the fifth year at a rate of return of 20% per annum. In the third case, the fund pays a large dividend at date 1 and runs until year five at a rate of return of 10% p.a.

Year	Sell all	Keep all	Early dividend
0	-100	-100	-100
1	150	0	100
2	0	0	0
3	0	0	0
4	0	0	0
5	0	311.04	73.21
IRR	50%	25%	28%
NPV	33.93	76.49	30.82
MIRR	19%	25%	18%
IMIRR	50%	25%	18%

Table 4: Calpers Performance Report 1990-1995, as of June 2007

Investment, distribution and total (distribution + remaining values) in million of U.S. dollars.

Fund Name	Year	Inv.	Dist.	Total	IRR	Mult.
Apax Ventures IV International Ptrs L.P.	1990	10	31	31	0.25	3.2
Warburg, Pincus Investors, L.P.	1990	100	236	236	0.15	2.4
Permira U.K. Venture III	1991	13	37	37	0.31	2.8
Hellman & Friedman Capital Partners II	1991	87	239	239	0.23	2.7
Media Communications Partners II, L.P.	1992	25	111	112	0.39	4.5
First Reserve Fund VI, L.P.	1992	35	99	100	0.26	2.9
Alta V Limited Partnership	1992	35	84	85	0.26	2.4
Landmark Equity Partners III, L.P.	1993	24	63	64	0.36	2.7
Madison Dearborn Capital Partners I, L.P.	1993	97	299	325	0.28	3.4
Welsh, Carson, Anderson & Stowe VI, LP	1993	50	94	97	0.13	1.9
1818 Fund II, L.P.	1993	75	117	125	0.11	1.7
Blackstone Capital Partners II, L.P.	1994	84	174	182	0.38	2.2
Golder, Thoma, Cressey & Rauner Fund IV	1994	25	53	53	0.25	2.1
Hicks, Muse, Tate & Furst Equity Fund II	1994	110	220	221	0.19	2.0
Landmark Equity Partners IV, L.P.	1994	31	45	46	0.17	1.5
FS Equity Partners III, L.P.	1994	75	164	165	0.16	2.2
TCW Special Credits V - The Principal Fd	1994	35	61	61	0.15	1.7
Green Equity Investors II, L.P.	1994	74	153	154	0.14	2.1
Levine Leichtman Capital Partners I, L.P.	1994	108	121	124	0.12	1.2
Aurora Equity Partners I, L.P.	1994	27	34	43	0.11	1.6
Bachow Investment Partners III, L.P.	1994	38	39	57	0.10	1.5
Technology Partners Fund V, L.P.	1994	18	24	26	0.07	1.4
Stonington Capital Apprec 1994 Fund LP	1994	101	32	97	0.00	1.0
PENMAN Private Equity & Mezzanine LP	1994	13	11	11	-0.02	0.9
Rice Partners II, L.P.	1994	60	51	52	-0.04	0.9
Beacon Group Energy Investment Fund LP	1994	132	94	95	-0.08	0.7
Fairview Capital I, L.P.	1994	50	22	27	-0.14	0.5
Information Technology Ventures I, L.P.	1995	25	139	139	0.90	5.6
Doughty Hanson Fund II, L.P.	1995	44	85	90	0.46	2.0
Kline Hawkes California, L.P.	1995	41	112	113	0.41	2.7
Hellman & Friedman Capital Partners III	1995	120	275	275	0.35	2.3
APA Excelsior IV, L.P.	1995	25	48	50	0.20	2.0
Welsh, Carson, Anderson & Stowe VII, LP	1995	150	317	333	0.18	2.2
Apollo Investment Fund III, L.P.	1995	137	207	219	0.11	1.6
McCown De Leeuw & Co. III, L.P.	1995	51	67	68	0.10	1.3
Lombard/Pacific Partners, L.P.	1995	355	371	446	0.05	1.3
SpaceVest Fund Limited Partnership	1995	31	16	17	-0.07	0.6
TSG Capital Fund II, L.P.	1995	49	31	32	-0.09	0.7
INROADS Capital Partners, L.P.	1995	20	3	5	-0.20	0.3
Median					**0.15**	**2.00**
Mean (value weight)					**0.14**	**1.81**

Table 5

This table shows hypothetical cash-flows from four projects. The stock market index is set to a constant 12% per year. NPV is computed using 12% as a hurdle rate.

Year	Project A	Project B	Project C	Project D
0	-100	-150	-189	-195
1	-100	0	0	0
2	600	600	600	600
IRR	100%	100%	78%	75%
MIRR	78%	100%	78%	75%
NPV	289	328	289	283

Table 6: A new performance report format

Hypothetical cash flows from N investments made by one fund are shown. Average S&P 500 rate of return is 18% p.a. Assume capital committed is 100. Fund multiple is sum distributed divided by capital committed. Investment multiple is sum distributed divided by sum invested.

Panel A: Generated cash flows

Dates	Inv. *1*	Inv. *2* to *N-1*	Inv. *N*	Fund
Mar-91	-10	0	0	-10
Mar-92	50	-20	0	30
Aug-92	0	-20	0	-20
Apr-93	0	-20	0	-20
Jan-94	10	0	0	10
May-94	0	-20	0	-20
Jun-95	0	20	0	20
Jul-96	0	20	0	20
Jun-97	20	0	0	20
Aug-97	0	20	0	20
Jan-98	0	0	-10	-10
Sep-98	0	20	0	20
Jan-99	0	0	-10	-10
Oct-99	0	20	0	20
Nov-00	0	20	0	20
Dec-00	0	0	10	10

Panel B: Traditional Performance Measures

	Start date	End date	IRR	Multiple	*IMIRR_0%*
Investment 1	1 Mar-91	1 Jun-97	405%	8.0	*39%*
…	…	…	…	…	…
Investment N	1 Jan-98	1 Dec-00	-25%	0.5	*-21%*
	Start date	End date	IRR	Multiple	*MIRR_0%*
Fund performance	1 Mar-91	1 Dec-00	43%	1.9	*7%*

Panel C: Summary Performance Report Format

	Start date	End date	IMIRR_S&P	IMIRR_8%
Investment 1	1 Mar-91	1 Jun-97	56%	46%
…	…	…	…	…
Investment N	1 Jan-98	1 Dec-00	-17%	-20%
	Start date	End date	MIRR_S&P	MIRR_8%
Fund performance	1 Mar-91	1 Dec-00	19%	13%