

How can the portfolio return be calculated?

There are numerous methods in the financial industry for calculating the performance of portfolios. Two of the best-known approaches are TWR (time-weighted return) and MWR (money-weighted return). The aim of this document is to provide a better understanding of the two performance indicators and highlight their respective advantages and disadvantages.

Time-weighted return (TWR)

TWR is a measure of the average growth rate of an investment and is expressed as a percentage. It is calculated by linking the returns from individual periods and combining them with equal weighting to produce an overall key figure.

Calculating the TWR begins by determining the daily return R_t for each day. This is done using the following formula:

$$R_t = \frac{\text{End value} - (\text{initial value} + \text{cash flow})}{\text{Initial value} + \text{cash flow}}$$

The portfolio value at the end of the day, the portfolio value at the beginning of the day and the cash flow are used to quantify the change in the portfolio due to the market. It is assumed that investments are made at the beginning of the period.

The TWR is then calculated by geometrically linking these individual daily returns – from the first return R_1 to the last return R_n for the period under consideration. The geometric link is particular, because it combines the returns in such a way that the effect of the cash flows is eliminated.

$$\text{TWR} = (1 + R_1) \times (1 + R_2) \times (\dots) \times (1 + R_n) - 1$$

The multiplication above is used to determine the cumulative return on the portfolio over the period under consideration. This eliminates the distorting effect of inpayments and outpayments.

Example

We consider a portfolio that begins with a starting value of CHF 0. Three further transactions are carried out in the course of the time horizon under consideration. In this example, the TWR is calculated as follows:

| Day | Initial value | Cash flow | End value | Daily return R_t |
|-----|---------------|------------|-----------|--------------------|
| 1 | 0 CHF | +1,000 CHF | 1,200 CHF | 0.2 |
| 2 | 1,200 CHF | -200 CHF | 750 CHF | -0.25 |
| 3 | 750 CHF | +3,000 CHF | 4,875 CHF | 0.3 |

Daily return R_1 : $(1,200 - (0 + 1,000)) / (0 + 1,000) = 0.2 = 20\%$

Daily return R_2 : $(750 - (1,200 - 200)) / (1,200 - 200) = -0.25 = -25\%$

Daily return R_3 : $(4,875 - (750 + 3,000)) / (750 + 3,000) = 0.3 = 30\%$



TWR calculation

$$\begin{aligned} \text{TWR} &= (1 + R_1) \times (1 + R_2) \times (1 + R_3) - 1 \\ \text{TWR} &= (1 + 0.2) \times (1 - 0.25) \times (1 + 0.3) - 1 \\ \text{TWR} &= 0.17 = 17\% \end{aligned}$$

The TWR for the given example is therefore 0.17 or 17.0 percent and reflects the performance over all three days.

Advantages and disadvantages

TWR is a simple calculation method and makes it possible to compare different investment strategies, as the distorting effect of all inpayments and outpayments is eliminated by linking the daily returns.

In contrast, cash flows can lead to distortions if the simple rate of return is used, as is often the case in everyday life. Only the current total value of the investment and the net investment (value of all inpayments minus outpayments) are taken into account. This method is helpful if you need a quick and easy-to-understand calculation of the return, but is less suitable for comparisons with other portfolios or benchmarks.

$$\text{Simple return} = \frac{\text{Current total value} - (\text{net investment})}{\text{net investment}}$$

In the previous example, the simple return would be calculated as follows:

$$4,875 - (4,000 - 200) / (4,000 - 200) = 0.2829 = 28.29\%$$

As a higher amount is paid in on the third day, the change on this day is weighted much more heavily in the simple return than the changes on the previous days. As a result, the negative trend on the second day is weighted only slightly. Consequently, the simple return is distorted upwards compared to the TWR. The time-weighted return (TWR), on the other hand, shows the average growth trend of the portfolio, as it neutralizes inpayments. This makes a comparison with other portfolios (in which there are different cash flows) using the TWR very suitable.

However, neutralizing inpayments and outpayments can make interpretation more difficult, as the following example illustrates:

Suppose we consider the following example with two transactions:

| Day | Initial value | Cash flow | End value | Daily return R_t |
|-----|---------------|------------|-----------|--------------------|
| 1 | 0 CHF | +1,000 CHF | 1,200 CHF | 0.20 |
| 2 | 1,200 CHF | +1,000 CHF | 1,870 CHF | -0.15 |

$$\begin{aligned} \text{TWR} &= (1 + 0.2) \times (1 - 0.15) - 1 = 0.02 = \mathbf{2\%} \\ \text{Simple return} &= (1,870 - (2,000)) / (2,000) = -0.065 = \mathbf{-6.5\%} \end{aligned}$$

A total of CHF 2,000 is invested, and CHF 1,870 remains at the end. In absolute terms, you have therefore lost CHF 130, which is expressed by the simple return of -6.5 percent. Nevertheless, the TWR is +2 percent.

In practice, the performance displayed may differ significantly from the actual performance of the portfolio in Swiss francs and may therefore not be in line with your own intuition.

Money-weighted return (MWR)

The alternative to TWR is money-weighted return (MWR). This value is used to assess the performance of investment decisions. In contrast to TWR, the amount and timing of inpayments and outpayments are included in the MWR calculation. This means that MWR can be used to assess whether investments were made at a good time or not.

Calculation

The MWR is determined by calculating the internal rate of return (IRR) for a portfolio's cash flows. We are looking for the interest rate that brings the present value of all inpayments and outpayments – i.e. the net present value (NPV) – in a portfolio to 0.

To find the MWR, the following equation must therefore be calculated:

$$\text{NPV} = 0 = \text{CF}_0 + \frac{\text{CF}_1}{(1 + \text{IRR})^1} + \frac{\text{CF}_2}{(1 + \text{IRR})^2} + (\dots) + \frac{\text{CF}_n}{(1 + \text{IRR})^n}$$

CF is the cash flow at each of the times n under consideration. CF_0 is the original investment, CF_1 is thus the cash flow on the first day, and so on. CF_n , the cash flow on the last day, is also used. The calculation is based on the portfolio amount that could theoretically be paid out.

Solving the equation requires an iterative process in which different values for the internal rate of return (IRR) are tried out until the equation is completed. The interest rate derived is then the MWR. To find the MWR, it is therefore best to use a spreadsheet programme such as Excel, which can automate the calculation and determine the IRR efficiently.

Example

The easiest way to calculate the MWR in Excel is to use the “=IRR()” function. Let’s look at the previous example again:

| Day | Reference | Amount | Excel input |
|-----|---------------|-----------|-------------|
| 0 | Initial value | 0 CHF | 0 |
| 1 | Inpayment | 1,000 CHF | 1,000 |
| 2 | Outpayment | 200 CHF | -200 |
| 3 | Inpayment | 3,000 CHF | 3000 |
| 4 | Current value | 4,875 CHF | -4,875 |
| MWR | | | 17.56%* |

* The MWR is calculated here using the Excel formula “=IRR(D2:D6)” and, in this case, shows the daily return. In contrast, the TWR calculated above shows the performance over the entire three-day period.

If you were to use the formula, it would look like this:

$$0 = 0 + \frac{1,000}{(1 + \text{IRR})^1} - \frac{200}{(1 + \text{IRR})^2} + \frac{3,000}{(1 + \text{IRR})^3} - \frac{4,875}{(1 + \text{IRR})^4}$$

Advantages and disadvantages

The MWR is an excellent way of measuring the individual performance of a portfolio, as it takes into account not only the amount but also the timing of the investments. This means the MWR reflects whether you have paid in or out at favourable times, i.e. investment decisions are taken into account.

One drawback, however, is the complicated calculation method, which makes it difficult to recalculate the reported performance. In addition, the direct dependence of the return figure on the cash flows makes it difficult to compare the performance with other portfolios or benchmarks.

Summary

Overall, it can be seen that all three key figures lead to different results when using the same example. The time-weighted return (TWR) illustrates the performance of the portfolio over its entire duration, independently of cash flows. The simple return indicates the percentage profit or loss that the invested capital has generated over the entire term. The money-weighted return (MWR), on the other hand, takes performance into account, including investment decisions. It therefore reflects whether you have paid in or out at favourable times.

The choice between TWR and MWR ultimately depends on which aspects of portfolio performance are most important to the person concerned. If the focus is on comparability with benchmarks or other portfolios, then the TWR is more suitable. However, if the focus is on an individual valuation of the investments, then the MWR is the better choice. For those who are only interested in how much profit or loss was achieved with the capital invested, the simple return is most suitable.

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