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Measuring portfolio performance

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All investors read their regular statements to see how their investment portfolios are performing. Let's take a look at investment returns. While it may seem straightforward, there are actually two primary methods of calculating returns: time-weighted return (TWR) and dollar-weighted return (DWR). By the end of 2016, client statements will be required to report returns using the DWR calculation. However, if an investor searches online or reads the newspaper, the returns for certain mutual funds are reported using the TWR calculation. The presence of the two different return results, based on two different calculations, can create confusion. This confusion can be made even worse during periods when the markets have been through wide swings, as these calculations can provide dramatically different results. In the end, understanding the purpose of each calculation and how each result is derived can go a long way.

Dollar-weighted return

Historically, the use of DWR has been associated with project planning and financing. This calculation is also known as the internal rate of return. In a business context, one would look at the anticipated cash expenditures (or outflows), and inflows generated by a project and decide if that was the best way to deploy scarce or borrowed capital. If the project was expected to generate a return that was higher than the cost of capital, it would pass this initial test and move forward for further consideration.

In the context of an investment portfolio, the DWR calculation works in a similar way and determines the rate of return that makes the present value of all cash flows and ending values equal to the initial investment. It is important to note that the timing and size of the cash flows directly affect the final rate of return.

The standard formula for the DWR calculation is as follows:

$$NPV = \sum_{t=0}^n \frac{C_t}{(1+r)^t} = 0$$

Simply put, it is the rate of return (r) that discounts the sum of all cash flows to zero.

Consider the following example:

Date	Amount invested	Amount withdrawn	Portfolio earnings	End value
1-Jan-14	\$1,000	\$0	\$0	\$1,000
30-Jun-14	\$100	\$0	\$10	\$1,110
30-Sep-14	\$0	\$50	\$110	\$1,170
31-Dec-14	\$0	\$1,150	(\$20)	\$0

Using an iterative process, r is identified as the rate that achieves a net present value of zero. In this case the equation is solved with a value of:

$$r = 9.7\%$$

This can be demonstrated as:

$$\text{Cash flow}_0 = -\$1,000$$

$$\text{CF}_1 = -\$100$$

$$\text{CF}_2 = \$50$$

$$\text{CF}_3 = \$1,150$$

$$\text{period}_0 = 0 \text{ days (or } 0/365^{\text{ths}} \text{ of one year, } 0.0)$$

$$\text{period}_1 = 180 \text{ days (or } 180/365^{\text{ths}} \text{ of one year, } 0.49)$$

$$\text{period}_2 = 272 \text{ days (or } 272/365^{\text{ths}} \text{ of one year, } 0.75)$$

$$\text{period}_3 = 364 \text{ days (or } 364/365^{\text{ths}} \text{ of one year, } 1.00)$$

$$\text{NPV} = 0 = (\text{CF}_0 / (1 + r)^{\text{per } 0}) + (\text{CF}_1 / (1 + r)^{\text{per } 1}) + (\text{CF}_2 / (1 + r)^{\text{per } 2}) + (\text{CF}_3 / (1 + r)^{\text{per } 3})$$

$$\text{NPV} = 0 = (-1000 / (1 + 0.097)^0) + (-100 / (1 + 0.097)^{0.49}) + (50 / (1 + 0.097)^{0.75}) + (1150 / (1 + 0.097)^1)$$

$$= (-1000)/1.00 + (-100)/1.05 + 50/1.07 + 1150/1.10$$

$$= (-1000) + (-95.55) + 46.68 + 1048.87$$

$$= 0$$

Performance standards

While the DWR can determine an individual's portfolio results, other calculations can be used to compare returns across different portfolio managers. According to the CFA Institute, the dollar-weighted return may add further value in understanding the impact to the client of the timing of external cash flows. However, it is less useful for comparing one firm or manager to another.¹ In 1995, the Association for Investment and Management Research (AIMR) began building support for establishing a globally accepted set of standards for performance reporting for investment managers. Prior to this time, there were generally agreed upon principals for measuring performance in most jurisdictions. However, the temptation to use what may have

¹ Global Investment Performance Standards Handbook, 3rd Edition, CFA Institute 2012

appeared to be more attractive performance results as a way to attract new investors left the direct comparison of two portfolio managers as a guessing game. In 1999, the first set of Global Investment Performance Standards (GIPS) was published by AIMR. Since then, AIMR has evolved into the CFA Institute and the GIPS standards have been voluntarily adopted by financial services companies in 34 countries. From an investor’s perspective, it is important to note that the GIPS standards are primarily based on the concept of presenting a firm’s composite performance to a prospective client rather than presenting individual portfolio returns to an existing client.²

Time-weighted return

The TWR is not influenced by the presence or absence of cash flows. Neither is it affected by the total amount invested, nor the order of the individual periodic returns. While the DWR calculation provides a single return result that is constantly evolving over time, the TWR calculation provides returns for a specific period, and remains fixed. The period returns are geometrically linked and longer period return calculations can be made. This allows the TWR to be used to make direct comparisons among various investments or portfolio managers. Another advantage to this calculation is its relative simplicity. The TWR is calculated by subtracting the beginning value of the portfolio and any net flows from the ending value, and dividing the result by the beginning value of the portfolio. Unlike the DWR calculation, no initial guess of the value of the return result is needed as the process is not an iterative one.

The standard formula for the TWR (please see Appendix 1 for other related TWR formulas) is as follows:

$$\bar{r}_{\text{geometric}} = \left(\prod_{i=1}^n (1 + r_i) \right)^{1/n} - 1$$

Or in this case, it is the geometric mean of the individual periodic rates of return (r_i).

Consider the previous example again:

Date	Amount invested	Amount withdrawn	Portfolio earnings	End value
1-Jan-14	\$1,000	\$0	\$0	\$1,000
30-Jun-14	\$100	\$0	\$10	\$1,110
30-Sep-14	\$0	\$50	\$110	\$1,170
31-Dec-14	\$0	\$1,150	(\$20)	\$0

The R_t (or total) is the geometric mean of the different individual return rates observed over the life of the portfolio.

² Global Investment Performance Standards Handbook, 3rd Edition, CFA Institute 2012

$$r_{\text{period}} = (\text{portfolio end value} - \text{portfolio start value} - \text{external cash flows}) / \text{portfolio start value}$$

$$= \text{portfolio earnings} / \text{portfolio start value}$$

$$R_t = 9.1\%$$

$$R_t = (1 + r_1) \times (1 + r_2) \times (1 + r_3)$$

$$= (1 + 10/1000) \times (1 + 110/1110) \times (1 + (-20/1170))$$

$$= (1 + 1.00\%) \times (1 + 9.9\%) \times (1 + (-1.7\%))$$

$$= (1.010) \times (1.099) \times (0.983)$$

$$= 9.1\%$$

Although there are advantages to the TWR calculation, there are also disadvantages. The TWR may not give a clear indication of how an individual's investment portfolio is actually performing. In the case of the two previous examples, the return results are similar: 9.7% DWR versus 9.1% TWR. However, a case where there is significant market volatility can produce very different results. The table below shows a portfolio where an investor deposits \$100 with a portfolio manager at the beginning of each year for three years. The final annualized TWR is 8.4%. However, the DWR is 2.4% and more closely reflects how the investor has done with their investment portfolio given the timing and size of the cash flows and the level of return volatility experienced by the portfolio.

Date	Amount invested	Amount withdrawn	Portfolio earnings	End value
1-Jan-12	\$100	\$0	\$25.00	\$125.00
1-Jan-13	\$100	\$0	\$45.00	\$270.00
1-Jan-14	\$100	\$0	(\$55.50)	\$314.50

TWR 8.4%
DWR 2.4%

TWR may be thought of as the return the first dollar invested in the portfolio would have earned if it was untouched for the life of the portfolio. Conversely, the DWR gives more weight to times when there are more dollars in the account and less weight to times when fewer dollars are invested.

Conclusions

- There are two main methods to calculate investment returns. DWR allows an investor to see how his or her personal investing history has progressed. TWR allows different investments or portfolio managers to be compared on an equal basis.
- Investors may understandably experience some confusion when examining reports that appear to show mutual fund portfolio returns that are different than returns reported by the mutual fund company.
- In some cases, differences in return figures can appear relatively small. However, significant volatility or substantial cash flows may produce widely varying results.
- The use of professional advice to gain an understanding of the basis of return calculations and why reporting may be different can help reduce investor confusion.

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Appendix 1

The information below has been obtained from the Global Investment Performance Standards Handbook, Third Edition.

Original Dietz

This method estimates when external cash flows are received into or withdrawn from a portfolio by assuming that all external cash flows occur at the mid-point of the period, thus half-weighting the net total external flow for the period when calculating the period's average capital invested (denominator):

$$r_t^{OD} = \frac{V_t^E - V_t^B - \sum_{i=1}^I CF_{i,t}}{V_t^B + \sum_{i=1}^I (CF_{i,t} \times 0.5)},$$

where

r_t^{OD} = the Original Dietz return for the portfolio for period t

V_t^E = the ending value of the portfolio for period t

V_t^B = the beginning value of the portfolio for period t

i = the number of external cash flows (1, 2, 3. . . I) in period t

$CF_{i,t}$ = the value of cash flow i in period t (*contributions to the portfolio are positive flows and withdrawals or distributions are negative flows*)

Modified Dietz

The Modified Dietz method improves upon the Original Dietz method, which assumes that all external cash flows occur during the mid-point of the period. In an attempt to determine a more accurate return, the Modified Dietz method weights each external cash flow in the denominator by the amount of time it is held in the portfolio. The formula for estimating the time-weighted rate of return using the Modified Dietz method is:

$$r_t^{MD} = \frac{V_t^E - V_t^B - \sum_{i=1}^I CF_{i,t}}{V_t^B + \sum_{i=1}^I (CF_{i,t} \times w_{i,t})},$$

where

r_t^{MD} = the Modified Dietz return for the portfolio for period t

V_t^E = the ending value of the portfolio for period t

V_t^B = the beginning value of the portfolio for period t

i = the number of external cash flows (1, 2, 3. . . I) in period t

$CF_{i,t}$ = the value of cash flow i in period t

$w_{i,t}$ = the weight of cash flow i in period t (assuming the cash flow occurred at the end of the day), as calculated according to the following formula:

$$w_{i,t} = \frac{D_t - D_{i,t}}{D_t},$$

where

$w_{i,t}$ = the weight of cash flow i in period t , assuming the cash flow occurred at the end of the day

D_t = the total number of calendar days in period t

$D_{i,t}$ = the number of calendar days from the beginning of period t to cash flow i