Calculating a Portfolio's Annual Rate of Return

Chris Reed 2018
RetailInvestor.org

Abstract

Educational material explaining the difference between the two methods for calculating a portfolio's rate of return, is long on math, catch-phrases and self-justifications, but short on any conceptual understanding of how the math is 'thinking about' cash flows or what the math is measuring. This paper attempts to fill the void.

Introduction

You want to calculate your portfolio's annual rate of return to compare it to a benchmark index's return or to a friend's return. The % return has meaning only when and because it is comparable. Since market returns are hugely variable from year to year, a higher-than-normal return in any year is not necessarily something to brag about. And vice versa. In isolation, your portfolio's % return is meaningless. It is just 'a number'.

There is no difficulty with this exercise when (e.g.) a portfolio worth $1,000 grows to $1,100 at year end, with no additions or withdrawals of principal. The math is simple. Divided the $100 profit (1,100 - 1,000) by the $1,000 principal invested. 100 / 1,000 = 10%.

Problems arise when there are inflows and outflows of principal during the year. The principal working to earn profits varies during the year. If (e.g.) $1,000 savings is added at the end of June, and earns a $100 profit by year end, how should that half-year profit be translated into a full year's profit? The numerator is a fact = $100 profit. But what is the denominator? The $1,000 principal was working only half the time, with $0 principal working the other half.

There are two calculation methods that give different results. The first is called the 'Dollar Weighted Rate of Return' or 'IRR' (Internal Rate of Return). The second is called the 'Time Weighted Rate of Return' or, as called here because it is more descriptive, the 'Per Unit Return'.

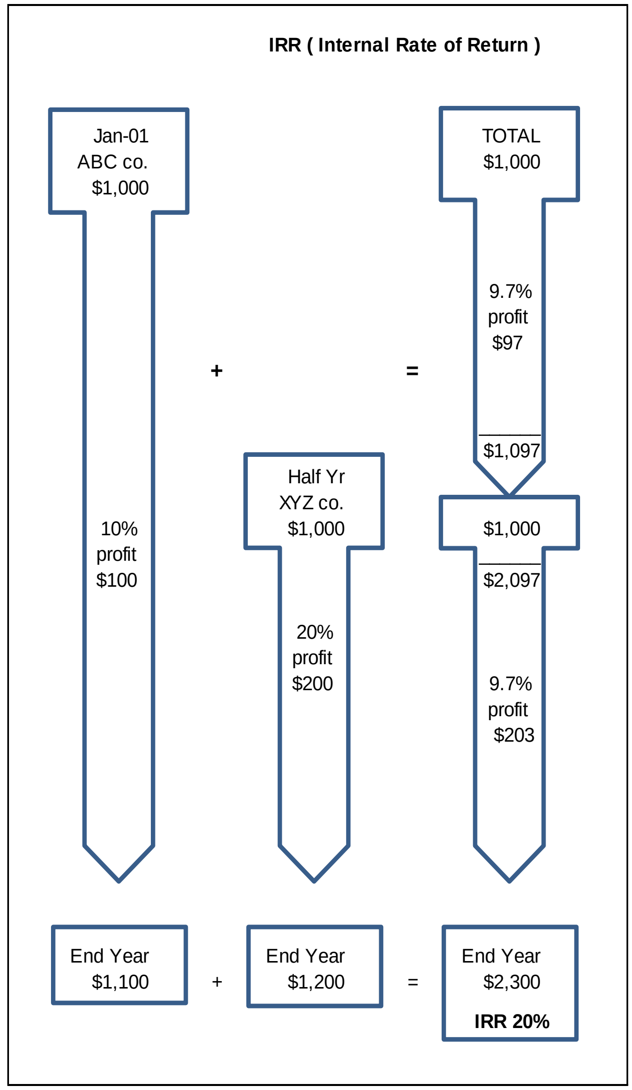
IRR Methodology (dollar weighted)

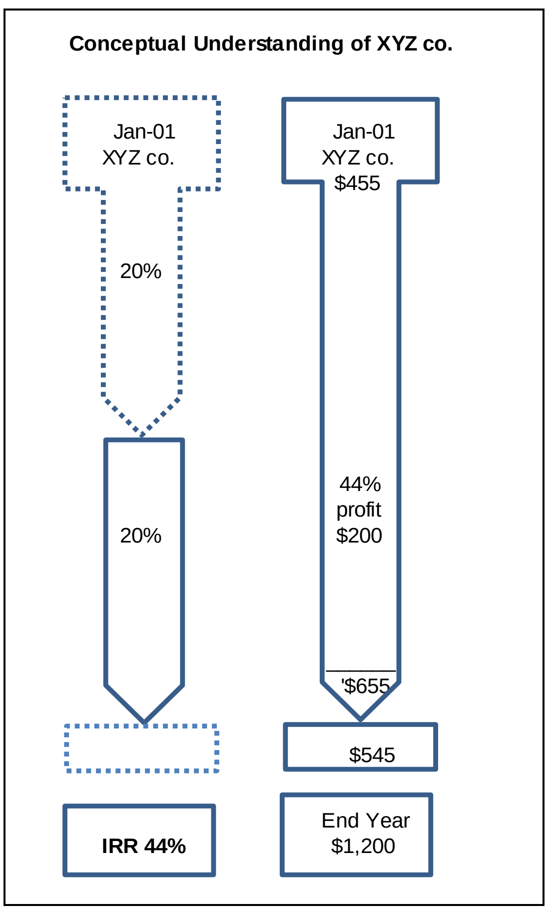
This method looks only at cash flow dollars and dates, counting the starting portfolio value as an inflow, and the ending value as an outflow. It needs dates because its math presumes that yearly profits are earned evenly through the year. This is the metric your broker will give you because he can calculate it with data he has kept on file. He will sell it as your 'personal' return even though both methods generate a 'personal' return. He will sell it as 'adjusting for your personal cash flows' even though both methods do so.

The portfolio chosen for an example has the year starting with a $1,000 portfolio invested in ABC co. Half way through the year another $1,000 is added to buy XYZ co. At the end of the year ABC co. has grown 10% to equal $1,100. XYZ co has grown 20% to equal $1,200. The total portfolio is valued at $2,300.

A calculator determines through trial and error, the half-year 9.6875% that reconciles the cash flows. The original $1,000 grows at 9.6875% to equal $1,097 at the half-year. The mid-year $1,000 additional principal is added. $2,097 is invested at 9.6875% for the second half year to equal $2,300 at year end. The annual IRR is the economic equivalent of two periods of 9.6875% compounded.

IRR = (1 + 9.6875%)*(1 + 9.6875%) = 1.2031 subtract 1 = **20%.**





You can check this yourself using the XIRR function in Excel or an [online calculator](). If it does not work for you it is probably because you mistake the half-year point to be June 30. Count the days. Or you end the year one day short of a full year.

THE CONCEPTUAL MODEL: The IRR model treats the $1,000 half-year investment in XYZ co. as if it earns the same return while not in the portfolio, as it earns while in the portfolio. The 20% earned in the second half-year is duplicated by another 20% in the first half-year. When two periods of 20% are compounded the annual rate is 44%.

IRR = (1 + 20%)(1 + 20%) = 1.44 subtract 1 = **44%**.

Most everyone agrees that IRR results like 44%, with its presumption of duplicating returns in the time when principal is NOT in the portfolio, are not useful. But when combined with other assets invested throughout the year, IRR has a mechanism for moderation. IRR equates '*$1,000 invested for half a year*', to about '*$500 invested for the full year*'. Most people agree that is pretty reasonable. So while IRR magnifies the full year's rate of return 2.2 times (44/20), it also divides the principal at work by that same factor ($1,000 / 2.2 = $454.55). The principal at work is only $454.55. The remaining $545 (of the actual $1,000) is considered to be added at the year's end without ever being invested.

The portfolio's return =
$300 Profit (ABC's $100 plus XYZ's $200), divided by
$1,454.55 Principal (ABC's $1,000 plus XYZ's $454.55)
= **20% IRR**.

THE PROBLEM : That math seems very reasonable, but the resulting 20% lacks meaning. Was it astute market timing that prompted the additional investment at mid-year to catch a market rebound? If so then where was the principal during the first half? Or was it just luck, because that was when you received a tax refund? Was your choice of XYZ co. astute, or did all stocks spike 20% in the second half, even ABC co.?

For most people cash flows in and out of their portfolio are not strategic investment decisions. We add principal whenever we accumulate savings from our pay cheques. We withdraw fund when needed; to fund a real estate down payment, or in retirement to pay the rent. It is only luck when our draws avoid losses and our savings catch gains.

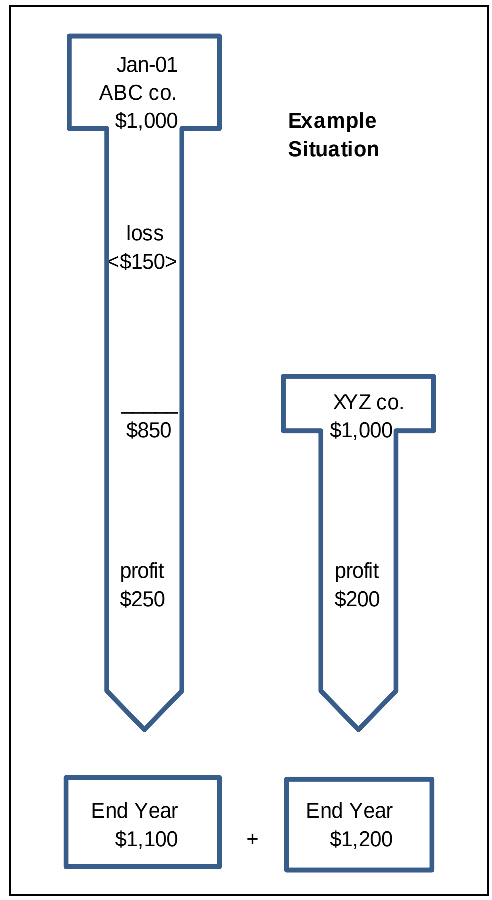
What if there are no distinct ABC or XYZ co. assets? Instead there is a portfolio of stocks owned at the start. The mid-year addition purchases more of the exact same portfolio. If the portfolio has 8.3% losses in the first half-year, followed by 20% gains in the second half, the original $1,000 principal earns the same yearly 10% profits. The additional principal catches only the later 20% gains. Does the portfolio's IRR = 20% make sense, if the assets themselves only earned 10%? Is it reasonable to presume the mid-year principal would have earned 20% in the first half-year, when we know that the assets actually lost money?

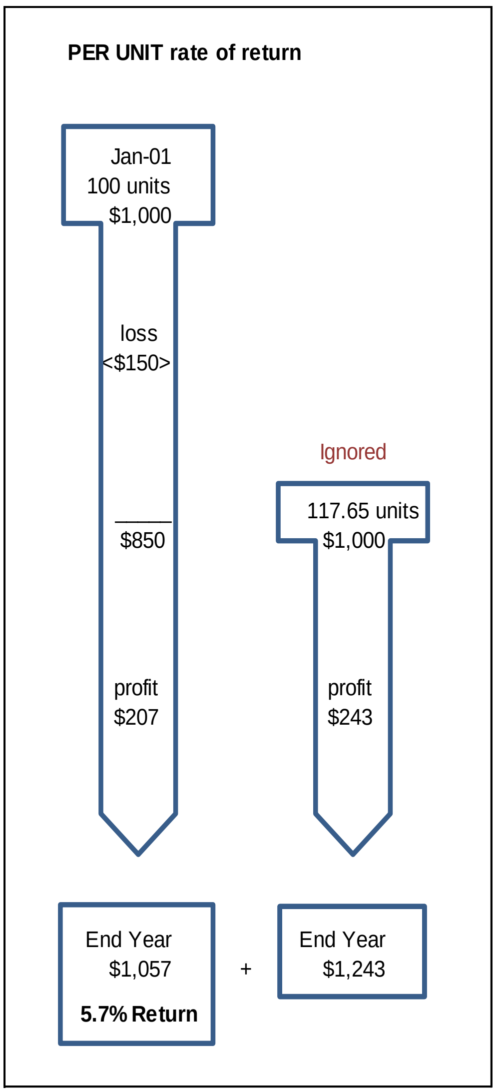
Even the industry body requiring brokers to report this metric explicitly warns that ... "*benchmarks are not relevant comparisons to an individual investor's Personal Rate of Return*". The IRR return cannot be compared to other investors' returns or even your own in other years because it ... "*is based on the individual investor's specific deposits into and withdrawals out of his/her account. Since each investor has a different combination of deposits and withdrawals, each investor could have a different Personal Rate of Return*". Even their claim that it can be compared to a 'target rate of return for planning purposes' can be disputed and is not justified.

PER UNIT RETURN Methodology (time weighted)

This method removes the effects of cash flows, so that it is only the investing decisions that determine the annual return. This method is used to judge mutual fund managers who have no control over cash flows. Arguable retail investors are no different. This rate of return is directly comparable to benchmarks and friends' returns, whose cash flows are different from yours.

Think of a mutual fund that issues additional units when money is invested, and cancels units when money is withdrawn. The market $value per unit determines how many units are created / destroyed per dollar of cash flow. Profits of all assets in the portfolio are allocated equally to all units, but it is only those units that are outstanding the full year that are referenced to determine the annual % return.





The example here is the same as used above. The portfolio at the beginning of the year is arbitrarily considered to have 100 units, so each unit is valued at $10 (= 1,000 / 100). Here the date of the later $1,000 addition is irrelevant. Instead what is important is the $850 market value at that time. The additional principal could have been added at any time in the year, and as long as the market value is $850 at that time, the resulting % return does not change.

The original 100 units start the year with a $150 loss. When the $1,000 is added mid-year the market value per unit is $8.50 (= 850 / 100), so 117.65 additional units are created (= 1,000 / 8.50). What then happens to the value of the 117.65 units is ignored in this calculation because the Per Unit metric tracks only units outstanding the full year. The portfolio earns $450 profit (= $250 from ABC and $200 from XYZ) which is allocated equally to each unit. The 100 units get $207 of the total (= 100 / 217.65 * 450). The year-end value of the 100 units is $1,057 or $10.57 per unit (also = total $2,300 / 217.65 units).

The Per Unit return =
$0.57 Profit ($10.57 ending value less $10 beginning value), divided by
$10 Principal invested per unit
= **5.7% return**.

The inputs for this calculation are easy to maintain during the year, requiring only the $ cash flows, and the portfolio's market value before each cash flow. If at year end you don't know what those market values were, you can estimate by averaging the month end values from your broker statements. A new line to the table below is added for each cash flow. A simple spreadsheet can do the math detailed.

	Market Value	# Units	$ / unit	Cash Flow	#units +/-
Start	1,000	100	10.00		
Add	850	100	8.50	1,000	117.65
End	2,300	217.65	10.57		
Profit			0.57 = **5.7%**		

The 5.7% Per Unit return is hugely different from the 20% IRR calculated from the same set of facts. The Per Unit return removes the effects of cash flows and measures only the returns of principal kept invested throughout the year. It reflects the investment choice to diversify into an asset whose subsequent profits are less than the original asset. XYZ co. earned only 20% (= 200 / 1,000) while the original ABC co. earned 29.4% (= 250 / 850). If ABC co. is your benchmark earning 10%, you underperformed because of that choice.

Conclusion

IRR is a valid metric in some situations, e.g. a business deciding between project options. In that situation it is reasonable to presume cash flows will earn a comparable return while not in the specific project. But for measuring meaningful personal portfolio returns, the Per-Unit Return is best.