Module 24: Portfolio Performance Evaluation

Module 24.1: Performance Evaluation

24.a: components of performance evaluations

3 interrelated components:

(1) Performance measurement: initial foundation phase, calculate risk & return

(2) Performance attribution: determines the key driver that generated the perf

(3) Performance appraisal: determines whether the performance is affected primarily by investment decisions, overall market or chance

24.b: Attributes of effective attribution process

effective attribution process includes:

- A reflection of 100% of the portfolio return / risk exposure
- PM's current decision-making process
- Active investment decisions
- Full explanation of excess risk & return

24.c: Contrast Return attribution & Risk Attribution, Contrast macro & micro return attribution

Return attribution: evaluate the impact of the active portfolio management decisions on fund investment returns

Risk attribution: evaluate the impact of the active portfolio management decisions on fund investment risks

Micro attribution: analyzes the portfolio @ the PM level. verify that PM did what they said they would & understand return drivers.

Macro attribution: analyzes the portfolio @ the fund sponsor level. quantifies the decision to deviate away from the strategic asset allocation & the timing

24.d. Return-based, Holding-based, Transaction-based

Returns-based: Regresses total port. return against major risk factors.

Holdings-based: assess active sector/stock selection bets from beginning-of-period holdings

Transaction-based:

/ /

Method	Advantages	Disadvantages
Returns-based	• Easy to implement • Does not require holding data	• Least Accurate b/c doesn't consider underlying holdings • Returns data can be manipulated
Holdings-based	• More Accurate than Returns-based b/c considers underlying holdings	• Needs data on fund holdings • mismatch due to trading effect (not appropriate for high T/O active funds)
Transaction-based	• Most Accurate	• Highest data req. • Highest Complexity

MODULE QUIZ 24.1

1. Which component of performance evaluation attempts to determine whether performance was affected primarily by chance?
   A. Performance appraisal.
   B. Performance attribution.
   C. Performance measurement.
2. Which method of performance attribution is the *most* reliable?
   A. Returns-based.
   B. Holdings-based.
   C. Transactions-based.

1. A
2. C

Module 24.2: Approaches to Return Attribution

24.e: Interpret the sources of portfolio returns

Arithmetic Attribution & Geometric Attribution.

	Period 1	Period 2
Port. Return (R)	5%	5%
BM Return (B)	3%	3%

Arithmetic Attribution = Active Return (R - B)

problem ⇒ single-period Arithmetic Active Return do not compound to equal active returns over multiple periods.

e.g. Arithematic return $= R - B$

$= (1+5\%)^2 - (1+3\%)^2$

$= 1.1029 - 1.0609$

$= 0.0416$

$(! = [(1+5\%) - (1+3\%)]^2)$

$(= 4.04\%)$

Geometric attribution (G):

$$G = \frac{1+R}{1+B} - 1$$

1-period: $(1+5\%) \doteq (1+3\%) - 1 = 1.94\%$

2-period: $(1+1.94\%)^2 - 1 = 3.92\%$

$$\frac{(1+5\%) \times (1+5\%)}{(1+3\%) \times (1+3\%)} - 1$$

Equity Return Attribution – the Brinson Model

24.h: interpret & identify investment results attributable to asset owner vs. investment managers.

Brinson Model – 2 different but very similar performance attribution methods: Brinson – Hood – Beebower method & Brinson – Fachler method

Brinson – Hood – Beebower method (BHB)

portfolio return:

$$R = \sum w_i R_i$$

BM return:

$$B = \sum W_i B_i$$

Active Return = $R - B$

BHB breaks down active return into 3 components:

① Allocation effect (value added/subtracted thru the decision to overweight/underweight a segment)

$$A_i = (w_i - W_i) \times B_i$$

② Selection effect (value added/subtracted thru selecting investments in the portfolio vs. BM):

$$S_i = W_i \times (R_i - B_i)$$

③ Interaction effect (the impact on active return of Allocation effect & Selection effect acting together)

$$I_i = (w_i - W_i) \times (R_i - B_i)$$

Figure 24.2: BHB Model Example

Style	Fund Weight	Fund Return	Benchmark Weight	Benchmark Return
Growth Equity Style	75%	13%	60%	10%
Value Equity Style	25%	19%	40%	20%
Total	100%	14.5%	100%	14.0%

Allocation effect: $(75\% - 60\%) \times 10\% + (25\% - 40\%) \cdot 20\%$

$= -1.5\%$

Selection effect: $60\% \cdot (13\% - 10\%) + 40\% \cdot (19\% - 20\%)$.

$= 1.8\% - 0.4\%$

$= 1.4\%$.

Interaction effect $= (75\% - 60\%) \cdot (13\% - 10\%) + (25\% - 40\%) \cdot (19\% - 20\%)$

$= 15\% \cdot 3\% + -15\% \cdot -1\%$

$= .45\% + .15\%$

$= .60\%$

Brinson - Fachler Model

address BHB drawback: allocation effect for segment i under BHB is problematic b/c the sign of resulting alloc effect does not automatically indicate whether to overweight / underweight a segment was correct.

FH Allocation Effect:

$$A_i = (w_i - W_i) \times (B_i - \underline{B})$$

Macro vs. Micro Attribution

BHB & BF model attributions are macro. (i.e look at value added via decisions made by the sponsor to overweight/underweight diff styles of managers vs. the BM & the value added by the sponsor's ability to select good managers in these styles)

For example, an expansion of the previous example might show that the managers made active bets on size (small-cap vs. large-cap stocks) as follows:

Figure 24.3: Micro Attribution Example

Style	Fund Weight	Fund Return	Benchmark Weight	Benchmark Return
Growth Equity Style	75%	13%	60%	10%
Large-cap growth equities	50%	15%	30%	8%
Small-cap growth equities	25%	9%	30%	12%
Value Equity Style	25%	19%	40%	20%
Large-cap value equities	25%	19%	40%	20%
Total	**100%**	**14.50%**	**100%**	**14.00%**

Using BF alloc effect $(A_i = (w_i - W_i) \times (B_i - B))$:

large-cap growth alloc effect: $(0.50 - 0.30) \times (8\% - 14\%)$

$= -1.20\%$

small-cap growth alloc effect: $(0.25 - 0.30) \times (12\% - 14\%)$

$= 0.10\%$

Total growth alloc effect: $-1.20\% + 0.10\%$

$= -1.10\%$

⇒ Growth manager allocated poorly by overweighting large-cap & underweighting small-cap.

Equity Return Attribution – Factor-based Return Attribution

Carhart Model:

$$R_p - R_f = a_p + b_{p1} RMRF + b_{p2} SMB + b_{p3} HML + b_{p4} WML + E_p$$

- R_p = port return
- R_f = risk-free rate
- a_p = alpha / return above expected return
- b_p = factor sensitivities
- RMRF = return on a value-weighted equity index above that of the one-month T-bill rate.
- SMB = Small minus big, size / mkt cap factor
- HML = High minus low, value factor
- WML = Winners minus loser, momentum factor
- E_p = error

not responsible for calculation but for interpretation

24.f: FI Return Attribution

3 common methods of FI Return Attribution:

1. Exposure decomposition – duration based
2. YC decomposition – duration based
3. YC decomposition – full-repricing based

Major active bets FI managers would take to generate income:

- Duration
- Curve shape
- Sector selection (e.g. corp bond vs. gov. bond)
- Bond selection

Exposure decomposition - duration based

partitions both portfolio & BM by weight into duration "buckets". (e.g. short/mid/long). For each duration bucket, the portfolio & BM are also partitioned by weight into sectors

Figure 24.6: Fixed-Income Exposure Decomposition Analysis

Bucket	Duration
Short	2 or less
Medium	Greater than 2 up to and including 8

Figure 24.7: Exposure Decomposition Example

	Portfolio Weights			Portfolio Duration			Portfolio Contribution to Duration		
	Short	Medium	Total	Short	Medium	Total	Short	Medium	Total
Corporate	20%	45%	65%	1.20	7.30	5.42	0.24	3.29	3.53
Government	20%	15%	35%	1.40	6.90	3.76	0.28	1.04	1.32
Total	40%	60%	100%	1.30	7.20	4.84	0.52	4.32	4.84

	Benchmark Weights			Benchmark Duration			Benchmark Contribution to Duration		
	Short	Medium	Total	Short	Medium	Total	Short	Medium	Total
Corporate	25%	20%	45%	1.20	7.30	3.91	0.30	1.46	1.76
Government	31%	24%	55%	1.40	6.90	3.80	0.43	1.66	2.09
Total	56%	44%	100%	1.31	7.08	3.85	0.73	3.12	3.85

	Portfolio Weights			Portfolio Return			Portfolio Contribution to Return		
	Short	Medium	Total	Short	Medium	Total	Short	Medium	Total
Corporate	20%	45%	65%	2.10%	2.18%	2.16%	0.42%	0.98%	1.40%
Government	20%	15%	35%	3.00%	2.76%	2.90%	0.60%	0.41%	1.01%
Total	40%	60%	100%	2.55%	2.33%	2.42%	1.02%	1.40%	2.42%

	Benchmark Weights			Benchmark Return			Benchmark Contribution to Return		
	Short	Medium	Total	Short	Medium	Total	Short	Medium	Total
Corporate	25%	20%	45%	2.10%	2.18%	2.14%	0.53%	0.44%	0.96%
Government	31%	24%	55%	3.00%	2.76%	2.90%	0.93%	0.66%	1.60%
Total	56%	44%	100%	2.60%	2.50%	2.56%	1.46%	1.10%	2.56%

Note: Figures are rounded for presentation.

Key points:

- active return = 2.42% - 2.56% = -0.14%.
- overall port. duration = 4.84, BM duration = 3.85. port. would outperform if YC. experienced parallel shift down. Higher duration achieved thru overweighting med. duration bucket.
- Overweight Corp. bond (65%) vs. BM. (45%)

Figure 24.8: Hypothetical Decomposition—Attribution Results

Duration Bucket	Duration Effect	Curve Effect	Total Interest Rate Allocation	Sector Allocation	Bond Selection	Total
Short	–0.15%	–0.16%	–0.31%	0.05%	0.00%	–0.26%
Medium	0.48%	–0.23%	0.25%	–0.13%	0.00%	0.12%
Total	0.33%	–0.39%	–0.06%	–0.08%	0.00%	–0.14%

duration-based Exposure decomposition allows simple presentation of the output of the attribution w/ relatively low data requirements.

YC decomposition - duration based

Recall 6. components of FI income:

- cpn
- roll
- shift

- curve shape
- Spread
- residual

duration based YC decomposition decomposes the active return of a portfolio manager to those sources.

This requires more data & more operational complexity when calculating. (so tend to be used by analysts & portfolio managers than for marketing or client comms).

YC decomposition - full-repricing

The approach breaks down the active return of the manager using individual spot rates for CF occuring @ diff maturities.

24.g. Risk Attribution.

Inv. Process	Relative	Absolute.
Bottom-up.	Security's marginal contribution to tracking error	Security's marginal contribution to total risk.
Top-down	Attribute tracking error to relative allocation & selection	
Factor based	Factor's marginal contribution to tracking error & active specific risk.	Factor's marginal contribution to total risk & specific risk

MODULE QUIZ 24.2

1. The following is an extract from a micro attribution analysis of one of the investment managers of the Hiatus fund:

Economic Sectors	Portfolio Weight (%)	Sector Benchmark Weight (%)	Portfolio Return (%)	Sector Benchmark Return (%)
Energy	8.38	7.72	3.55	3.32
Financial	15.48	13.42	1.66	1.10
Technology	17.89	22.01	3.21	3.18

*The overall benchmark return was 2.32%.

Using the previous table, **calculate** and **evaluate**:

(i) The allocation effect for the energy sector using the Brinson-Fachler model.

(ii) The selection effect for the financial sector.

(iii) The interaction effect for the technology sector.

i) $A_i = (W_i - W_B) \times (B_i - B)$

$A_E = (8.38\% - 7.72\%) \times (3.32\% - 2.32\%)$

$= 0.0066\%$ /

ii) $S_i = W_i \times (P_i - B_i)$ $13.42\% \times (1.66\% - 1.10\%)$

$S_F = 15.48\% \times (1.66\% - 1.10\%)$ x $= 0.0752\%$

$= 8.67$ bps

iii) $I_i = (W_i - W_B) \times (r_i - r_B)$

$= (0.1789 - 0.2201) \times (3.21\% - 3.18\%)$

$= -0.0012\%$ /

Use the following information for Questions 2 through 4.

Patty McDaniel and Peggy Peterson are consultants to Sigma Advisors. Sigma manages funds for wealthy individuals and small institutions. McDaniel and Peterson have been asked by Sigma to develop a plan to evaluate investment manager performance.

As part of McDaniel's and Peterson's task, Sigma asks them to perform micro performance attribution on one of its managers, Frank Matson. Matson invests primarily in large-cap value stocks. Matson's performance relative to the appropriate benchmark is shown in the following table.

	Portfolio Sector Weight	Benchmark Sector Weight	Portfolio Sector Return	Benchmark Sector Return
Agricultural	4.00%	6.00%	−2.00%	−1.00%
Capital goods	8.00%	9.00%	−4.00%	−5.00%
Consumer durables	32.00%	35.00%	2.00%	3.00%
Energy	6.00%	6.00%	8.00%	2.00%
Financial	20.00%	18.00%	6.40%	4.00%
Technology	16.00%	16.00%	2.60%	−2.00%
Utilities	12.00%	10.00%	4.00%	−2.00%
Cash	2.00%	0.00%	0.20%	
Total	100.00%	100.00%		
Portfolio plus cash return			2.90%	0.86%

2. From the data in the table, does Matson demonstrate an ability to wisely allocate funds to the capital goods and/or financial sectors?
   A. Yes, but only in the capital goods sector.
   B. Yes, but only in the financial sector.
   C. Yes, in both capital goods and financial sectors.
3. Does Matson demonstrate an ability to select stocks in the consumer durables and/or technology sectors?
   A. Yes, in both technology and consumer durables sectors.
   B. Yes, but only in the technology sector.
   C. No, he does not demonstrate the ability to select stocks in either sector.
4. Does Matson demonstrate an ability to generate a positive return from interaction effect in the agricultural and/or utilities sectors?
   A. Yes, but only in the agricultural sector.
   B. Yes, in both agricultural and utilities sectors.
   C. Yes, but only in the utilities sector.

2. $A_C = (8\% - 9\%) \times (-5\% - 0.86\%) = (+)$
   $A_F = (20\% - 18\%) \times (4\% - 0.86\%) = (+)$
   } good
   (C) ✓
3. B ✓
4. B ✓

Module 24.3 : BM-ing Investments & Managers.

24.i : Use of liability-based BMs.

liability-based BMs focus on the CFs necessary to satisfy the liability & frequency limits the inv't choices available to the portfolio manager (e.g. defined benefit plan requires CFs to fund future liabilities)

24.j: Types of asset-based BMs.

7 primary types of BMs:

1. Absolute (e.g. Min. Acceptable Return (MAR) used to calculate sortino ratio)
   Advantage: simple & straightforward
   Disadvantage: not investable.

2. Broad Market indexes (e.g. S&P 500).
   Advantage: well recognized, unambiguous, appropriate if reflective of manager's style.
   Disadvantage: manager's style may deviate

3. Style indexes
   Advantage: Widely available, widely understood & acceptable, appropriate if reflective of manager's style.
   Disadvantage: definition of investment style may differ, may overweight/underweight sectors.

4. Factor-model-based

$$R_p = a_p + b_1 F_1 + b_2 F_2 + \ldots + b_K F_K + \varepsilon$$

   Advantage: useful in performance eval, provides insight into account's factor exposure.
   Disadvantage: may be ambiguous, not intuitive, may be expensive to model

5. Returns-based
(using managed account returns over specific period & corresponding returns on several style indexes for the same periods). Those return series are submitted to an allocation algo that solves for the combo of investment-style
Advantage: generally easy to use & intuitive, meets the criteria of a valid BM, useful where the only info available is a/c return
Disadvantage: style indexes may not reflect what the manager

6. Manager universe.
7. Custom security-based

24.k: BM Quality Evaluation

A valid BM should possess the following qualities:

1. specified in advance
2. appropriate
3. measurable
4. unambiguous
5. Reflective
6. Accountable
7. Investable

$$P = M + S + A$$

P = investment manager's portfolio return
M = return on the market index
S = B - M (i.e. excess return to style)
A = P - B (i.e. active return)

EXAMPLE: Test of Benchmark Quality

A large-cap growth portfolio fell 11% in the first six months of the year. In the same period, a relevant large-cap growth index fell by 12% and the broad domestic equity index fell by 10%.

A client has expressed concern about the active return of the manager during the period, stating that they would have expected a skillful growth manager to outperform the broad market during the period.

Evaluate the validity of the concern of the client.

concern is not valid, b/c the manager has performed well for a growth-style manager, even though underperforming the broad market during the period.

The incremental return to the large-cap growth style, S, for the period is equal to the return of the large-cap growth index (B) minus the return of the broad market index (M) = -12% - (-10%)
= -2%

This indicates that growth style has been out of favor during the period & has underperformed the general market.

The return due to active management, A, is the return of the portfolio (P) minus the growth index return (B) = -11% - (-12%) = +1%. The indicates that the manager hes outperformed the style-specific benchmark & therefore has positive returns. to active management. That implies that the client's comment regarding active return is not valid

24.m: BMing Alt. Inv.

Hedge Funds:

- 3 general types of BM:
  - broad market indexes
  - risk-free rate
  - hedge fund peer universes.

Real Estate:

Private Equity:

Commodities:

/ /

Managed Derivatives:

Distressed Securities: impossible to determine BM due to iliquidity & severe lack of marketability. Market indexes do exist but suitability is questionable.

24.l: Impact of BM misspecification on attribution & appraisal analysis.

MODULE QUIZ 24.3

1. Rhombus Asset Management (Rhombus) runs a U.S. small-cap equity portfolio. The portfolio generated an 8.9% return during 2005. Rhombus uses the Russell 2000® Index as the most appropriate benchmark. The Russell 2000® Index yielded 9.1% over the same evaluation period. The Wilshire 5000, a broad U.S. equity market index, yielded 8.5% over the same evaluation period.
   Calculate Rhombus's return due to style and due to active management. **Assess** Rhombus's performance compared to the benchmark and to the market.

2. Hexagon PLC is an investment management company based in London. It manages portfolios consisting of European equities only. It states that its benchmark is to beat the median manager. **Discuss** the validity of the median manager benchmark approach.

Module 24.4: Performance Appraisal

24.n,o: Calculate & interpret diff. ratios & limitations of appraisal measures.

Sharpe Ratio

$$S_A = \frac{\bar{R}_A - \bar{r}_f}{\hat{\sigma}_A}$$

Treynor Ratio

$$S_A = \frac{\bar{R}_A - \bar{r}_f}{\hat{\beta}_A}$$

Information Ratio

$$IR = \frac{E(r_p) - E(r_B)}{\sigma(r_p - r_B)}$$

"alpha" / tracking error

Appraisal Ratio

$$AR = \frac{\alpha}{\sigma_\varepsilon}$$

recall CAPM: $E(R_i) = R_f + \beta[E(R_M) - R_f]$

$$\sigma_i^2 = \beta^2 \sigma_m^2 + \sigma_\varepsilon^2$$

rearranged, $\sigma_\varepsilon^2 = \sigma_i^2 - \beta^2 \sigma_m^2$

EXAMPLE: Appraisal ratio

Annualized data relating to the performance of an investment manager is presented in the following:

Portfolio return	8%
Portfolio standard deviation	20%
Portfolio beta	1.2
Market index return	6%
Market standard deviation	16%
Risk-free rate	1%

Calculate the appraisal ratio of the manager.

$$E(R) = R_f + \beta_i [E(R_m) - R_f]$$
$$= 1\% + 1.26 (6\% - 1\%)$$
$$= 7\%.$$

$$\text{alpha} = 8\% - 7\% = 1\%$$

$$\sigma_\varepsilon^2 = \sigma_i^2 - \beta^2 \sigma_m^2$$
$$= 0.20 - (1.2^2 \times 0.16^2) = 0.003136.$$

$$AR = 0.01 \div \sqrt{0.003136} = 0.18$$

Sortino Ratio

$$SR_D = \frac{E(r_p) - r_T}{\sigma_D}$$

$$\hat{SR}_D = \frac{\bar{r}_p - \bar{r}_T}{\hat{\sigma}_D}$$

Capture Ratios.

Drawdown

24.p : Skill of an investment manager

Example of Attribution Analysis

Manager X has a benchmark of the Euronext 100. The following summary information states that Manager X underperformed the benchmark by 67 bps. The question is whether the underperformance is due to lack of skill or bad luck.

	Manager X		Euronext 100		Attribution Effects		
Market	Weight	Annualized Return	Weight	Annualized Return	Allocation	Selection + Interaction	Total
France	60%	10.14%	63%	11.49%	–0.04%	–0.81%	–0.85%
Netherlands	15%	8.78%	19%	7.65%	0.09%	0.17%	0.26%
Belgium	15%	9.12%	11%	8.12%	–0.07%	0.15%	0.08%
Portugal	6%	4.35%	5%	4.99%	–0.05%	–0.04%	–0.09%
Luxembourg	4%	7.14%	2%	7.92%	–0.04%	–0.03%	–0.07%
Total	**100%**	**9.32%**	**100%**	**9.99%**	**–0.12%**	**–0.56%**	**–0.67%**

Example of Appraisal Analysis

In this section, performance appraisal measures for the same period will be analyzed for Managers X, Y, and Z. All managers will be compared to the same benchmark; return and standard deviation percentages are all expressed on an annualized basis.

Appraisal Measure	Manager X	Manager Y	Manager Z	Benchmark
Return	9.32%	11.42%	8.12%	9.99%
Standard deviation	11.65%	13.76%	10.11%	11.98%
Sharpe ratio	0.63	0.68	0.61	0.67
Treynor ratio	0.07	0.08	0.06	0.08
Information ratio	(0.22)	0.41	(0.72)	–
Sortino ratio (MAR = 4%)	0.75	0.78	0.63	0.87

MODULE QUIZ 24.4

1. One of your portfolio managers, Mort Van Sleet, has recently complained that by measuring risk-adjusted returns using the Sharpe ratio, he is placed at an unfair disadvantage. He has stated flatly that the standard deviation of his portfolio returns is artificially inflated. **Explain** how this can be true, and **offer** and **explain** a potential solution to the problem.

2. During an up market, assume a manager earns 4% and the benchmark earns 3%. Then, in a down market, the same manager earns −4% and the benchmark earns −8%. Which of the following amounts is *closest* to the manager's capture ratio?
   A. 0.25.
   B. 0.38.
   C. 2.67.