Introduction

- Introduction to portfolio management
- Portfolio management: passive strategies
- Tracking error and index portfolio construction
- Portfolio management: active strategies
- Investing styles
- Value vs. growth investing

Portfolio Management Strategies

Portfolio Management Strategies

Portfolio management strategies can be placed into either a passive or active category

- The passive category portfolios aim to replicate some index (e.g., Nifty)
- Since not much effort is put in terms of time and resources in the acquisition of information, these strategies involve very less management fees
- In contrast, active portfolio management involves continuous accumulation of information to achieve higher risk-adjusted returns as compared to the market or some other benchmark
- Given this effort of management, management charges excess fees

Portfolio Management Strategies – Passive Strategy

The total returns from the passive strategy are decomposed into two components: risk-free return + risk premium

- Passive funds follow the approach called indexing
- It is a long-term buy-and-hold strategy, except for the occasional rebalancing of the portfolio that is required due to changes in the index
- The deviation between the passive funds and index returns is called ‘tracking error”
- The portfolio is judged by its ability to minimize this tracking error

Portfolio Management Strategies – Active Strategy

The active funds, in contrast, attempt to beat the market and claim to offer some risk-adjusted excess abnormal returns, often denoted as ‘Alpha’

- That is, to outperform some benchmark (usually an index) on a risk-adjusted basis
- This Alpha is the difference between the actual and expected returns
- Essentially, this Alpha is the value a manager had added or subtracted from the investment process

Portfolio Management Strategies

An investor faces certain trade-offs while selecting between these two active and passive strategies

- Indexing is a low-cost (because of the low management fee) strategy but assured returns
- The active strategy may offer, at times, lucrative returns but with higher management costs
- At times, these higher management costs make net-returns inferior to investors

Portfolio Management Strategies

Stock markets world-over are said to be considerably efficient

- The implication is that it is extremely difficult for active fund managers to beat the market and justify the active management fee (1%–2%) charged
- Passive funds do not charge this management fee
- However, passive management strategies also require buying and selling of portfolios over time
- This leads to a slight underperformance by the fund amounting to 0.05% to 0.25%

Passive Portfolio Management Strategies

Passive Strategies

Often three techniques are employed to construct a passive index portfolio

(a) Full replication: all the securities in the index are purchased in proportion to their weights in the index

- While this strategy ensures extremely efficient tracking, but the need to purchase/sell many securities will reduce the returns by transaction costs
- Also, for such a large number of securities, a considerable amount of dividends are paid

Passive Strategies

(b) Sampling: in this technique, only a limited sample of stocks are employed that broadly represent all the industry sector classification, as captured by the benchmark index

- This solves the problem of buying a large number of stocks
- In particular, the stocks with large weights are purchased according to their weight in the index
- The small stocks are purchased to approximate/mimic their aggregate characteristics in the index (e.g., beta, industry, and dividend yield)
- While this will decrease the transaction cost, the efficiency of tracking, and therefore, the returns of the portfolio may differ from the benchmark

Passive Strategies

(c) Quadratic programming: in this case, the sampling technique differs from sampling

- That is, for sampling, rather than matching the characteristics of the security, historical information about the security returns and correlations are employed to construct a portfolio that can minimize the return deviations from the benchmark
- One challenge is that this technique draws heavily from the past information of the securities, and, therefore, if the security characteristics change from that observed in the past, then the portfolio may not be efficient in tracking the returns

Tracking Error and Index Portfolio Construction

Tracking Error and Index Portfolio Construction

- The main objective of a passive portfolio is to replicate a particular benchmark index
- It does not aim to achieve higher returns but to match the performance of that portfolio
- Therefore, a manager is judged by his performance relative to the performance of the benchmark, using a measure called tracking error

Tracking Error and Index Portfolio Construction

- Consider a period *t* return on a portfolio of *N* assets:

  $R_{pt} = \sum_{i=1}^{N} w_i R_{it}$ where *N* is the number of assets in the portfolio

- The difference between the period t benchmark portfolio and index returns:

  $\Delta_t = R_{pt} - R_{bt}$; generally, Δ_t is a function of the portfolio weights

- Also, since all the assets (mostly the small ones) may not be included in the managed portfolio, weight (*w*) = 0 for those assets

Tracking Error and Index Portfolio Construction

- For a sample of *T* return observations, the variance of Δ_t can be calculated as:

$$\sigma_{\Delta}^2 = \frac{\sum_{t=1}^{T}(\Delta_t - \bar{\Delta})^2}{(T-1)}$$

- If σ_{Δ} is calculated for daily period then annualized tracking error (TE) = $\sigma_{\Delta}\sqrt{252}$
- For monthly period the error will be TE = $\sigma_{\Delta}\sqrt{12}$
- Basically, TE (Annualized) = $\sigma_{\Delta}\sqrt{t}$, where *t* are the number of returns periods in the year

Tracking Error and Index Portfolio Construction

Period	Return on Portfolio (%)	Return on Index (%)	Difference (%)
1	2.3	2.7%	−0.4%
2	−3.6	−4.6	1.0
3	11.2	10.1	1.1
4	1.2	2.2	−1.0
5	1.5	0.4	1.1
6	3.2	2.8	0.4
7	8.9	8.1	0.8
8	−0.8	0.6	−1.4
		Average	0.20%

$\sigma_\Delta^2 = \frac{\sum_{t=1}^{T}(\Delta_t - \bar{\Delta})^2}{(T-1)} = \frac{[(-0.4-0.2)^2+(1.0-.2)^2+\cdots+(-1.4-0.2)^2]}{(8-1)}$ =1.0; $\sigma_\Delta = 1.0\%$ quarterly

TE = $\sigma_\Delta * \sqrt{4}$=2.0%

Active Investment Strategies

Active Investment Strategies

Active equity management strategies aim to earn returns that exceed market (benchmark) returns, net of transaction costs

- These strategies aim to increase the exposure to those stocks/sectors that the fund considers undervalued
- It may be noted that increasing exposure to a certain sector may lead to additional risk
- However, the fund management may believe that actual returns will be higher (net of transaction costs) than those justified by the risk premium associated with the risk of investment

Active Investment Strategies

Active equity management strategies are classified in three buckets: (A) fundamental, (B) technical, and (C) market anomalies and security attributes

(A) Fundamental strategies: The fundamental strategies are of two kinds (a) top-down and (b) bottom-up

- In the top-down investment process, one starts with the broad country level and sector level analysis. Then, move towards asset class to security specific allocation

Active Investment Strategies

- The bottom-up approach straight away focusses on the individual security rather than the market-sector analysis. Then, if found good, the analysis moves from asset class to sector, and then to the country level
- The end objective in both the approaches is to identify the securities that are undervalued given their fundamentals

Active Investment Strategies

(A) Fundamental strategies: a fund manager may identify the asset class that is undervalued, e.g., stocks, bonds, and government securities

- They may increase the exposure to that asset class as a whole
- Second, they may invest (increase exposure) in certain industry sectors or the investment styles (large cap, small cap, value, and growth)
- Finally, funds can identify and add undervalued stocks to their portfolios
- Another strategy recently developed, called as "130/30." Funds take long positions up to 130% of the original capital. Then, they take short positions of 30%

Active Investment Strategies

(B) Technical strategies: rely on two aspects of past price performance: (a) the past trends will continue and (b) the past trends will reverse

- For example, a contrarian strategy will suggest that the best time to buy a stock when everybody is acting bearish (selling) and vice versa
- This strategy relies on the overreaction hypothesis: investors overreact to the information leading to excess movements in the prices
- As the prices correct in the short to medium term, there is a reversal
- The contrarian investor will purchase the stock when the price is low and falling and sell it when the price is high and rising

Active Investment Strategies

(B) Technical strategies: in contrast, the momentum trading strategy assumes that the momentum will continue

- This strategy relies on the underreaction hypothesis
- That is, investors have limited capacity to absorb information
- As the information arrives in the market, investors gradually absorb this information
- The investor following the momentum strategy buys the stock when the prices start rising and holds in expectation of further increase, and vice versa

Active Investment Strategies

(C) Anomalies and attributes: these strategies rely on anomalies or firm attributes

- It has been observed that firms with small capitalizations produce bigger risk-adjusted returns that those with large market capitalizations
- Similarly, firms with low P/E and P/BV ratios produce higher risk-adjusted returns than those with higher levels of these ratios
- It appears that market, at times, favors some attributes more than others
- In this context, sector rotation involves increasing (overweighing) stocks with certain attributes and decreasing the stocks with opposite attributes

Investing Styles

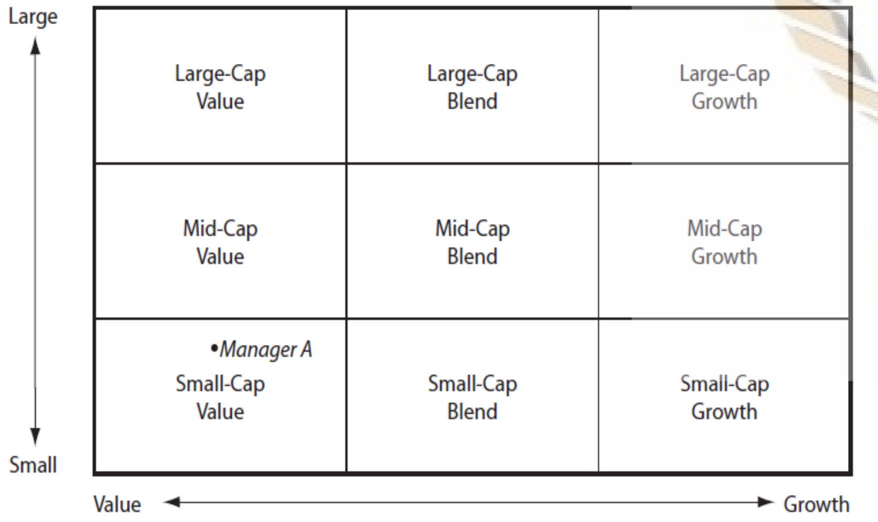
Investing Styles

Various investment styles are available to investors

- These include forming portfolios with stock characteristics including market capitalization, leverage, industry sector, relative valuation, and growth potential
- Essentially, style analysis defines benchmark portfolios (index) based on these characteristics
- Securities are chosen depending upon their sensitivity to this portfolio
- The relationship between a funds return to that with various indices is examined
- The higher the correlation of the fund with a portfolio associated with certain characteristics, it is said that the portfolio manager gives a higher weight to that investment style

Investing Styles

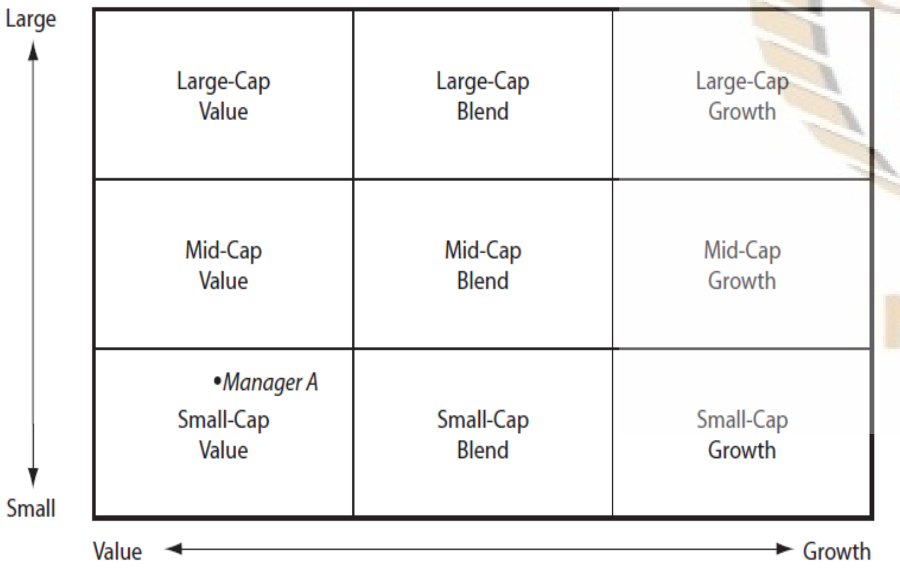
- Consider the style grid below. Here, we are trying to capture the performance of the manager along two dimensions: firm size (large-, mid-, and small-cap) and relative value (value, growth, and blend)
- Manager A's performance is best captured by the small-cap value style



Reilly and Brown, *Investment Analysis and Portfolio Management*, 10th edition (Chapter 16)

Investing Styles

- These style grids can be formed to classify funds, indices, or other portfolios
- Only those portfolios that are found similar in styles can be compared for their return performances



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Investing Styles – A Formal Approach

A more formal constrained least square approach to style analysis is discussed below

- Only those portfolios that are found similar in styles can be compared for their return performances
- The return from the manager's portfolio 'R_{pt}' are regressed on the returns on different style (*j*) factor 'F_{jt}' for the same period
- The following form of regression model is employed
- $R_{pt} = \left[b_{p1}F_{1t} + b_{p2}F_{2t} + \cdots + b_{pn}F_{nt}\right] + e_{pt}$
- Here, b_{pj} is the sensitivity of the portfolio to style *j*. e_{pt} is the portion of the returns not explained by the variability in the set of employed factors

Investing Styles – A Formal Approach

$$R_{pt} = [b_{p1}F_{1t} + b_{p2}F_{2t} + \cdots + b_{pn}F_{nt}] + e_{pt}$$

- The regression R^2 is interpreted as the percentage of return variability due to style
- The rest $(1 - R^2)$ is ascribed to the manager's selection skills
- The styles are measured through benchmark portfolios
- No intercept term is specified, the coefficients must sum to one, and all the coefficients are non-negative
- Here, $R^2 = 1 - [\frac{\sigma^2(e_p)}{\sigma^2(R_p)}]$

Investing Styles – A Formal Approach

$$R_{pt} = \left[b_{p1}F_{1t} + b_{p2}F_{2t} + \cdots + b_{pn}F_{nt}\right] + e_{pt}$$

- It may often be the case that a fund manager may profess a different style while following another style
- This analysis clearly brings forth the true picture
- The analysis also helps in finding out if there has been a style drift.

Value vs. Growth Investing

Value vs. Growth Investing

We often hear investment management firms define themselves as value vs. growth firms

- For example, growth firms focus on the earnings (EPS) part of the P/E ratio
- They expect the earnings to grow which will lead prices to rise
- Growth stocks are not necessarily cheap based on the current earnings levels; in fact, they may be costly
- But the investor believes that the earnings will rise significantly and lead to a price rise in the near future

Value vs. Growth Investing

In contrast, the value investor defines the price (P) component of P/E ratio

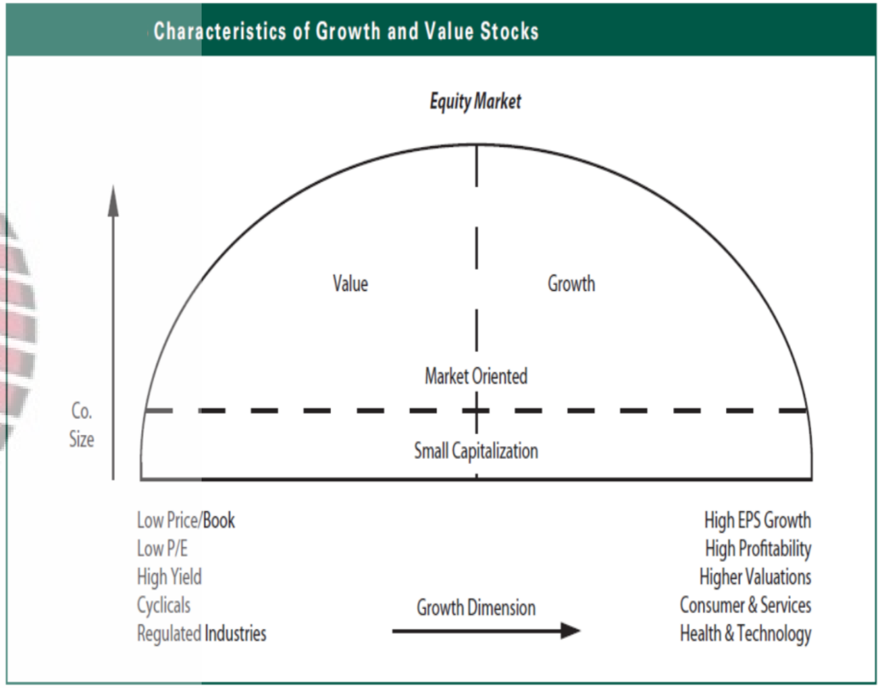
- The value investor believes that given the current level of earnings, prices are low (cheap) as compared to the other stocks in the same industry with similar profile
- P/E level is below the level based on some comparison, and the fact that the market will correct itself in the near term
- The prices will rise; thus, value stocks are cheap given their current earning levels

Value vs. Growth Investing

- To summarize, growth investor focuses on the current and future economic "story" of the firm, with less regard to share valuation
- The value investor focuses on share prices in anticipation of a market correction, possibly on account of improving company fundamentals

Value vs. Growth Investing

- Notice the characteristics of the value and growth stocks shown in the figure
- The figure shows one approach to classify securities according to style and market capitalization



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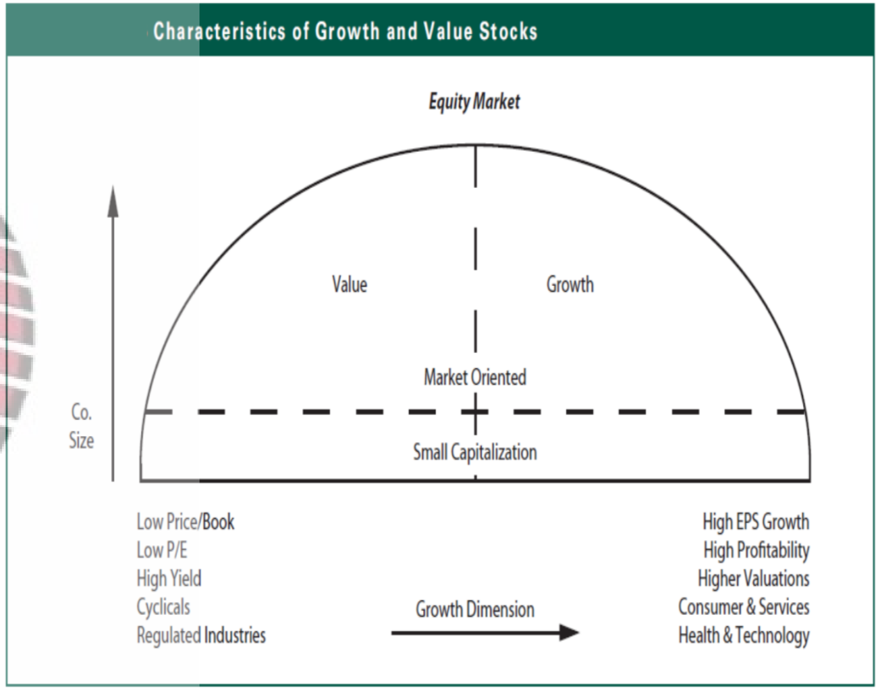
Value vs. Growth Investing

- We can see that value stocks are cheap (i.e., low P/BV and high yield) and have modest growth opportunities
- In contrast, growth stocks are expensive, reflecting their high future earning potential



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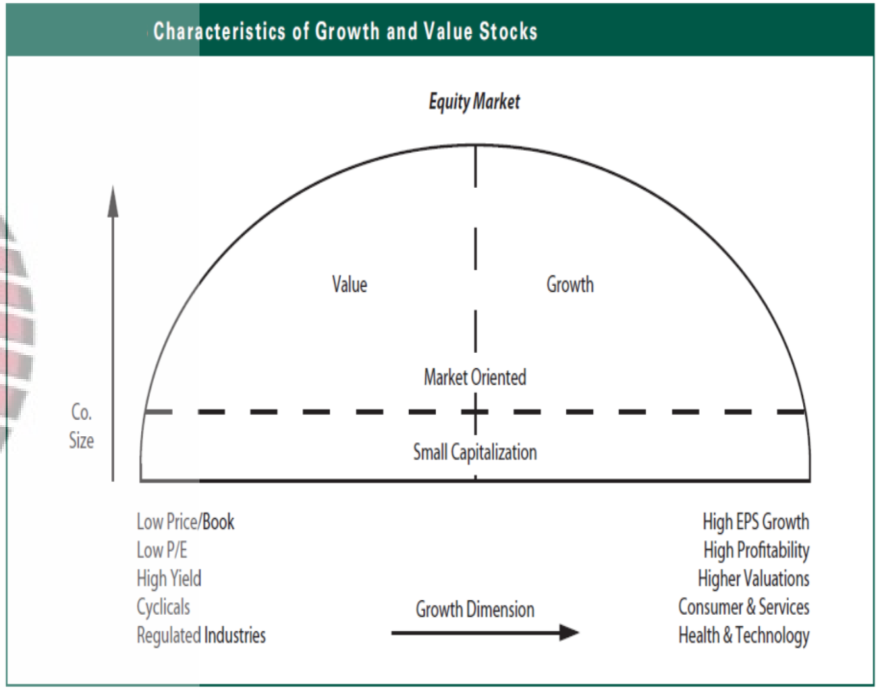
Value vs. Growth Investing

- Value style appears to be more tempting than growth, and in fact, studies show that value style indeed produces higher average returns than growth investing
- However, both strategies have their clientele



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Summary and Concluding Remarks

Summary and Concluding Remarks

- There are broadly two kinds of portfolio management strategies: (a) active management and (b) passive management
- Passive management strategies include: (a) full replication, (b) sampling, and (c) quadratic programming
- Passive management strategies aim to replicate the performance of some benchmark index
- Passive management strategies aspire to minimize the tracking error

Summary and Concluding Remarks

- Active management strategies aspire to generate higher returns
- Active investment strategies are of three kinds:
  (a) fundamental, (b) technical, and (c) market anomalies and security attributes
- Passive management strategies have low transaction costs, whereas active management may require additional transaction costs

Summary and Concluding Remarks

- Fund managers often follow one of the two main investing styles: value vs. growth
- Growth stocks sell at premium in anticipation of high future growth while value stock are cheap at their current valuations
- A more formal approach employs regression modelling to examine what factors/styles are being followed by a fund manager

Introduction

- Introduction to portfolio performance evaluation
- One-parameter measures
  - Sharpe ratio
  - Treynor's measure
  - Jensen's measure (α)
  - Information ratio (IR) measure
- Performance measurement with downside risk: Sortino's ratio
- Summary and concluding remarks

Portfolio Performance Evaluation

Portfolio Performance Evaluation

While evaluating the performance of a portfolio, the following questions are asked

- What are the policies that the fund has pronounced for itself, and how well those policies are followed?
- How diversified is the fund?
- What is the asset allocation?

- The portfolios being evaluated must be comparable
- For example, if a fund has restricted that its managers should invest only in AA-rated instruments or better should not compare with those funds that invest in funds that have no such restrictions

Portfolio Performance Evaluation

- Therefore, the return earned is directly linked to the amount of risk borne by the fund
- But problems arise where the funds that are compared have different risk levels
- In the ensuing discussions, we will focus on one-parameter measures that are most commonly employed in the literature

One-Parameter Measures: Sharpe Ratio

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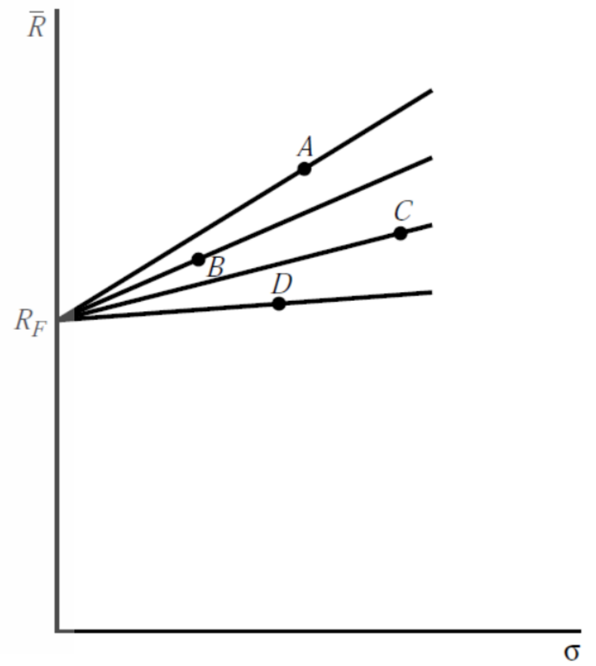
Sharpe Ratio

Sharpe ratio of point $A = \frac{\overline{R_A} - R_f}{\sigma_A}$

- The ratio measures excess return over risk-free rate against the risk borne by the fund
- The portfolios on line joining the investment A and R_f offer the highest slope and, therefore, the best Sharpe ratio measure of performance



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Sharpe Ratio

Sharpe ratio of point A= $\frac{\overline{R_A} - R_f}{\sigma_A}$

- Compare the examples of three portfolios that follow the Sharpe measure

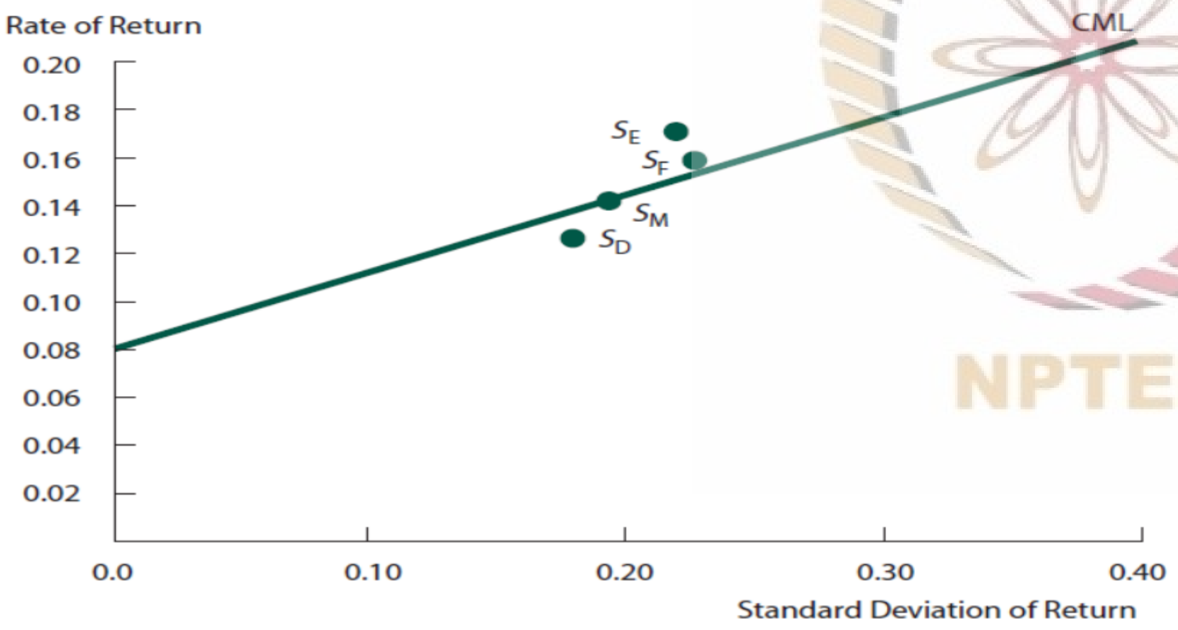
Portfolio	Average Annual Rate of Return	SD	Sharpe Measure
D	13%	0.18	(0.13−0.08)/0.18 = 0.278
E	17%	0.22	(0.17−0.08)/0.22 = 0.409
F	16%	0.23	(0.16−0.08)/0.23 = 0.348
Market	14%	0.20	(0.14−0.08)/0.20 = 0.300
Risk-free	8%		

- Here, portfolio *D* performs the worst, even as compared to the market portfolio
- Portfolio *E* performs best

Sharpe Ratio

The performance of these portfolios can be plotted on the capital market line (CML)

Portfolios *E* and *F* are above the CML line, indicating better risk-adjusted performance



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Sharpe Ratio

- The measure of risk considered here is the standard deviation, i.e., total risk of the fund
- This includes the market risk (systematic risk) and stock-specific risk
- Please note that if the fund is well diversified, then most of the fund’s risk will be systematic risk
- In most of the situations, the investors invested in the fund are small retail investors, who invest a sizable portion of their risk in the fund

Sharpe Ratio

- For the investor, the entire risk of the fund is important, not only the market risk part of it
- Since these investors rely precisely on the ability of the fund to diversify on behalf of them
- The Sharpe measure looks at the decision from the point of view of an investor choosing a mutual fund to represent the majority of his investment

Sharpe Ratio

- An investor choosing a mutual fund to represent a large part of her wealth would likely be concerned with the full risk of the fund, and the standard deviation is a measure of that risk
- The measure computes risk-premium earned per unit of total risk
- This measure uses CML to compare portfolios

One-Parameter Measures: Treynor’s Measure

Treynor's Measure

Treynor's measure = $\frac{\overline{R_p} - R_f}{\beta}$

- Treynor's measure examines excess return with risk measure being beta
- For the diversified investors who only consider the systematic risk for performance evaluation, Treynor's measure is the appropriate measure
- Treynor's measure is applicable to majority of the investors irrespective of their risk preferences
- Treynor argues that rational, risk-averse investors would always prefer the portfolios on security market line

Treynor’s Measure

Treynor’s measure = $\frac{\overline{R_p} - R_f}{\beta}$

- Treynor argues that rational, risk-averse investors would always prefer the portfolios on security market line
- That is, risk-free assets combined with risky portfolios with the largest slope, in order to achieve the highest indifference curve
- The slope of this curve is Treynor’s measure
- The risk measure here is the systematic risk component, i.e., beta

Treynor's Measure

Treynor's measure = $\frac{\overline{R_p} - R_f}{\beta}$

- The measure assumes a diversified portfolio and that all investors are risk-averse and would like to maximize this value
- The measure for the standard market portfolio will be $\frac{\overline{R_M} - R_f}{\beta_M}$ where $\beta_M = 1$
- For any portfolio in general: $\frac{\overline{R_P} - R_f}{\beta_P} = (\overline{R_M} - R_f)$ from security market line (SML)
- The equation of SML is shown here: $\overline{R_P} = R_f + \beta_p * (\overline{R_M} - R_f)$

Treynor's Measure

Treynor's measure = $\frac{\overline{R_p} - R_f}{\beta}$

- The equation of SML is shown here: $\overline{R_P} = R_f + \beta_p * (\overline{R_M} - R_f)$
- Combined with Rf, this portfolio will generate the SML
- Any higher value would indicate that the portfolio offers excess risk-adjusted returns and plots above SML

Treynor's Measure

Consider the information about three investment managers below (w, x, and y). In addition, we are given the market rate of return and the risk-free rate

Investment Manager	Average Annual Rate of Return	Beta	Treynor's Measure
w	12%	0.90	(0.12 − 0.08)/0.90 = 0.044
x	16%	1.05	(0.16 − 0.08)/1.05 = 0.076
y	18%	1.20	(0.18 − 0.08)/1.20 = 0.083
Market	14%	1.00	(0.14 − 0.08)/1.00 = 0.060
Risk-free	8%	0.00	

- These results indicate that Manager w not only performed worst among the three managers but performed worse than the market as well, on a risk-adjusted basis

Treynor’s Measure

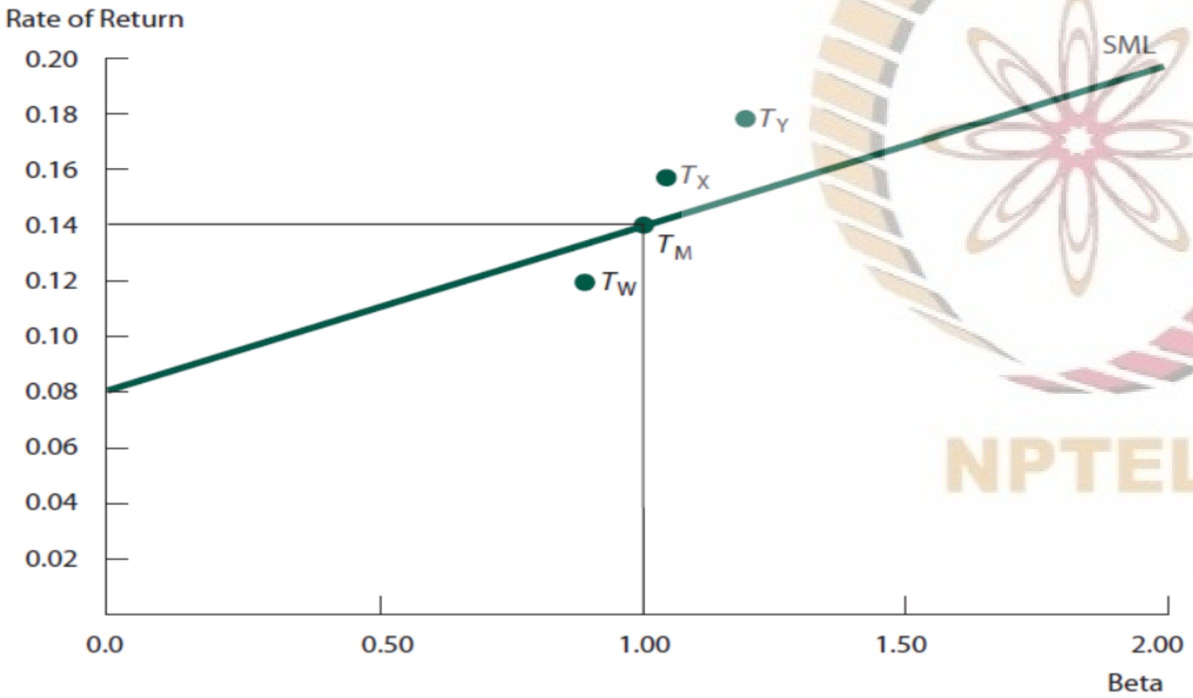
These results indicate that Manager w not only performed worst across the three managers, but performed worse than the market as well, on risk-adjusted basis

- While x and y performed better than the market, y performed best

Investment Manager	Average Annual Rate of Return	Beta	Treynor’s Measure
w	12%	0.90	(0.12 − 0.08)/0.90 = 0.044
x	16%	1.05	(0.16 − 0.08)/1.05 = 0.076
y	18%	1.20	(0.18 − 0.08)/1.20 = 0.083
Market	14%	1.00	(0.14 − 0.08)/1.00 = 0.060
Risk-free	8%	0.00	

Treynor's Measure

Their performance on SML can be plotted as follows



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Treynor's Measure

What is the challenge with this measure?

- Consider two portfolios: one, which offers a return that is below risk-free (although with the positive beta)
- The negative measure would indicate poor performance
- Even when plotted on SML, this point would indicate a very poor performance
- Second, consider a security with a negative beta that offers a very high return above the risk-free rate
- This would also offer a negative measure despite good performance

Treynor's Measure

What is the challenge with this measure?

- For example, a portfolio of gold mining stocks with a beta of −2 performs well and offers a 10% return
- Then the measure would be (0.10 − 0.08)/(− 0.2) = − 0.10
- However, if plotted on SML, this will be above SML and indicate exceptional returns
- See for example. $E\left(R_{\text{gold}}\right) = R_f + \beta_{\text{gold}}(R_M - Rf)$= 0.08 + (− 0.2)*(0.14 − 0.08) = 6.8% expected returns, which is lower than the actual return of 10%. Thus, the point will be above SML

One-Parameter Measures: Jensen's Measure (α)

Jensen's Measure (α)

- Jensen's measure is the differential in the return as predicted by the CAPM model
- $R_p = \alpha_p + \bar{R}_p = \alpha_p + R_f + (\bar{R}_M - R_f)\beta_p$
- $\bar{R}_p$ is the expected return. Then $R_p - \bar{R}_p$, this differential return is called the Jensen's measure of performance
- The key assumption here is that CAPM is the guiding model

Jensen's Measure (α)

- $R_{pt} - R_f = \alpha_p + \beta_j [R_{mt} - R_f] + e_{jt}$
- In this model, we expected $\alpha_p = 0$
- Presence of positive intercept (constant term) α_p would indicate the ability of security selection or predicting the market performance by a portfolio manager
- A negative Alpha would indicate poor performance

One-Parameter Measures: Information Ratio (IR) Measure

Information Ratio (IR) Measure

Information ratio (IR) measure: $\frac{\overline{R_P} - \overline{R_b}}{\sigma_{ER}} = \frac{\overline{\mathrm{ER}_B}}{\sigma_{ER}}$

- Here, $\overline{R_P}$ is the return on a portfolio, $\overline{R_b}$ is the return on the benchmark portfolio
- $\overline{\mathrm{ER}_B}$ is the excess return. σ_{ER} is the standard deviation of excess returns
- The numerator here measures the ability of the portfolio manager to perform better than a given benchmark (e.g., Nifty)

Information Ratio (IR) Measure

Information ratio (IR) measure: $\frac{\overline{R_P}-\overline{R_b}}{\sigma_{ER}} = \frac{\overline{\mathrm{ER}_B}}{\sigma_{ER}}$

- The denominator measures the residual (or incremental) risk that the manager took to obtain these excess returns
- Thus, IR can be interpreted as a benefit to cost ratio
- It evaluates the quality of information with the manager (or stock selection ability) adjusted by the non-systematic taken by the investor

Information Ratio (IR) Measure

- Consider a set of quarterly returns below
- Compute IR= $\frac{\overline{R_P}-\overline{R_b}}{\sigma_{\text{ER}}} = \frac{\overline{\text{ER}_B}}{\sigma_{\text{ER}}}$

Quarter	Portfolio Returns	Benchmark Returns	Difference
1	2.30%	2.70%	−0.40%
2	−3.60%	−4.60%	?
3	11.20%	10.10%	?
4	1.20%	2.20%	?
5	1.50%	0.40%	?
6	3.20%	2.80%	?
7	8.90%	8.10%	?
8	−0.80%	0.60%	?
Average	?	?	$\overline{R_P} - \overline{R_b}$ =?
SD			σ_{ER} =?

Information Ratio (IR) Measure

- IR = 0.2%/1%=0.20; this represents the manager's incremental performance (Alpha, relative to the index) per unit of risk incurred in the pursuit of those active returns
- IR will be only positive when the manager outperforms his benchmark

Quarter	Portfolio Returns	Benchmark Returns	Difference
1	2.30%	2.70%	−0.40%
2	−3.60%	−4.60%	1.00%
3	11.20%	10.10%	1.10%
4	1.20%	2.20%	−1.00%
5	1.50%	0.40%	1.10%
6	3.20%	2.80%	0.40%
7	8.90%	8.10%	0.80%
8	−0.80%	0.60%	−1.40%
Average	2.99%	2.79%	$\overline{R_P} - \overline{R_b}$=0.20%
SD			σ_{ER} =1.00%

Performance Measurement With Downside Risk: Sortino's Ratio

Sortino's Ratio

Sortino's ratio: $\frac{\overline{R_p} - T}{D_R}$

- Here, D_R is the downside risk. Total risk, i.e., SD, includes upside and downside both risks
- T is the target rate of return
- In most of the computations, $T = R_f$ (risk-free rate) or some target return as set by fund management
- $D_R = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\mathrm{Min}(0, R_i - \mathrm{MAR})\right)^2}$

Sortino's Ratio

Sortino's ratio : $\frac{\overline{R_p}-T}{D_R}$; $D_R = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\mathrm{Min}(0, R_i - \mathrm{MAR})\right)^2}$

- MAR is the minimum acceptable rate of return, often considered as the target return
- Also, in most of the computations, MAR = Average returns ($\overline{R_p}$)
- Risk-free returns (R_f), also in some cases, MAR can be = 0
- Sortino's measure measures returns in excess of a pre-defined target rate

Sortino's Ratio

Sortino's ratio : $\frac{\overline{R_p}-T}{D_R}$; $D_R = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\mathrm{Min}(0, R_i - \mathrm{MAR})\right)^2}$

- This excess return is not adjusted by the total risk (SD) but only by the downside risk
- The downside risk is computed against some minimum acceptable returns
- This kind of downside risk is often considered more appropriate because the downside volatility is often associated with a shortfall
- Thus, this downside risk can be considered to capture the fear of investors more efficiently

Sortino's Ratio: Example

Sortino's Ratio

Consider the example below, where we compare the Sharpe and Sortino measures with a risk-free rate of 2%

Year (R_f = 2%)	Portfolio A Return (%)	Portfolio B Return (%)
1	−5	−1
2	−3	−1
3	−2	−1
4	3	−1
5	3	0
6	6	4
7	7	4
8	8	7
9	10	13
10	13	16
Average	4	4
SD	5.60	5.92

Sortino's Ratio

The Sharpe ratios of portfolios A and B are computed as follows

- $S_A = \frac{4-2}{5.60} = 0.357$ and $S_B = \frac{4-2}{5.92} = 0.338$
- Based on these numbers, it appears that portfolio A outperformed portfolio B
- Let us see what happens when we only consider the downside risk
- Let us use the average return of 4% as MAR to compute the downside return, and target return T as a risk-free return

Sortino's Ratio

The Sortino's ratios of portfolios A and B are computed as follows

- All the positive returns are considered zero
- Sortino's ratio: $\frac{\overline{R_p} - T}{D_R}$
- $D_R = \sqrt{\frac{1}{N} \sum_{i=1}^{N} \left(\text{Min}(0, R_i - \text{MAR}) \right)^2}$

Sortino's Ratio

The Sharpe ratios of portfolios A and B are computed as follows

Assume a target rate of 4% (average return)

MAR = risk-free = 2%

$$DR_A = \sqrt{\frac{[(-5-4)^2 + \cdots .. + \cdots ... + \cdots .. + \cdots ....]}{10}} = ?$$

$$DR_B = \sqrt{\frac{[(-1-4)^2 + \cdots .. + \cdots ... + \cdots ... + ...^2]}{10}} = ?$$

Year (R_f = 2%)	Portfolio A Return (%)	Portfolio B Return (%)
1	−5	−1
2	−3	−1
3	−2	−1
4	3	−1
5	3	0
6	6	4
7	7	4
8	8	7
9	10	13
10	13	16
Average	4	4
SD	5.60	5.92

Sortino's Ratio

The Sharpe ratios of portfolios A and B are computed as follows

Assume the target rate of 4% (average return)

MAR = risk-free = 2%

Sortino's ratios for both of these funds are computed as

$ST_A = : \frac{\overline{R_A} - T}{DR_A} = ?$ and $ST_B = \frac{\overline{R_B} - T}{DR_B} = ?$

Year (R_f = 2%)	Portfolio A Return (%)	Portfolio B Return (%)
1	−5	−1
2	−3	−1
3	−2	−1
4	3	−1
5	3	0
6	6	4
7	7	4
8	8	7
9	10	13
10	13	16
Average	4	4
SD	5.60	5.92

Sortino's Ratio

Let us see what happens when we only consider the downside risk

- Let us use the average return of 4% as MAR to compute the downside return

- All the positive returns are considered zero

- $DR_A = \sqrt{\frac{[(-5-4)^2+(-3-4)^2+(-2-4)^2+(3-4)^2+(3-4)^2+]}{10}} = 4.10$

- $DR_B = \sqrt{\frac{[(-1-4)^2+(-1-4)^2+(-1-4)^2+(-1-4)^2+(0-4)^2]}{10}} = 3.41$

Sortino's Ratio

Let us see what happens when we only consider the downside risk

- Let us use the average return of 4% as MAR to compute the downside return
- All the positive returns are considered zero
- Sortino's ratios for both of these funds are computed as
- $ST_A = \frac{4-2}{4.10} = 0.488$ and $S_B = \frac{4-2}{3.41} = 0.587$

Sortino's Ratio

With Sortino's ratio, portfolio B appears to perform better

- This happens because portfolio A appears to have more extreme negative returns
- Various risk-averse investors would be uncomfortable with this aspect of portfolio A

Year (R_f = 2%)	Portfolio A Return (%)	Portfolio B Return (%)
1	−5	−1
2	−3	−1
3	−2	−1
4	3	−1
5	3	0
6	6	4
7	7	4
8	8	7
9	10	13
10	13	16
Average	4	4
SD	5.60	5.92

Summary and Concluding Remarks

Summary and Concluding Remarks

- If portfolios are well diversified, then Treynor's measure and Sharpe give the same results
- However, for poorly diversified portfolios, one can get a high rank on Treynor's measure (as it ignores the systematic risk), despite performing poorly on Sharpe's measure
- Also, to be noted that these measures provide comparisons and produce relative rankings, not absolute performance rankings
- In this regard, the advantage of Jensen's Alpha is that it produces an absolute measure

Summary and Concluding Remarks

- For example, an Alpha value of 2% would indicate that manager generated an excess return of 2% per period, more than the expected returns
- Also, the result from Jensen's Alpha has certain statistical significance
- Moreover, Jensen's Alpha has the flexibility to compute the Alpha with respect to any given model
- Another class of measures capture the downside risk dimension only: Sortino's ratio

Introduction

- Portfolio performance evaluation
  - Timing A
  - Selection
- Statistical significance of portfolio performance
- Holding measure of timing and security selection
- Characteristic selectivity (CS) performance measure
- Summary and concluding remarks

Portfolio Performance Evaluation: Timing

Portfolio Performance Evaluation: Timing

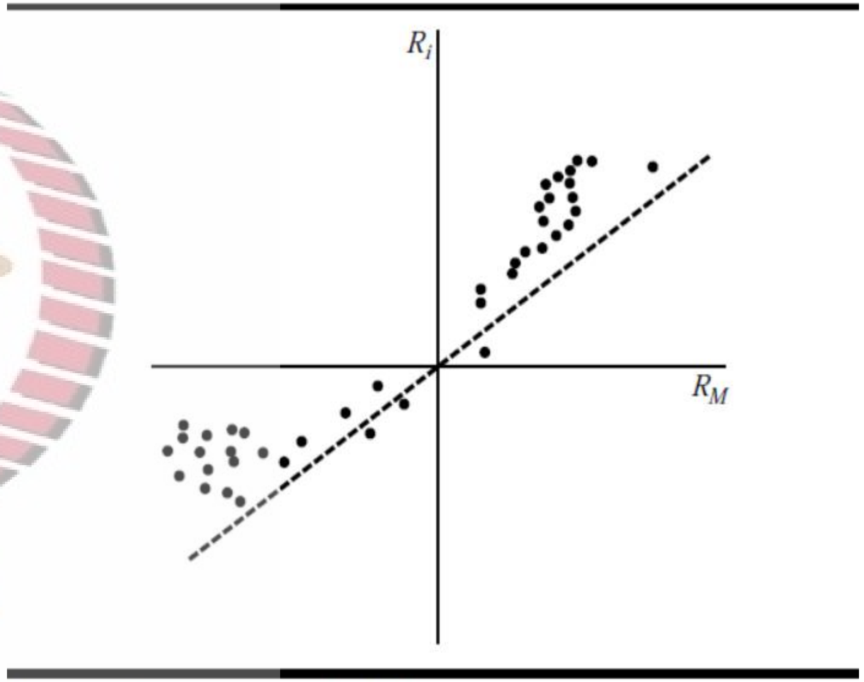
Timing involves changing the sensitivity of the portfolio to one or more systematic influences in anticipation of future market movements

- For example, in anticipation of market movements, the manager would want to adjust the portfolio
- If you believe that the market will go up and want to exploit this, you can buy high beta stocks and sell low beta stocks
- Alternatively, you can buy equity and sell debt
- Another less costly method is to buy and sell stock index futures

Portfolio Performance Evaluation: Timing

The following exercise can be done to test the ability of a manager to time the market

- One can plot the returns with market returns
- When the market increases substantially, the fund would have a higher beta than the normal
- Also, the returns would be above the normal returns



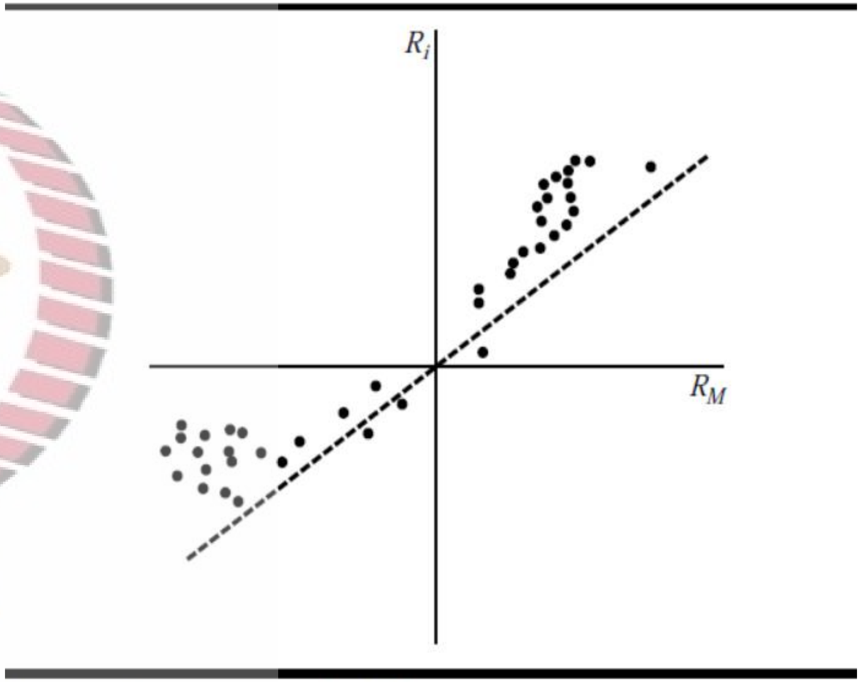
Returns for manager with timing.

Elton, Gruber, Brown, and Goetzmann, Modern Portfolio Theory and Investment Analysis, 9th edition (Chapter 26)

Portfolio Performance Evaluation: Timing

Likewise, in the cases of market declines, the low beta would be observed

- Then, the decline in portfolio returns would be less than the normal decline in the market downturn



Returns for manager with timing.

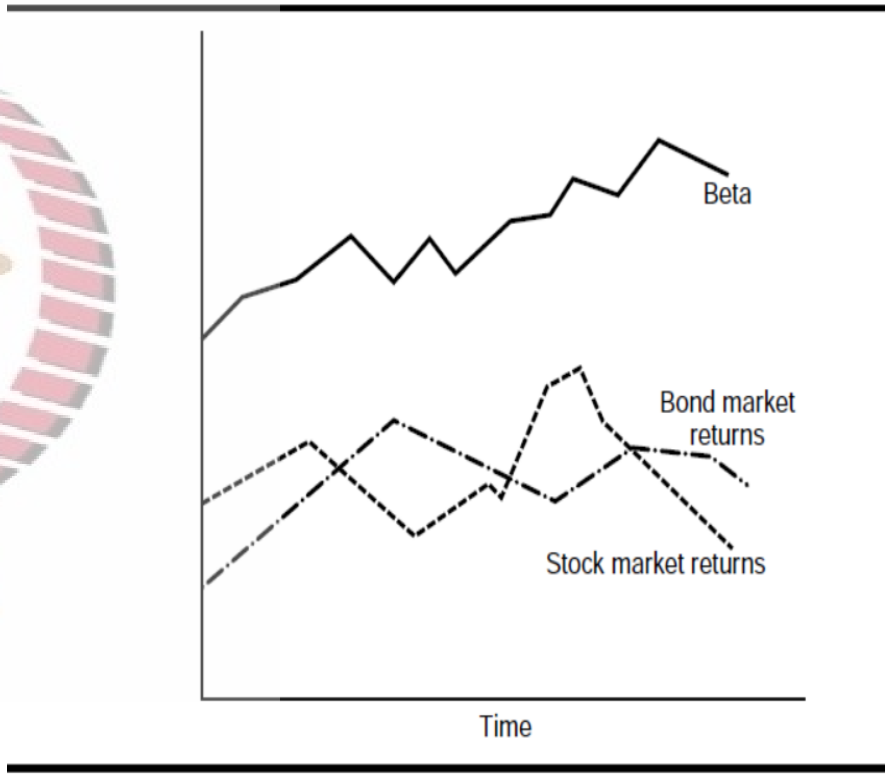
Elton, Gruber, Brown, and Goetzmann, Modern Portfolio Theory and Investment Analysis, 9th edition (Chapter 26)

Evaluation of Market Timing

Evaluation of Market Timing

One way to observe whether the manager is trying to time the market is to visualize (i.e., graphically examine) the movements of the market versus the beta of the fund

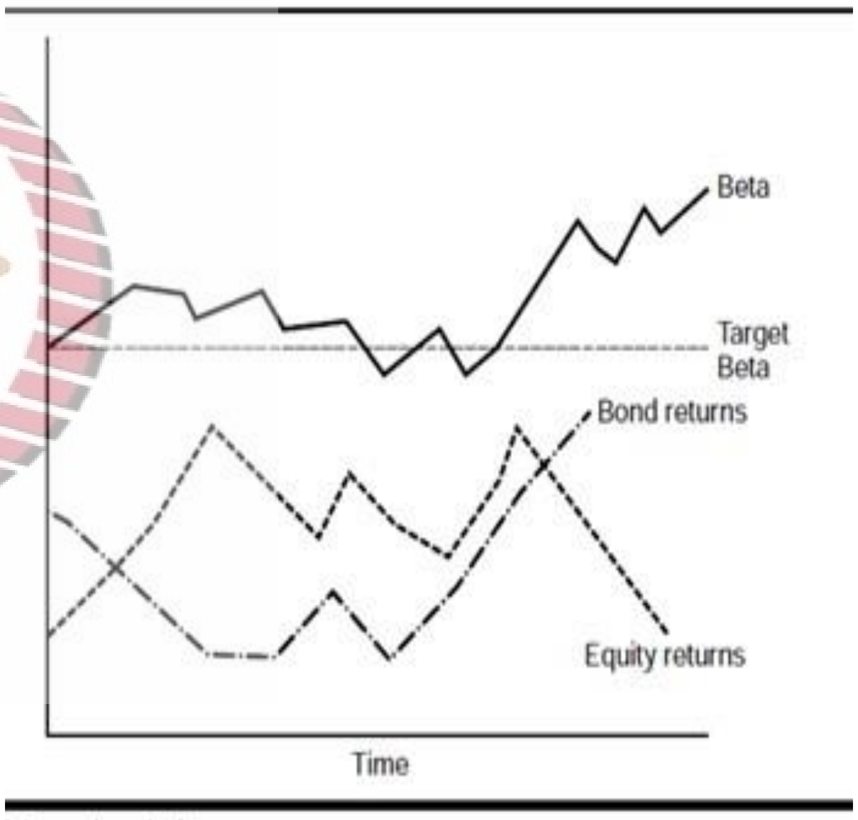
- Or bond-stock mix (capital allocation in the fund)
- If a fund is successfully able to time the market, then the beta of the firm should mimic the market movements in advance



Elton, Gruber, Brown, and Goetzmann, Modern Portfolio Theory and Investment Analysis, 9th edition (Chapter 26)

Evaluation of Market Timing

- In order to perform the timing analysis, we examine the beta policy of the fund
- Then, we examine the deviations from the policy and their relation to market movements



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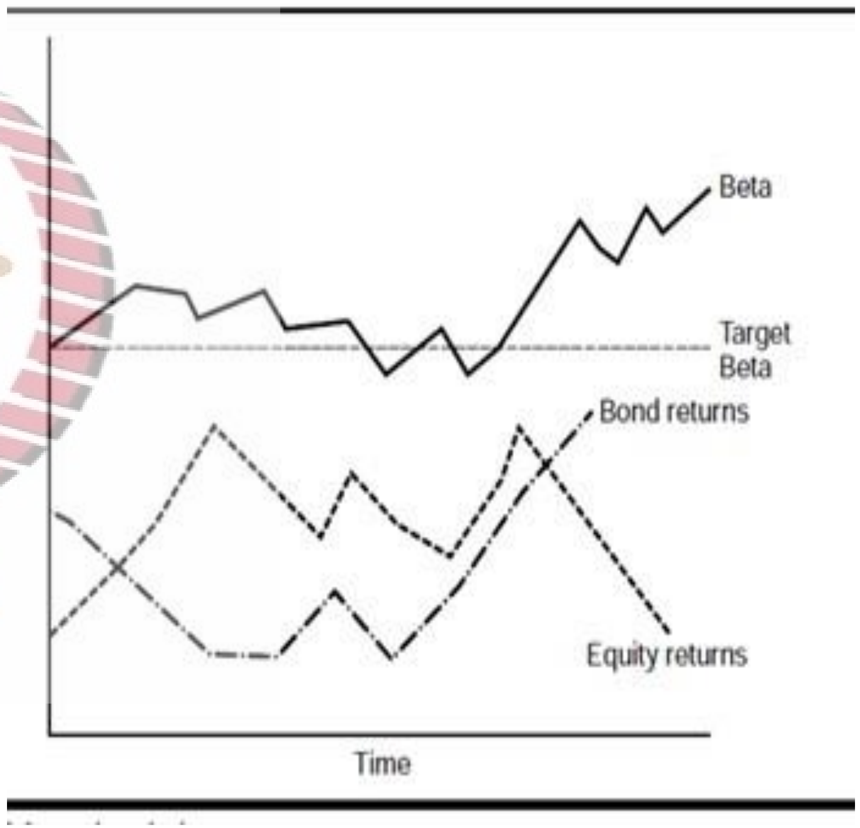
Evaluation of Market Timing

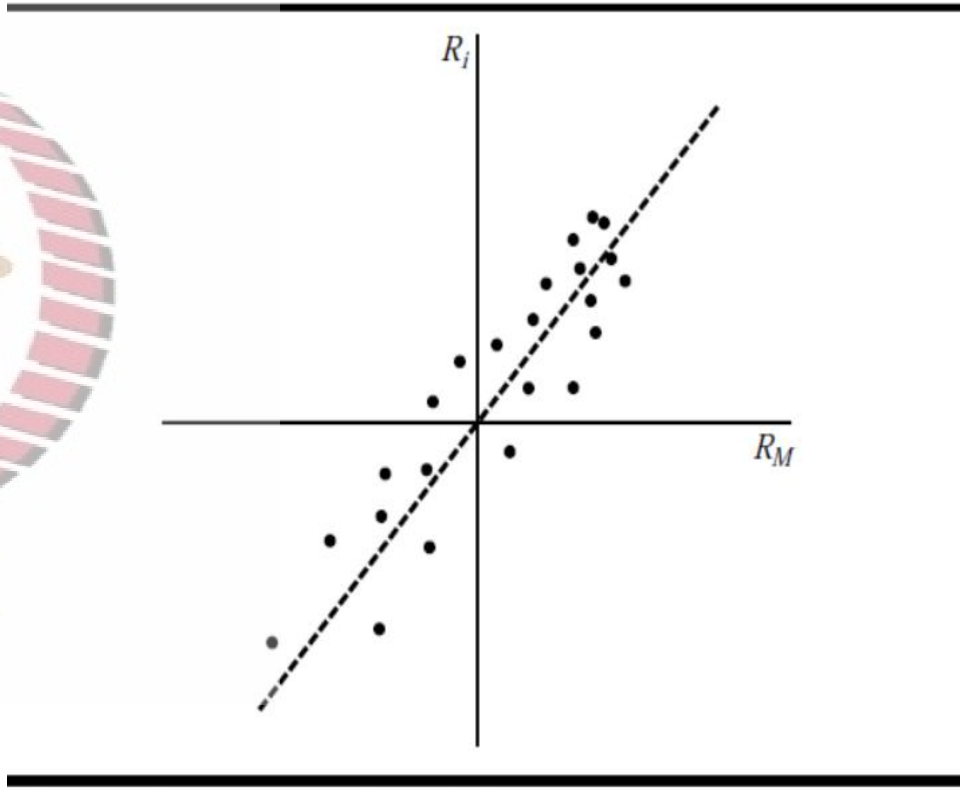
- If there is some relation between portfolio beta (or bond stock mix) and market return, then this should be apparent from the plot
- If the portfolio is fairly diversified with no stock-specific variations, and the only risk that is present in the portfolio is represented by beta
- This means that the relation between portfolio return and market return would essentially represent this beta



Elton, Gruber, Brown, and Goetzmann, Modern Portfolio Theory and Investment Analysis, 9th edition (Chapter 26)

Evaluation of Market Timing

- In the figure, we can see that, on average, the market return and fund (portfolio) return are in the form of a straight line
- This means that no timing strategy
- The scattered nature of points around the line indicates the presence of diversifiable risk in small quantities



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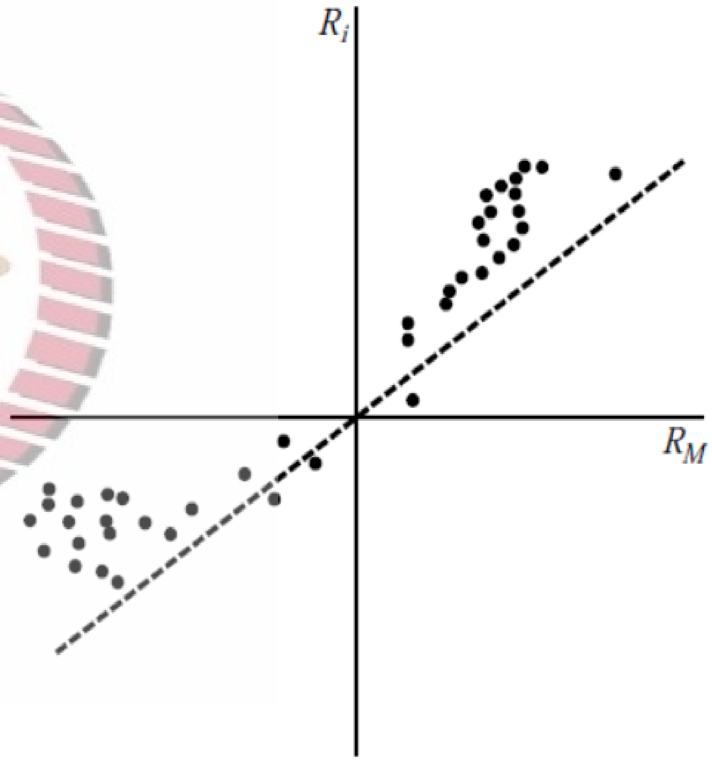
Evaluation of Market Timing

If the fund is successfully following the timing strategy by changing the beta of the fund, then if it anticipates a rising market, the fund would exhibit a higher beta in advance and tend to do well as compared to normal conditions

- This would cause the return points to be above the line that shows the average relationship between the fund and market during normal times



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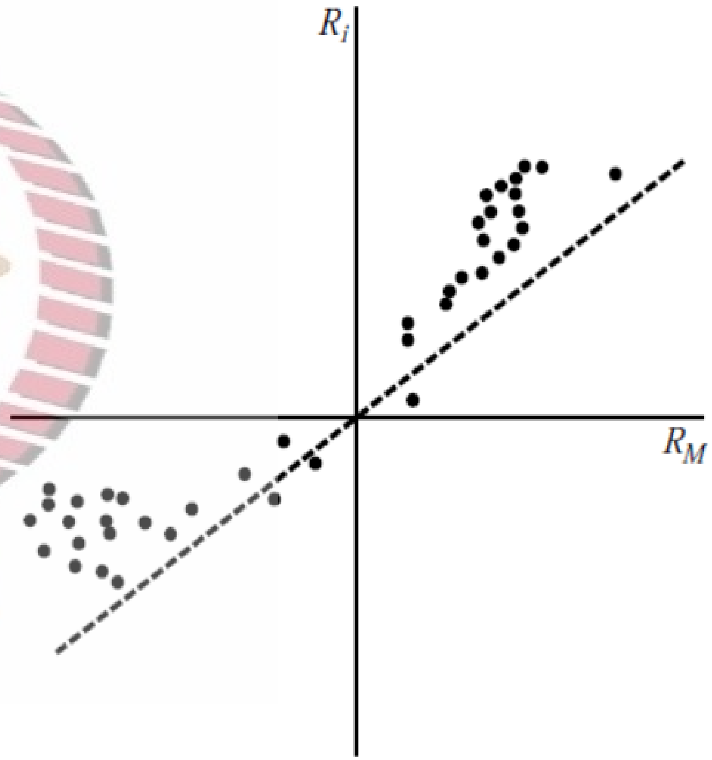
Evaluation of Market Timing: Manager With Timing

Similarly, in the cases of market declines, the fund would decrease beta

- Therefore, the fall in prices would be less, and the return points would still be above the line showing the average relationships during normal times
- In both cases, the points will be above the normal relationship line and may exhibit a curvature



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Statistical Significance of Portfolio Performance

Statistical Significance of Portfolio Performance

How to statistically measure this performance?

- $R_{it} - R_{Ft} = a_i + b_i(R_{mt} - R_{Ft}) + c_i(R_{mt} - R_{Ft})^2 + e_{it}$
- Here, R_{it} is the return on fund '*i*' in period t
- R_{mt} is the return on the market index in period t
- R_{Ft} is the riskless asset return, and e_{it} is the residual return
- Here, if there is no strategy, then the coefficient c_i that captures the relationship of excess returns $(R_{it} - R_{Ft})$ with the curvature term '$(R_{mt} - R_{Ft})^2$' should be insignificant and zero

Statistical Significance of Portfolio Performance

- Suppose we find that the coefficient c_i is significantly positive, this would indicate the ability of the fund to time the market
- Therefore, c_i here becomes a measure of fund's timing ability
- What if c_i is negative?
- Also, please note here that we are considering CAPM/single factor APT; the model can be adjusted to reflect multi-factor APT as well

Holding Measure of Timing

Holding Measure of Timing

In contrast to examining the relationship between the fund returns and market returns, holding measures rely on the portfolio holdings

- Beta is estimated as the weighted average beta of securities that comprise the portfolio
- This requires beta estimation of each security in the portfolio
- Then, using holdings data, one can compute the security proportions in the fund, and thereby estimate portfolio beta

Holding Measure of Timing

One holding measure of performance evaluation is discussed as follows [Elton, Gruber, Blage: EGB measure]

- $\text{Timing} = \sum_{t=1}^{T} \frac{(\beta_t^* - \beta_{At})R_{pt}}{T}$
- Here, β_t^* is the target beta and β_{At} is the actual beta for the beginning of the period
- T is the number of time-periods and R_{pt} is the return in the period
- The measure captures whether the fund deviated from the target beta in the same direction as the return on the index deviated from its normal pattern

Holding Measure of Timing

$$\text{Timing} = \sum_{t=1}^{T} \frac{(\beta_t^* - \beta_{At})R_{pt}}{T}$$

- Does the fund increase its beta when index returns are high and decrease when the index returns are low?
- Target beta is determined by the firm policy and an agreed-upon normal beta
- Often average beta overtime can also be used as a proxy for the target beta

Holding Measure of Timing

$$\text{Timing} = \sum_{t=1}^{T} \frac{(\beta_t^* - \beta_{At}) R_{pt}}{T}$$

- Certain aspects of the market can be forecasted with reasonable accuracy
- For example, the dividend price ratio can be employed to forecast prices
- Therefore, the fund manager should not get credit for price changes that can be easily forecasted using metrics such as dividend price ratio
- Then, the beta (price) forecasted using the metrics (e.g., dividend price ratio) may also be used as the target beta

Holding Measure of Security Selection

Holding Measure of Security Selection

By looking at the portfolio holdings, the investor can find which securities the manager buys or sells in the portfolio

- Then, one can establish which stock or bond positions led to these performances
- For example, consider the Grinblatt–Titman (GT) performance measure as follows
- $GT_t = \sum_{j=1}^{N} \left(w_{jt} - w_{jt-1}\right) R_{jt}$
- The manager's security selection ability can be established by understanding how the manager adjusted these weights

Holding Measure of Security Selection

$$GT_t = \sum_{j=1}^{N}(w_{jt} - w_{jt-1})R_{jt}$$

- $w_{jt} - w_{jt-1}$ = change in the weights for the jth security between the periods 't' and 't−1'
- R_{jt} = Return on the security 'j' during period 't'
- A series of GTs can be averaged over several periods to get an average measure ($\frac{\sum_{i=1}^{T} GT_t}{T}$)
- This average GT is an indicator of the quality of the manager's decision-making

Holding Measure of Security Selection: Example

Holding Measure of Security Selection: Example

Different portfolio performances are shown

- Panel A shows the share prices of all the five (5) stocks available for investment
- These are shown for six different dates relative to the current date 0. For these stocks, the returns are computed and are shown

A. Stock Market Data						
	Share Price ($):					
Stock	Date –1	Date 0	Date 1	Date 2	Date 3	Date 4
A	10	10	14	13	13	14
B	10	10	8	8	8	6
C	10	10	8	8	7	6
D	10	10	10	11	12	12
E	10	10	10	10	10	10

A. Stock Market Data				
	Return (%):			
Stock	Period 1	Period 2	Period 3	Period 4
A	14/10 – 1 = 40%	–7.14	0	7.69
B	–20	0	0	–25
C	–20	0	–12.5	–14.29
D	0	10	9.09	0
E	0	0	0	0

Holding Measure of Security Selection: Example

Panel B shows the shares outstanding at the beginning dates for each of the periods. The index weights are also shown at the beginning of the periods.

- The index weights (28% for A at the beginning of 2) are computed by multiplying the stock price (14 for A Date 1) with the number of stocks (200 for A Date 1) for the numerator
- Denominator = 200 × (14 + 8 + 8 + 10 + 10) = 10000
- This is a value-weighted passive portfolio

B. Value-Weighted Index Holding Data					
	Shares Outstanding On:				
Stock	Date –1	Date 0	Date 1	Date 2	Date 3
A	200	200	200	200	200
B	200	200	200	200	200
C	200	200	200	200	200
D	200	200	200	200	200
E	200	200	200	200	200

B. Value-Weighted Index Holding Data					
		Index Weight (w_{jt}) at Beginning Of:			
Stock	Period 0	Period 1	Period 2	Period 3	Period 4
A	0.2	0.2	0.28	0.26	0.26
B	0.2	0.2	0.16	0.16	0.16
C	0.2	0.2	0.16	0.16	0.14
D	0.2	0.2	0.2	0.22	0.24
E	0.2	0.2	0.2	0.2	0.2

Holding Measure of Security Selection: Example

Panel C shows the holdings of the active manager at the beginning dates for each of the periods

- The portfolio weights (33.3% for A at the beginning of 2) are computed by multiplying the stock price (14 for A Date 1) with the portfolio holdings (10 for A Date 1) for the numerator
- Denominator is = $14 \times 10 + 8 \times 5 + 8 \times 5 + 10 \times 10 + 10 \times 10 = 420$

C. Active Manager Holding Data					
	Shares Held On:				
Stock	Date –1	Date 0	Date 1	Date 2	Date 3
A	0	10	10	10	10
B	10	5	5	0	0
C	10	5	5	10	10
D	10	10	10	10	10
E	10	10	10	10	10

C. Active Manager Holding Data					
	Portfolio Weight (w_{jt}) at Beginning Of:				
Stock	Period 0	Period 1	Period 2	Period 3	Period 4
A	0	0.25	0.333	0.31	0.31
B	0.25	0.125	0.095	0	0
C	0.25	0.125	0.095	0.19	0.167
D	0.25	0.25	0.238	0.262	0.286
E	0.25	0.25	0.238	0.238	0.238

Holding Measure of Security Selection: Example

Now, let us compute the GT measure

Value-Weighted Index				
Stock	$(w_1 - w_0) \times R_1$	$(w_2 - w_1) \times R_2$	$(w_3 - w_2) \times R_3$	$(w_4 - w_3) \times R_4$
A	0	–0.57	0	0
B	0	0	0	0
C	0	0	0	0.29
D	0	0	0.18	0
E	0	0	0	0
GT	0.00%	–0.57%	0.18%	0.29%

Active Manager				
Stock	$(w_1 - w_0) \times R_1$	$(w_2 - w_1) \times R_2$	$(w_3 - w_2) \times R_3$	$(w_4 - w_3) \times R_4$
A	10	–0.59	0	0
B	2.5	0	0	0
C	2.5	0	–1.19	0.34
D	0	–0.12	0.22	0
E	0	0	0	0
GT	15.00%	–0.71%	–0.97%	0.34%

Holding Measure of Security Selection: Example

Now, let us compute the GT measure

- Average GT for VWA index= (0.00 – 0.57 + 0.18 + 0.29)/5 = 0.02%
- Average GT for the active manager = (15.00 – 0.71 + 0.97 + 0.34)/5 = 3.12%
- For the index, the average GT across the investments is close to zero (–0.02%)
- This is expected for the passive buy-and-hold portfolio
- In contrast, the average GT for an active portfolio should be positive (3.41% in this case) or negative when he has not done well

Holding Measure of Security Selection: Example

Now, let us compute the GT measure

- This positive GT indicates that the manager added substantial value through his stock selection skills
- In period 1, the decision to buy stock A at date 0 contributed 10%, whereas the decisions to sell stocks B and C contributed 2.5% each
- In contrast, the decision to repurchase stock C on date 2 subtracted 1.19% if the value

Characteristic Selectivity (CS) Performance Measure

Characteristic Selectivity (CS) Performance Measure

This is an improvement over GT

- One shortcoming of the GT measure is that it does not control for the market trends (that are public), causing increasing returns
- For example, a fund or portfolio may simply perform well because the market (or some benchmark index of which this stock was part of) did well, and it was public knowledge
- Thus, an improvement over the GT measure is suggested by comparing the returns of the actively managed fund to those of a benchmark fund that has the same aggregate investment characteristics

Characteristic Selectivity (CS) Performance Measure

This measure is described as follows: $CS_t = \sum_{j=1}^{N} w_{jt}(R_{jt} - R_{Bjt})$

- Here, R_{Bjt} is the return to a passive portfolio whose investment characteristics are matched at the beginning of period 't' with those of stock *j*
- With this, the values of CS_t can be averaged over a period to indicate the manager's ability to pick specific stocks
- Average CS = $\frac{\sum_{t=1}^{T} \text{CS}}{T}$

Characteristic Selectivity (CS) Performance Measure

This measure credits the manager for selecting the stock that outperforms a style-matched index investment and penalizes when the opposite is true

- The argument is that why should an investor pay the management fee of actively managed stock when the investor can simply buy these indexes that suit certain investment styles
- Thus, the manager is rewarded only when his portfolio outperforms the passive portfolio matched in terms of investment style indices
- One challenge to this measure is the identification of risk and style characteristics of stocks that the active manager plans to hold

Summary and Concluding Remarks

Summary and Concluding Remarks

- Portfolio performance can be evaluated along two dimensions: (a) timing and (b) selection
- Timing involves changing the sensitivity of the portfolio to one or more systematic influences in anticipation of market movements
- One can statistically measure the timing ability, whether the manager is successfully able to predict future market movements
- Holding measures of timing involve estimate properties of the portfolio using holdings data

Summary and Concluding Remarks

- Selection involves the ability of the manager to select securities with positive alphas
- Similar to timing, one can also compute the holding measure of security selection
- Some of the useful performance measures we discussed included EGB measure of timing, GT measure of security selection, and characteristic selectivity measure of performance