



UNIVERSITY OF CALGARY
HASKAYNE SCHOOL OF BUSINESS

Investments & Portfolio Management

Portfolio Performance Evaluation

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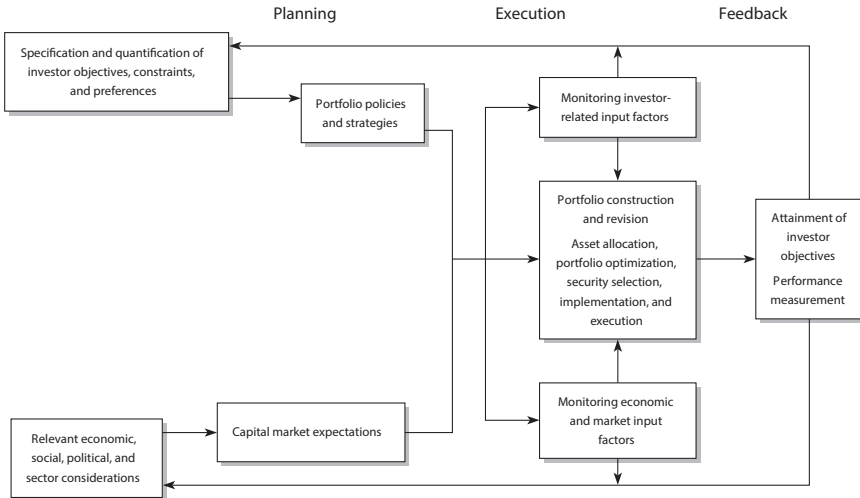
Performance evaluation qualifies and quantifies the outcomes of portfolio management.

- Assess the quality of the investment approach and identify changes to improve it.
- Communicate the assessment of outcomes to investor(s).
- Can be used to compensate portfolio managers (e.g. 2/20 of hedge funds).

Performance evaluation process

- Performance measurement (i.e. 'what was the portfolio's performance?')
 - ▶ Calculation of absolute returns for the portfolio and its benchmark, and the excess return of the portfolio over its benchmark; then consider/adjust for risk (if risk borne is different).
- Performance attribution (i.e. 'how was the performance achieved and the risk incurred?')
 - ▶ Decompose excess return and risk into component sources, to help explain why the portfolio manager over or underperformed the benchmark.
- Performance appraisal (i.e. 'was the performance achieved through manager skill or luck?')
 - ▶ Assess if the performance was mostly the outcome of portfolio decisions or mostly due to market changes outside of the portfolio manager's control.

A modern investment management process (per the CFA Institute) 3/14



In reality, portfolio management goes from the relatively simple (e.g. duplicate an index using passive management) to the extraordinarily complex (e.g. quantitative portfolio management à la Renaissance Technologies), and this across many asset classes and geographies. Furthermore, the data is quite noisy, the asset pricing models somewhat unreliable, and, most importantly, the people being evaluated are unusually well trained and sophisticated. All that makes the evaluation of portfolio performance quite challenging and the subject of a lot of debates and controversies.

The CFA Institute offers the Certificate in Investment Performance Measurement (CIPM) which focuses on portfolio performance evaluation (18 months, 310 hours of study time, and two exams). It is an indication that significant know-how is required to provide a credible evaluation of performance.

Some services providers offer to carry out portfolio performance evaluation (e.g. State Street) while others provide comprehensive suites of tools to support it (e.g. Bloomberg). If you delegate portfolio management to a third party, you can have its performance evaluation done by another third party.

Of note, following innovative academic research, it has been found that many active managers were in fact 'Closet Indexers' (see CNBC article and video here and Globe and Mail article here).

For a single period-holding period return (HPR) there is no need to do an average (but there might be a need to annualize the return).

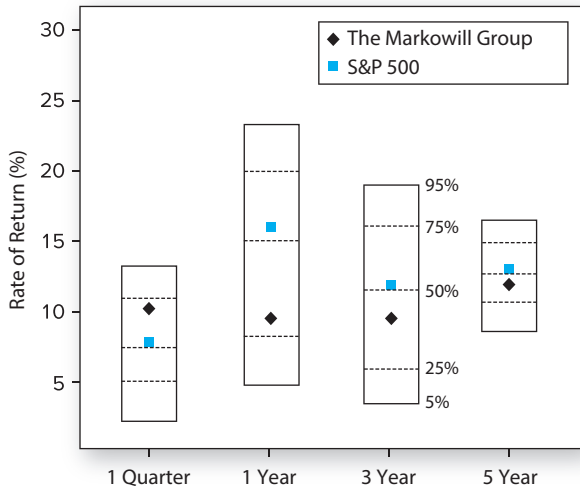
For a multi-period return, compounding is required and a geometric mean, called a time-weighted return, is preferable to an arithmetic mean.

However, all kind of transactions take place within a portfolio, like dividends received and reinvested, securities sold or bought, deposits and withdrawals by investors, etc. The timing and magnitude of these cash flows are often not trivial and, while doable, are not addressed well by the time-weighted approach. Using the timing and amount of each cash flow, it is possible to find the discount rate, called the dollar-weighted return, that would present value them to the initial investment (basically finding the internal rate of return 'IRR', use Excel function XIRR).

Time-weighted Returns versus Dollar-weighted Returns: an example 6/14

Time	Event	Cash flow	Discount	PV
01-01-2018	Purchase first share at 50	-50	1	-50.000
01-01-2019	Purchase second share at 53	-53	0.9336	-49.479
01-01-2019	Receive dividend of 2 per share	2	0.9336	1.867
01-01-2020	Receive dividends of 2 per share	4	0.8715	3.486
01-01-2020	Market value of shares at 54	108	0.8715	94.125
Dollar-weighted return		7.12%	NPV	0.000
Time-weighted T01		10.00%		
Time-weighted T12		5.66%		
Time-weighted T02		7.81%		

The dollar-weighted average is less than the time-weighted average in this example because more money is invested in year two, when the return was lower.



The return performance of 'The Markowill Group' has been consistently lower than its benchmark, the S&P 500, as well as lower than the the median of its peer group for the last five, three and one-year periods.

While its performance over the last quarter has been better, performance over short periods of time are more likely to be influenced by unusual events.

Except for the last quarter, the trend in performance over the last five years has been negative as the under performance has increased during the period.

Performance Measure	Definition	Application
Sharpe ratio	$\frac{\text{Excess return}}{\text{Standard deviation}}$	When choosing among portfolios competing for the overall risky portfolio
Treynor measure	$\frac{\text{Excess return}}{\text{Beta}}$	When ranking many portfolios that will be mixed to form the overall risky portfolio
Information ratio	$\frac{\text{Alpha}}{\text{Residual standard deviation}}$	When evaluating a portfolio to be mixed with the benchmark portfolio

The Sharpe ratio measures reward to total volatility trade-off (portfolio returns minus risk-free rate).

The Treynor measure is like the Sharpe ratio but uses systematic risk instead of total risk.

- Assume and is appropriate for ranking when investing in many portfolios at once.

The Information ratio measures abnormal return (Jensen's alpha) per unit of unsystematic risk.

- The risk-reward of the deviation from the benchmark portfolio.

Jensen's alpha is the average return on the portfolio over and above that predicted by CAPM (or by another asset pricing model, often the four-factor model). Alpha underpins the three other metrics because outperforming the passive market index requires the portfolio to generate a positive alpha.

$$\alpha_p = \bar{r}_p - [\bar{r}_f + \beta_p (\bar{r}_M - \bar{r}_f)] \rightarrow \bar{r}_p - \bar{r}_f = \alpha_p + \beta_p (\bar{r}_M - \bar{r}_f)$$

	Treynor (T_p)	Sharpe (S_p)	Information Ratio
Relation to alpha	$\frac{E(r_p) - r_f}{\beta_p} = \frac{\alpha_p}{\beta_p} + T_M$	$\frac{E(r_p) - r_f}{\sigma_p} = \frac{\alpha_p}{\sigma_p} + \rho S_M$	$\frac{\alpha_p}{\sigma(e_p)}$
Improvement compared to market index	$T_p - T_M = \frac{\alpha_p}{\beta_p}$	$S_p - S_M = \frac{\alpha_p}{\sigma_p} - (1 - \rho)S_M$	$\frac{\alpha_p}{\sigma(e_p)}$

	Portfolio P	Portfolio Q	Market Index
Average return	2.77%	7.56%	1.64%
Std. Dev. of returns	6.45%	15.55%	8.84%
Sharpe ratio	0.43	0.49	0.19
Alpha	1.63%	5.26%	0.00%
Beta	0.70	1.40	1.00
Treynor measure	3.96	5.40	1.64
Std. Dev. of residuals	2.02%	9.81%	0.00
Information ratio	0.81	0.54	n/a

Both portfolios P and Q have outperformed the market index, since having higher Sharpe ratios than the market index and positive alphas. If the investor must choose between P and Q as sole risky investment, then Q is better given its higher Sharpe ratio. Q outrank P as sub-portfolio since its Treynor measure is higher. As an add-on to a market index position, P should be chosen given its higher Information ratio. It illustrates that performance depends on the investor's investment plan.

How long it takes for an alpha to be found statistically significant? 11/14

	Portfolio	Market Index
Alpha (per month)	0.20%	0.00%
Beta	1.20	1.00
Std. Dev. of residuals	2.00%	0.00
Std. Dev. of returns		6.50%

$$\rho_{pM} = \left[\frac{\beta^2 \sigma_M^2}{\beta^2 \sigma_M^2 \sigma^2(e)} \right]^{\frac{1}{2}} = \left[\frac{1.2^2 \times 6.5^2}{1.2^2 \times 6.5^2 + 2^2} \right]^{\frac{1}{2}} = 0.97$$

$$t(\hat{a}) = \frac{\hat{a}\sqrt{N}}{\hat{\sigma}(e)} \rightarrow 1.96 = \frac{0.2\sqrt{N}}{2} \rightarrow N = 384 \text{ months (32 years)}$$

Even for a reasonably well diversified portfolio (i.e. $\rho=0.97$), and a reasonably large alpha (2.4% a year), it would take a minimum of 384 months of data to be able to conclude that the alpha is statistically significant (i.e. different from zero) at the 5% level (i.e. a t-value of a minimum of 1.96). That statistical challenge makes it very difficult to conclude that superior performance exists since it is nearly impossible to 'statistically conclude' between skill and luck in favor of skill.

Learning Objectives covered

- L01 only

Concept checks

- Concept checks 1 to 3 (solutions provided at the end of the chapter).

Exercises

- Suggest solving 24-6 and 24-8.

Time	Event	Nb. Shares	Share price	Dividend	Cash flow	Discount	PV	Return
01-01-2016	Purchase three shares	3	100	4	-300	1.00000	-300.000	
01-01-2017	Purchase two shares	5	120	4	-228	1.00161	-228.368	24.00%
01-01-2018	Sell one share	4	90	4	110	1.00323	110.355	-21.67%
01-01-2019	Sell four shares	0	100	4	416	1.00484	418.013	15.56%
Dollar-weighted return:					-0.16%	NPV	0.000	
Return arithmetic mean T03:								5.96%
Return geometric mean T03:								3.92%

	Portoflio A	Portoflio B	S&P500	T-bill
Exp. Return	12%	16%	13%	5%
Std. Deviation	12%	31%	18%	
Beta	0.7	1.4	1.0	
CAPM return	11%	16%		
Alpha	1.40%	-0.20%		
Sharpe ratio	0.58	0.35		

a) long position in A and short B (given respective expected alphas)

b) select portoflio A (highest Sharpe ratio)