Investment Time Weighted Rate of Return

Performance measures are designed to produce numbers that represent returns. They are designed to give information for evaluating the effectiveness of management or strategy.

Simple performance measurements may be used in cases where portfolio activities are relatively static. But where the portfolio activity is voluminous, measuring performance is move involved and computationally intensive.

In this memorandum, we look at the holding period return (HPR) to explore the basic idea of how portfolio return is computed and apply it to portfolio activity which are relatively static. We will examine its limitation where there are numerous activities in the portfolio. Finally, we will show the calculation of the time weighted rate of return (TWRR), the industry standard for portfolio performance measurement.

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Holding Period Return (HPR)

HPR is the total return received from holding an asset over a period of time.

Below is an illustration of the returns on the investment.

Example 1

Date	Market Value	Period Yield	Annualized
1-Jan-19	1,000,000.00		
31-Jan-19	1,002,135.21	0.2135%	2.5138%

Table 2

$$HPR = \frac{1{,}002{,}135.21 - 1{,}000{,}000.00}{1{,}000{,}000.00} = 0.2135\%$$

$$HPR = 0.2135\%$$

The return computed is for a period of 31 days from 1-Jan-2019 to 31-Jan-2019. Returns are usually annualized to 365 days for ease of comparison between portfolio or between different time periods or periods with different tenure. The annualised equivalent for the above return is as follows:

$$HPR_{ann} = \frac{0.2135\%}{31\ days} \times 365\ days = 2.5138\%$$

The HPR can take into account income received in the period. If the investor received an income from the investment (coupon or dividend) of, say, 100, this can be added to period end closing value.

$$HPR = \frac{1{,}002{,}135.21 + 100 - 1{,}000{,}000.00}{1{,}000{,}000.00} = 0.2235\%$$

$$HPR_{ann} = \frac{0.2235\%}{31\ days} \times 365\ days = 2.6318\%$$

In general, the formula for determining HPR is:

$$\frac{I + (MV_e - MV_s)}{MV_s}$$

Where

$$MV_s = Market\ Value\ at\ the\ start\ of\ period$$

$$MV_e = Market\ Value\ at\ the\ end\ of\ period$$

$$I\ = Period\ Income\ *$$

$*\ In\ theory, the\ income\ has\ to\ be\ received\ on\ the\ last\ day\ of\ the\ period.$

Limitation of HPR Calculation

Although the HPR computation is simple, it suffers from a serious drawback in the event of cash contribution from the portfolio.

For example, consider the situation where 400,000 is added to the portfolio. A straight application of the formula above will show a result as follows:

Example 2

Date	Contribution	Market Value	Period Yield	Annualized
1-Jan-19		1,000,000.00		
11-Jan-19	400,000.00			
31-Jan-19		1,403,121.50	40.3122%	474.6436%

Table 3

$$HPR = \frac{1{,}403{,}121.50 - 1{,}000{,}000.00}{1{,}000{,}000.00} = 40.3122\%$$

$$HPR_{ann} = \frac{40.3122\%}{31\ days} \times 365\ days = 474.6436\%$$

The holding period of over 40% (or 474% annualised) is incorrect. The reason for this anomaly is because the formula attributes the contribution as return on the investment.

Time Weighted Capital Return (TWRR)

To handle situations with contribution, the TWRR method is used. This method computes the geometrically linked or compounded return over time.

This is done by breaking the period into sub-periods based on the date of the contribution. For each sub-period, the return is given by the formula.

$$r_n = \frac{(MV_n - C_n) - MV_{n-1}}{MV_{n-1}}$$

Where

$$MV_n = Market\ Value\ at\ the\ end\ of\ period\ n$$

$$MV_e = Market\ Value\ at\ the\ end\ of\ period$$

$$C_n\ = Period\ n\ contribution$$

The overall TWRR is computed using the formula as follows:

$$TWRR\ = [(1 + r_1) \times (1 + r_2) \times \cdots \times (1 + r_n)] - 1$$

This calculation is illustrated in Example 3.

Example 3

The period and the starting market value of the portfolio is the same as Example 1 and 2.

On 11-Jan, there is a cash contribution to the portfolio of 400,000.

The overall period is divided into 2 parts: 1-Jan-2019 to 11-Jan-2019 (date of contribution); and 11-Jan-2019 to 31-Jan-2019. This is represented in the table below:

Date	Contribution	Market Value	Period Yield	Annualized
1-Jan-19		1,000,000.00		
11-Jan-19	400,000.00	1,401,236.00	0.1236%	
31-Jan-19		1,403,121.50	0.1346%	
			0.2583%	3.1430%

Table 3

$$r_1 = \frac{(1{,}401{,}236.00 - 400{,}000.00) - 1{,}000{,}000.00}{1{,}000{,}000.00} = 0.1236\%$$

$$r_2 = \frac{(1{,}403{,}121.50 - 0.00) - 1{,}401{,}236.00}{1{,}401{,}236.00} = 0.1346\%$$

$$TWRR = [(1 + 0.1236\%) \times (1 + 0.1346\%)] - 1$$

$$TWRR = 0.2583\%$$

$$TWRR_{ann} = \frac{0.2583\%}{31\ days} \times 365\ days = 3.1483\%$$

The formula is applicable for both contribution as well as for withdrawal. Withdrawal is considered as a negative contribution.

The table below extends the example in Table 3 with a withdrawal of 300,000 on 25-Jan-2019.

Example 4

Date	Contribution	Market Value	Period Yield	Annualized
1-Jan-19		1,000,000.00		
11-Jan-19	400,000.00	1,401,236.00	0.1236%	
25-Jan-19	(300,000.00)	1,101,684.00	0.0320%	
31-Jan-19		1,101,784.00	0.0091%	
			0.1647%	1.9392%

Table 4

$$r_3 = \frac{\big(1{,}101{,}684.00 - (-300{,}000)\big) - 1{,}401{,}236.00}{1{,}401{,}236.00} = 0.0320\%$$

$$r_4 = \frac{(1{,}101{,}784.00 - 0) - 1{,}101{,}684.00}{1{,}101{,}684.00} = 0.0091\%$$

$$TWRR = [(1 + 0.1236\%) \times (1 + 0.0320\%) \times (1 + 0.0091\%)] - 1$$

$$TWRR = 0.1647\%$$

$$TWRR_{ann} = \frac{0.1647\%}{31\ days} \times 365\ days = 1.9392\%$$

Sale and Purchase as Contributions

Sale and purchase of security within a portfolio is regarded as a contribution. This can happen frequently if the portfolio is used to manage daily working capital. In the case of managed funds, it occurs when fund managers make changes in allocation and rebalance the portfolio. For large portfolios, such an exercise can take place daily.

Challenges

HIGHLIGHT

The TWRR is the required measure by the Association of Investment Management and Research. It is today, the gold standard for measuring portfolio performance.

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Evident from the computation is that the entire portfolio needs to be revalued at the end of each sub-period. And revaluing each portfolio can be computationally heavy if there are large numbers of securities and if the asset class consists of complex derivatives. Market data needs also to be archived for each security at each point in time.

Revaluing portfolio at every incidence of contribution and withdrawal is a computationally heavy exercise if there are large number of security and if the asset class consist of complex derivatives. Market data need also be archived for each all security at each point in time.

CS Lucas Time Weighted Return

The CS Lucas Solution provides a set of reports to compute the time weighted return over user definable time period with supporting schedule showing activity and net asset values at relevant points in time as illustrated in Table 4. ***Learn more.***