WHITE PAPER

Money Weighted Return and Time Weighted Return

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Introduction

Why do we measure performance? We use the information derived from performance to analyze the progress of a portfolio, evaluate the portfolio manager and provide analysis of asset allocation and the selection of securities. There is a great debate on how to best calculate a portfolio return. There are a few ways to quantify a return performance when cash flows are present. The money weighted return (MWR) and time weighted return (TWR) can be used to calculate returns.

Money Weighted Return

Money weighted return is used when you are trying to measure the performance experienced by an investor. It is a way to measure the return of a portfolio over a specified time period. The return is influenced by the time of decisions to deposit or withdraw funds from the portfolio, as well as the decisions made by the portfolio manager. MWR takes into consideration not only the amount of the cash flow but also the timing of the cash flow.
Modified Dietz is a calculation that is used to determine a return on a portfolio based upon money weighted cash flows. Modified Dietz provides a computational advantage over Internal Rate of Return (IRR). Unlike IRR, it does not require iterative trial and error to solve for the return.[1]

$$\frac{EMV - BMV - CF}{BMV + \sum_{i=1}^{n} Wi \times CF_i}$$

Modified Dietz Formula

Where:	
EMV	Ending Market Value
BMV	Beginning Market Value
CF	Cash Flow
Wi	Weight to be applied to the Cash Flow on day i
CF*i*	Cash Flow on day i

Notes:

- Account: Cash flows are end of the day. (Deposits/Withdrawals/Position Transfers)
- Symbol and Asset Level: Opening proceeds are beginning of the day. Closing proceeds are end of day.

1 Peter Dietz. Pension Funds: Measuring Investment Performance. 1966.

Example of Modified Dietz

Date	Market Value	Cash Flow	Days in Period	Weight	Weighted Cash Flow
10/1/2011	4,549,863.44	-	1.00	1.00	0.00
10/4/2011		(225,000.00)	4.00	0.87	(195,967.74)
10/7/2011		81,500.00	7.00	0.77	63096.77
10/12/2011		(75,000.00)	12.00	0.61	(45,967.74)
10/14/2011		125,000.00	14.00	0.55	68,548.39
10/20/2011		7,500.00	20.00	0.35	2,661.29
10/31/2011	4,256,598.99	-	31.00	0.00	0.00
Total		**(86,000.00)**			**(107,629.03)**

[(4,256,598.99) – (4,549,863.44) – (-86,000.00)] / [(4,549,863.44) + (–107,629.03)] = –207,264.45 / 4,442,234.41 = –4.67%

For the month of October, the MWR was –4.67%.

Time Weighted Return

Time weighted return provides a way to calculate the performance solely attributed to the portfolio manager's actions. TWR eliminates the impact of the timing of cash flows and leaves only the effects of the market and the portfolio manager's actions.
To calculate TWR, the performance period is broken into sub-periods. The returns of the sub-periods are calculated and then geometrically linked to derive the TWR for the performance period.

Time Weighted Formula

$$RN = \frac{EMV}{BMV+CF} - 1 \qquad TWR = [(1+RN) \times (1+RN) \times \ldots - 1] \times 100$$

Where:	
EMV	Ending Market Value
BMV	Beginning Market Value
CF	Cash Flow
RN	Sub Period Return

Notes:

- Account: Cash flows are end of the day. (Deposits/Withdrawals/Position Transfers)
- Symbol and Asset Level: Opening proceeds are beginning of the day. Closing proceeds are end of day.

Example of Time Weighted Return

Sub Period Return

Date	Beginning Market Value	Ending Market Value	Cash Flow	Sub Period Return
10/3/2011	4,549,863.44	4,629,129.14	-	1.74%
10/4/2011	4,629,129.14	4,197,829.64	(225,000.00)	-4.68%
10/5/2011	4,197,829.64	4,278,627.55		1.92%
10/6/2011	4,278,627.55	4,249,124.71		-0.69%
10/7/2011	4,249,124.71	4,417,916.19	81,500.00	2.02%

To compute the total return over a time period, we do not simply add the sub period returns. Instead, we use the following geometrically linking calculation to arrive at the total return:

Geometrically Link
$[(1 + 1.74\%) \times (1 + -4.68\%) \times (1 + 1.92\%) \times (1 + -0.69\%) \times (1 + 2.02\%) - 1] \times 100$
The TWR for the period of 10/3 to 10/7 was 0.14%.

The return for multiple components (i.e. sectors or accounts) over a time period is calculated as follows: Add market values and cash flows across all components for each day, calculate a daily combined return, and then geometrically link the daily returns to get the combined return for the time period. Note that the sum of the component returns over the time period does not equal the combined return over the time period.

Conclusion

As stated earlier, the MWR performance measure factors in deposits and withdrawals. This method places a greater weight on the performance in periods in which the portfolio is the largest. For example, suppose the portfolio manager performs well when the portfolio is minuscule. In all likelihood, the portfolio owner will want to deposit additional funds. After the deposit is received, the market falls out of favor with the portfolio. Unfortunately, the return will be greatly impacted by the deposit. TWR is the preferred method of calculating returns by industry standards. A chief advantage of using TWR is that it enables the portfolio owner to determine the rate of return independent of when funds are added and or removed from the portfolio. Typically, portfolio managers have very little control on when they will receive funds or when they will be withdrawn by the portfolio owner.

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