Artificial Intelligence (AI) For Investments

Lesson 3: Portfolio Performance Evaluation – Timing and Selection

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

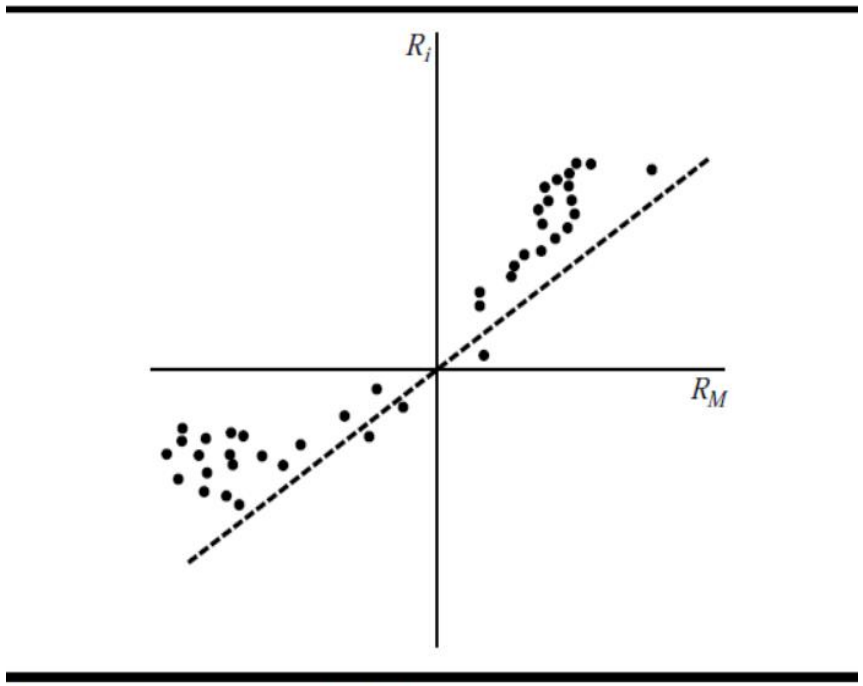
Timing involves changing the sensitivity of the portfolio to one or more systematic influences in anticipation of future market movements

- 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



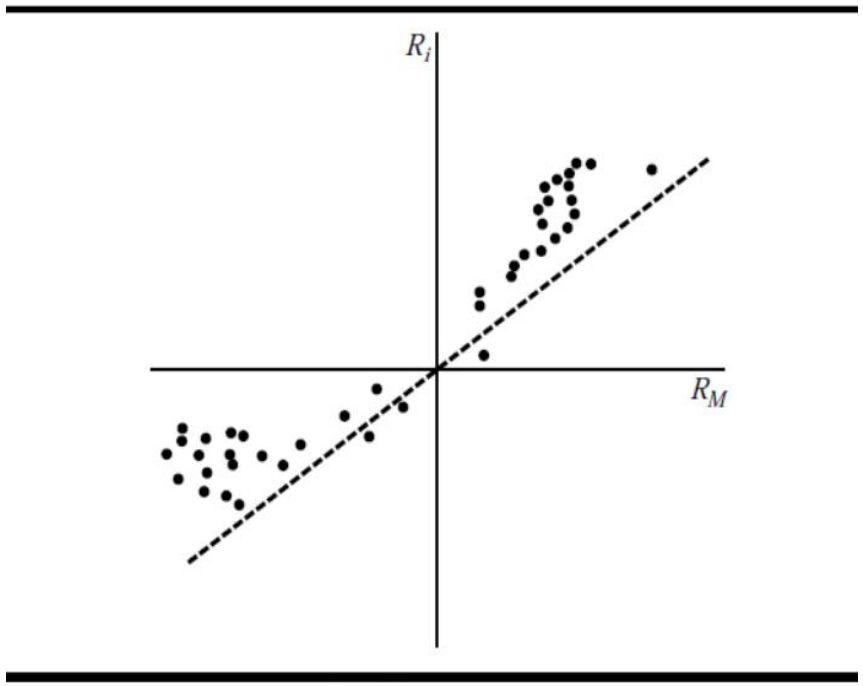
Returns for manager with timing.

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.

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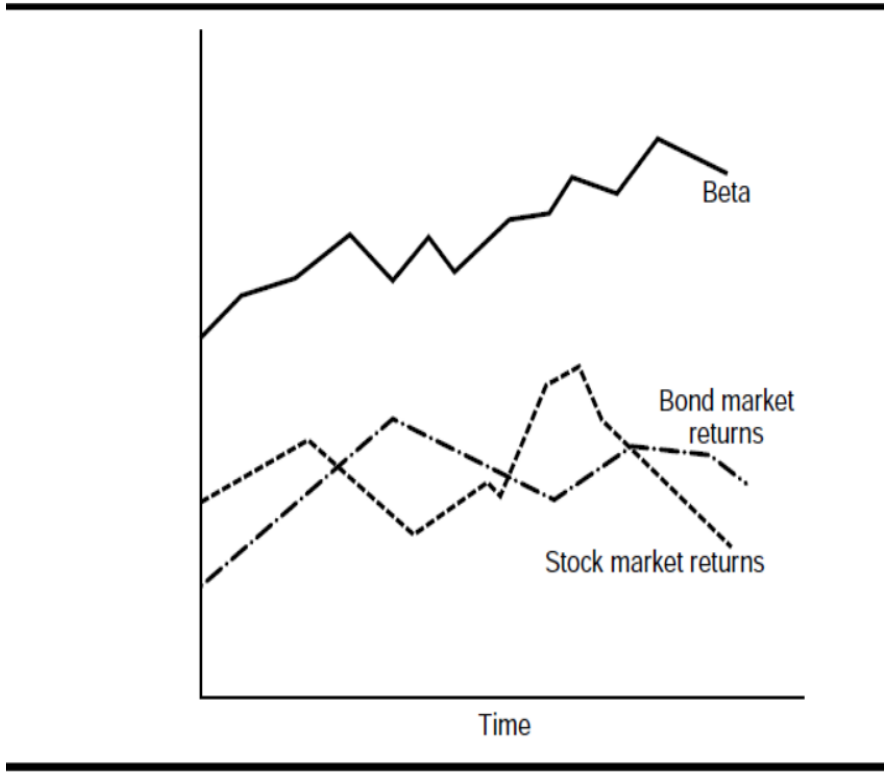
Evaluation of Market Timing

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



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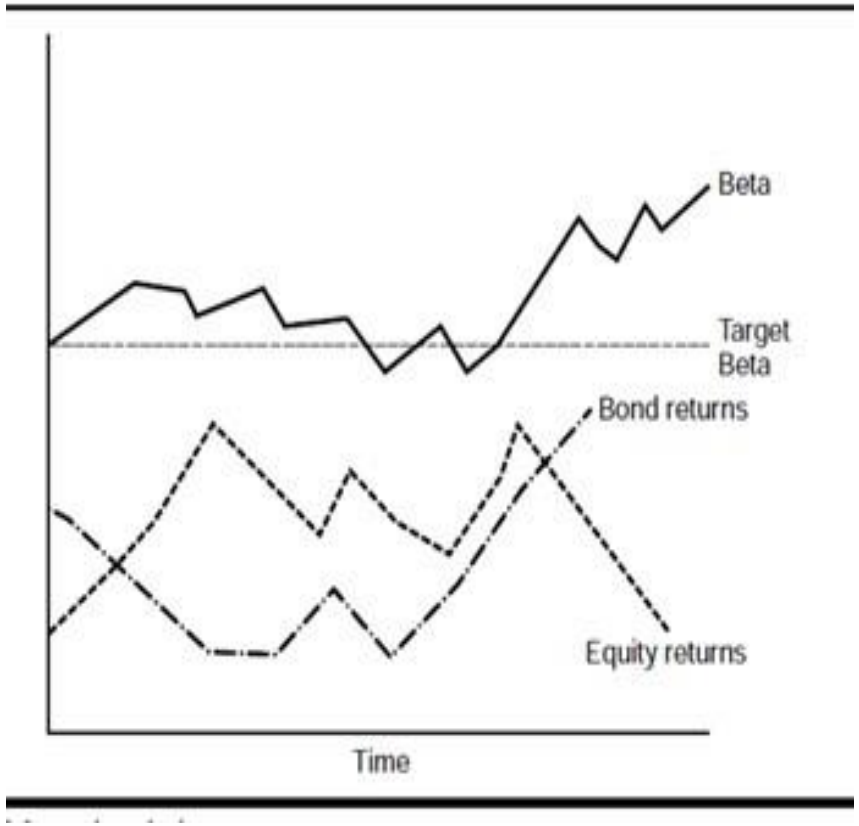
Evaluation of Market Timing

- 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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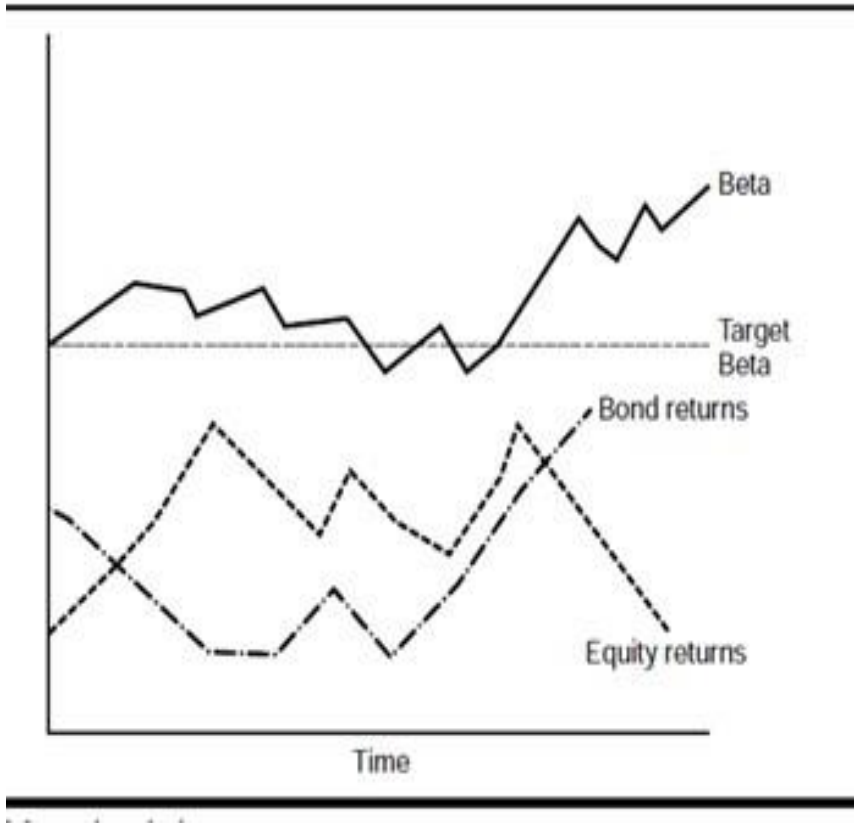
Evaluation of Market Timing

- 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



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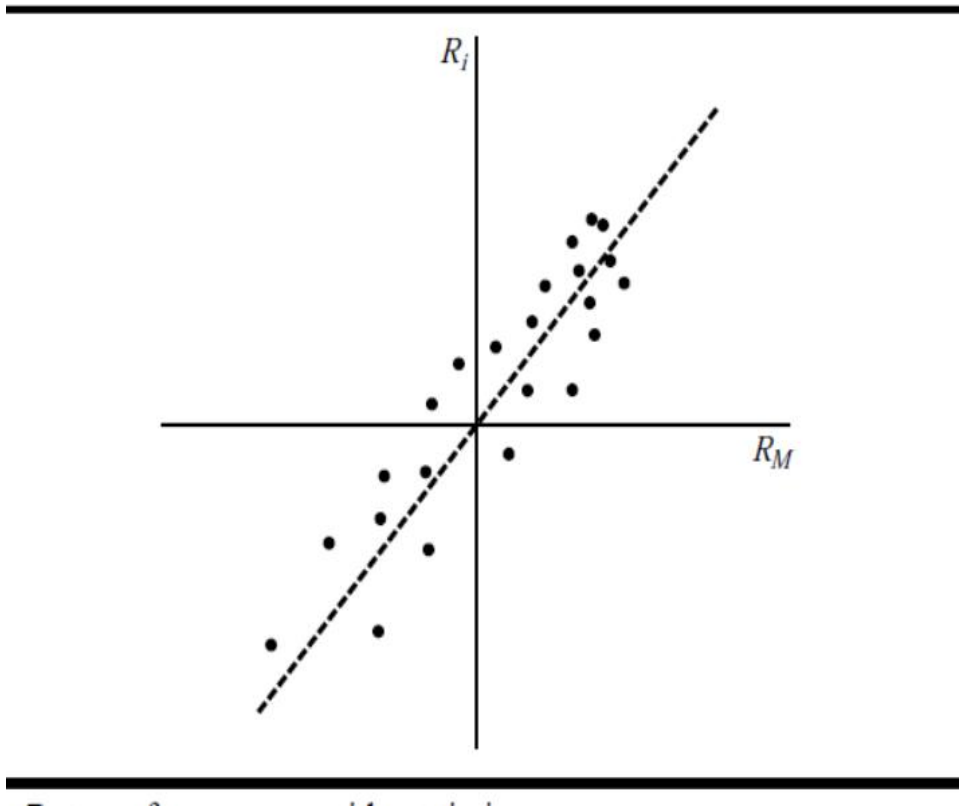
Evaluation of Market Timing

- 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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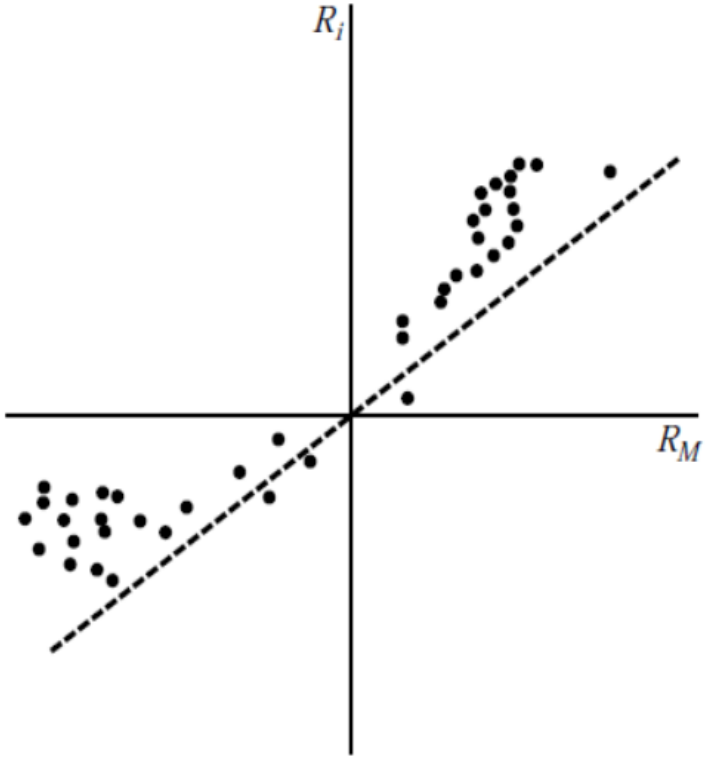
Evaluation of Market Timing

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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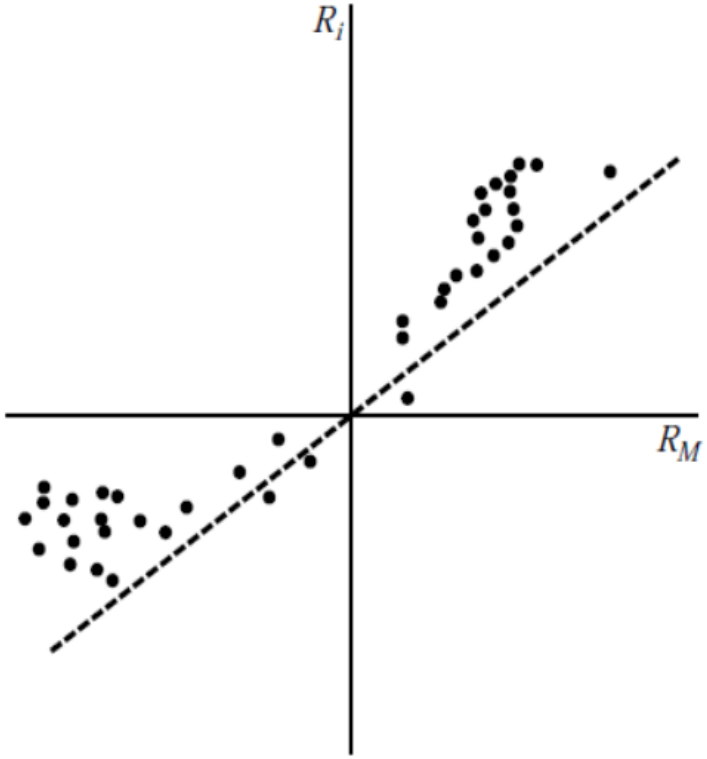
Evaluation of Market Timing: Manager With Timing

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
- $GT_t = \sum_{j=1}^{N} (w_{jt} - w_{jt-1}) R_{jt}$
- 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 *j*th 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_{it}) 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: $\mathrm{CS}_t = \sum_{j=1}^{N} w_{jt}(R_{jt} - R_{Bjt})$

- 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 = $\frac{\sum_{t=1}^{T} \mathrm{CS}}{T}$

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

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- 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

Thanks!