Learning Module 2: Security Market Indices

LOS 2a: describe a security market index

A security market index represents a given security market, market segment, or asset class, usually constructed as portfolios of marketable securities, known as constituent securities. Indexes help investors track performance and risk, benchmark active managers, and invest in broad markets at low costs.

An index may have two versions: a price return index, which tracks only the price of constituent securities, and a total return index, which accounts for reinvestment of interest, dividends, and other distributions.

Question

Assuming an index is made up of dividend-paying stocks, what type of index would likely post higher long-term returns?

A. Price return index.
B. Total return index.
C. Neither, price and total returns should be exactly equal.

Solution

The correct answer is **B**.

Since dividends are assumed to be reinvested back into the total return index and not the price return index, the total return index will outperform as dividends are added in and compounded over time.

LOS 2b: calculate and interpret the value, price return, and total return of an index

Index Value

The formula for calculating the value of a price return index is as follow:

$$V_{PRI} = \frac{\sum_{i=1}^{N} n_i P_i}{D}$$

Where:

V_{PRI} = the value of the price return index

n_i = the number of units of constituent security held in the index portfolio

N = the number of constituent securities in the index

P_i = the unit price of constituent security

D_i = the value of the divisor

While the formula for calculating the value of an index may seem somewhat complicated at first glance, it is similar to calculating the value of any other normal portfolio of securities as it involves adding up the values of constituent securities. Index value calculation has just one additional step of dividing the sum of constituent securities' values by a divisor, which is usually chosen at the inception of the index to set a convenient beginning value and then adjusted to offset index value changes unrelated to changes in the prices of constituent securities.

Example 1: Index Value

An index is made up of two constituent securities, Stock A and Stock B. What beginning divisor must be used to achieve a beginning value of 1,000?

Security	Units	Price/Unit
Stock A	50	10
Stock B	30	100

Let’s first calculate the sum of the values of both constituent securities.

Stock A value = 50 × 10 = 500

Stock B value = 30 × 100 = 3,000

Stock A value + Stock B value = 3,500

The divisor must be set such that this figure is adjusted down to 1,000.

$$1,000 = \frac{3,500}{D}$$

$$D = \frac{3,500}{1,000}$$

$$D = 3.5$$

Price Return and Total Return

The price return calculation – the return from the index in percentage terms – is simply the difference in value between the two periods divided by the beginning value.

$$PR_I = \frac{V_{PRI1} - V_{PRI0}}{V_{PRI0}}$$

The formula for total return is the same, except we need to add the income generated from the securities, usually in the form of dividends:

$$TR_I = \frac{V_{PRI1} - V_{PRI0} + Income_I}{V_{PRI0}}$$

PR_I = the price return of the index portfolio

V_{PRI1} = the value of the price return index at the end of the period

V_{PRI0} = the value of the price return index at the beginning of the period

TR_I = the total return of the index portfolio

$Income_I$ = the total income from all securities in the index over the period

Another way to calculate these returns would be to sum up the weighted returns of each constituent security in the index portfolio.

$$R_I = w_1R_1 + w_2R_2 + \ldots + w_NR_N$$

R_I = the return of the index portfolio number (as a decimal number)

R_i = the return of constituent security i (as a decimal number)

w_i = the weight of security i (the fraction of the index portfolio allocated to security

Note that this formula works for both price and total return calculations.

Example 2: Price Return and Total Return

Calculate the one-year price return and total return for the Uncommon & Riches 5, a fictional index made up of five constituent securities. The divisor's value begins and ends the year at 1.

Constituent Security	Units (billions)	Beginning Value	Dividend	Ending Value
Orange	5	107	2.15	116
Macrotough	7.75	55	1.20	62
Enout Stationary Corp	4	75	2.70	91
Draintree	0.5	660	0.00	750
Smith & Smith	2.75	100	3.00	115

Let's first calculate the beginning index price by multiplying the number of units and price of each constituent security and totaling the values.

V_{PRI0} = (5 × 107) + (7.75 × 55) + (4 × 75) + (5 × 660) + (2.75 × 100)

V_{PRI0} = 535 + 426.25 + 300 + 330 + 275 = 1,866.25

We'll do the same calculation again, except replace the beginning values with ending values.

$V_{PRI1} = (5 \times 116) + (7.75 \times 62) + (4 \times 91) + (5 \times 750) + (2.75 \times 115)$

$V_{PRI1} = 580 + 480 + 364 + 375 + 316.25 = 2{,}115.75$

And one more time to calculate portfolio income.

$\text{Income}_I = (5 \times 2.15) + (7.75 \times 1.20) + (4 \times 2.70) + (5 \times 0) + (2.75 \times 3)$

$\text{Income}_I = 10.75 + 9.30 + 10.80 + 8.25 = 39.10$

The one-year price return for the Uncommon & Riches 5 comes out to: (2,115.75 – 1,866.25)/1,866.25 = **13.37%**

To calculate the total return, we'll add in the portfolio income: (2,115.75 + 39.10 – 1,866.25)/1,866.25 = **15.46%**

LOS 2c: describe the choices and issues in index construction and management

Index providers generally take a top-down approach to constructing a portfolio by defining:

1. the target market;
2. the portfolio constituents within that market;
3. the weights of individual securities;
4. the rebalancing frequency; and
5. when to re-examine the portfolio construction methods.

Target Market

Depending on the index, the target market may be defined broadly or narrowly based on asset class, geographic region, exchange, and/or other characteristics (sector, size, style, duration, credit quality).

Security Selection

Constituent securities are then selected from the available universe of securities in the given target market. Some indices may limit the number of securities to a certain amount, while others may have their number of holdings vary over time. Finally, the securities are weighted based on price, equal weights, market capitalization, or fundamentals (book value, cash flow, revenues, earnings, dividends, the number of employees).

We will see those different weighting methods and the rebalancing methods commonly used in the next learning objectives.

Question

Which of the following is NOT usually a part of the standard index construction process?

A. Determining an appropriate benchmark for the index.
B. Deciding when the index portfolio should be rebalanced.
C. Deciding how to weight constituent securities within the index.

Solution

The correct answer is **A**.

Most of the time, an index can serve as a benchmark but does need to establish a benchmark for its own performance.

LOS 2d: compare the different weighting methods used in index construction

There is no perfect index weighting method as each one has its own strengths and weaknesses.

Price Weighting

In price-weighted indices, an equal number of shares of each security is purchased, and the beginning divisor is usually set to the total number of shares in the portfolio. Using this method, the highest-priced stocks have the highest weightings within the portfolio regardless of their total market capitalization. For stock splits not to change all portfolio weights, the divisor must be adjusted. Price-weighted indices are the easiest to calculate but generally have arbitrary index weightings.

Equal Weighting

Equal-weighted indices involve a simple calculation to find the appropriate weight of each constituent within the portfolio. Since securities that experience greater capital appreciation during a period will naturally become over-weighted in these indices, a rebalance to equal weighting helps to avoid allocating the most capital to the most expensive stocks. Equal-weighted indices involve frequent rebalancing and don’t necessarily reflect the overall performance of all investors in those securities.

Market-capitalization Weighting

To weight an index by market capitalization, a company’s shares outstanding are multiplied by its per-share market value and calculated as a proportion of total market capitalization. This helps introduce a natural momentum factor into the market-cap weighted index as price changes generally correspond with market capitalization and, therefore, the desired weighting in the index. Market capitalization indices are commonly used by index funds due to minimal turnover

but cause the investor to hold more of a constituent security as its price (and therefore market capitalization) increases faster than the broader market.

Float-adjusted Market-capitalization Weighting

In float-adjusted market-capitalization weighting, the weight of each constituent security is determined by adjusting market capitalization for its market float. Float refers to the regular shares a company has issued to the public available for investors to trade. Most market capitalization-weighted indices are adjusted for float.

Fundamental Weighting

Attempts to give the index a “value tilt” by weighting constituent securities based on certain factors such as book value, earnings, and dividends. While market capitalization indices mostly take on a momentum tilt, fundamental-weighted indices will do the opposite by rebalancing to “contrarian” positions when the price paid for the given factor is low.

Question

Which type of index weighting method is naturally rebalanced by price changes in its constituent securities?

A. Equal.
B. Fundamental.
C. Market-capitalization.

Solution

The correct answer is **C**.

Market-capitalization indices tend to rebalance automatically with changes in price since the outperformance of one constituent security against the broad portfolio will generally increase the weight of that security within the index in line with the security's increase in proportion of total market capitalization.

A is incorrect. Unless all constituent securities move together, any price changes in equal-weighted indices must be frequently rebalanced.

B is incorrect. Fundamental-weighted indices must also be constantly rebalanced based on price changes and updates in company fundamentals.

LOS 2e: calculate and analyze the value and return of an index given its weighting method

Every index weighting method has a formula that calculates the weighting of a given constituent security within an index. For the following examples, the same portfolio of three securities will be used to help illustrate the weighting methods. Note that while income from constituent securities could hypothetically be reinvested in the index, the index level adjusts only for price changes.

Security	Beg. Price/Share	Income	End Price/Share
Security A	500	0	750
Security B	20	1	21
Security C	45	1	25
Total		2	

Price Weighting

Here, the weight of each security *i* is given by:

$$w_i^P = \frac{P_i}{\sum_{i=1}^{N} P_i}$$

Where:

w_i = fraction of the portfolio that is allocated to the security or weight of the security

N = number of securities in the index

P_i = price of the security

Example of a price-weighted index

Security	Beg. Value	Income	End Value	Shares	Beg. Weight	End Weight
Security A	500	0	750	1	88.5%	94.2%
Security B	20	1	21	1	3.5%	2.6%
Security C	45	1	25	1	8.0%	3.1%
Total	188.33		265.33	3	1	1
Price Return	40.9%					
Total Return	41.2%					

One share of each security is held in the index, and the divisor is set to 3 – the total number of shares. The high weighting of Security A in both periods is perhaps the most interesting part of this index. While this is an extremely concentrated index, price/share is nevertheless very important in how securities are weighted in price indices, even though it remains a mostly arbitrary figure.

Equal Weighting

Here, the weight of each security *i* is given by:

$$w_i^E = \frac{1}{N}$$

Where:

N = number of securities in the index

Example of an equal-weighted index

Security	Beg. Value	Income	End Value	Shares	Beg. Weight	End Weight
Security A	500	0	750	1	33.3%	48.3%
Security B	500	25	525	25	33.3%	33.8%
Security C	500	11	278	11.11	33.3%	17.9%
Total	1,500.00	36.11	1,552.78	37.11	100%	100%
Price Return	3.5%					
Total Return	5.9%					

As shown in the table, each of the three securities is equally weighted within the index at the beginning of the period but largely strayed from the initial weights. While the price index posted

returns above 40%, returns of the three-security portfolio were much more modest when beginning with the same values.

Market-capitalization

Here, the weight of each security *i* is given by:

$$w_i^M = \frac{Q_i P_i}{\sum_{i=1}^{N} Q_i P_i}$$

Where:

Q_i = number of shares outstanding of security

Example of a market-capitalization index

Security	Beg. Value	Income	End Value	Out. Shares(mm)	Beg. Weight	End Weight
Security A	1,500	0	2,250	3	25.6%	46.7%
Security B	300	15	315	15	5.1%	6.5%
Security C	4,050	90	2,250	90	69.2%	46.7%
Total	5,850.00	105.00	4,815.00	108.00	100%	100%
Price Return	−17.7%					
Total Return	−15.9%					

Note that the column that recorded constituent shares as part of the index portfolio is now equal to millions of outstanding shares. The beginning and ending values now reflect the market capitalizations of the companies in the index portfolio. Since Security C has by far the largest amount of shares outstanding, it accounts for more than two-thirds of market capitalization when multiplied out with the share price at the beginning of the period. As a result of Security C's heavy weighting, the market-capitalization index performed very poorly during the period.

Float-adjusted Market-capitalization Weighting

Here, the weight of each security *i* is given by:

$$w_i^{fM} = \frac{f_i Q_i P_i}{\sum_{i=1}^{N} f_i Q_i P_i}$$

Where:

f_i = fraction of shares outstanding in the market float

Example of a float-adjusted market-capitalization index

Security	Beg. Value	Income	End Value	Out. Shares(mm)	Beg. Weight	End Weight	M
Security A	750	0	1,125	3	15.4%	31.7%	
Security B	270	14	284	15	5.5%	8.0%	
Security C	3,848	86	2,138	90	79.0%	60.3%	
Total	4,867	99.00	3,546.00	108.00	100%	100%	
Price Return	−27.1%						
Total Return	−25.1%						

To calculate float-adjusted market capitalization, we multiply each market capitalization by its respective fraction of outstanding shares in the market float. Since Security A is more closely held with just 50% market float, its weight is significantly reduced in the float-adjusted index compared to the unadjusted market capitalization index. In this scenario, the index's performance becomes highly skewed by Security C’s losses during the period.

LOS 2f: describe rebalancing and reconstitution of an index

Index managers must consider when the index should be rebalanced and when the security selection and weighting decisions should be re-examined.

Rebalancing

Rebalancing refers to adjusting the weights of the constituent securities in the index on a regularly scheduled basis – usually quarterly. Price-weighted indices are not rebalanced, and rebalancing is a minor concern for market capitalization indices as they mostly rebalance themselves.

Reconstitution

Reconstitution is the process of changing the constituent securities in an index. Since many indices base their portfolio allocation on a set of criteria, the securities that meet the criteria tend to change over time. Securities that no longer meet the criteria are excluded on the reconstitution date, and new securities are included. Oftentimes, the reconstitution will require further rebalancing as the turnover of securities changes the targeted allocations. Expected inclusion of certain securities in a widely-tracked index tends to drive prices up while expected exclusion tends to drive prices down in anticipation of future purchases or sales of related index funds.

Question

If a company in a market-capitalization index with a market capitalization of $15 billion at quarter-end will be replaced by a company with a market capitalization of $17.5 billion, what effect would the reconstitution have on the other companies within the index?

A. Allocations would stay the same.
B. Allocations to other companies would increase.
C. Allocations to other companies would decrease.

Solution

The correct answer is **C**.

Since the company to be added has a higher market capitalization than the one being kicked out of the index, the new company will be weighted more heavily thus reducing allocation to all other companies within the index.

LOS 2g: describe uses of security market indices

The primary uses of market indices are to (1) gauge market sentiments, (2) serve as proxies for measuring returns and risk, (3) serve as proxies for asset classes, (4) benchmark active managers, and (5) model portfolios for index funds and exchange-traded funds.

1. **Gauges of Market Sentiment:** the original purpose of indices was to get a sense of investor confidence and market sentiment.
2. **Return/Risk Proxies:** indices play a useful role in the capital asset pricing model as a certain index (like the S&P 500) sets the expected return and risk for the overall market. Beta (systematic risk) can then be calculated for individual securities based on their covariance with the index, and alpha (risk-adjusted excess returns) can be calculated for active managers.
3. **Asset Class Proxies:** Future assumptions regarding the return and risk profiles of certain asset classes are largely centered on how various broad indices have performed in the past.
4. **Active Management Benchmarks:** indices can also be useful in judging the relative performance of active managers as long as the selected benchmark targets the same markets as the active manager.
5. **Model Portfolios:** indices dictate the investments and weightings of index funds and exchange-traded funds, which help investors gain passive broad exposure to certain markets – usually at a lower cost than active management.

Question

What type of actively-managed fund might use the S&P 500 as a performance benchmark?

A. US small-cap equity fund.
B. US large-cap equity fund.
C. Global large-cap equity fund.

Solution

The correct answer is **B**.

Since the S&P 500 is based on the largest 500 liquid and publicly-listed stocks in the United States, it would not serve as an appropriate benchmark for a US small cap equity fund or for a global large cap fund.

LOS 2h: describe types of equity indices

Types of equity indices include broad market, multi-market, sector, and style indices.

1. **Broad Market Indices:** typically represents more than 90% of a selected market. Common US broad market indices include the Wilshire 5000 or Russell 3000.
2. **Multi-market Indices:** usually comprise indices from different countries and are designed to represent multiple security markets, useful for investors taking a global approach to equity investing. For example, the S&P Global 1200 is constructed as a composite of 7 headline indices, many of which are accepted leaders in their regions. These include the S&P 500® (US), S&P Europe 350, S&P TOPIX 150 (Japan), S&P/TSX 60 (Canada), S&P/ASX All Australian 50, S&P Asia 50, and S&P Latin America 40.
3. **Sector Indices:** represent and track different economic sectors on a national, regional, or global basis. Sector indices are helpful for investors wanting more exposure to certain sectors and to help determine if an active manager's performance is based on stock selection or sector allocation. The S&P Health Care Sector Index would be, as the name suggests, an example of a sector index.
4. **Style Indices:** represent groups of securities classified according to market capitalization, value, growth, or a combination of these characteristics. Large-cap, mid-cap, and small-cap equities can be further classified as value, growth, or blend (a combination of the two). The Russell 3000 Growth Index would be an example of a style index.

Question

A general emerging markets equity index fund likely tracks what type of index?

A. A style index.

B. A multi-market index.

C. A broad market index.

Solution

The correct answer is **B**.

Broad market indices mostly refer to those that represent a large proportion of a market within a given country, and style indices are only appropriate for index funds with a deliberate style-tilt. Since emerging markets equity funds span across different countries, it would be sensible for this index fund to follow a multi-market index.

LOS 2i: describe types of fixed-income indices

Construction

The number of fixed-income securities is often larger than the number of equity securities since fixed-income issuers often issue various fixed-income instruments with different characteristics. This expansive universe means that fixed-income indices may have to include thousands of different securities to track their target market accurately. Additionally, these markets lack liquidity, and index providers must contact dealers to obtain prices or even estimate prices based on other securities with similar characteristics. These challenges make it more difficult and costly for investors to replicate fixed-income indices.

Types of Indices

Fixed income securities may be classified by the issuer’s economic sector, geographic region, or the economic development of the issuer’s region. Classification may also be based on the type of issuer or financing, the currency of payments, maturity, credit quality, or the presence of inflation protection. Fixed-income indices are further categorized into aggregate or broad market indices, market sector indices, style indices, economic sector indices, and specialized indices (high-yield, inflation-linked, emerging market).

Question

Which of the following is *least likely* a challenge in constructing a fixed-income index?

A. Lack of liquidity .
B. Large size of the investment universe.
C. Difficulty estimating future interest payments.

Solution

The correct answer is **C**.

Options A and B are incorrect since they are, in fact, challenges. Fixed-income index managers often struggle with a low amount of liquidity and a high number of securities.

Another challenge is estimating current value for illiquid fixed-income securities, but estimating future interest payments is not a necessary step or challenge in constructing a fixed-income index.

LOS 2j: describe indices representing alternative investments

As alternative investments have increased in popularity, it has become necessary to create alternative investment indices. The most widely followed classes of indices include commodities, real estate, and hedge funds.

Commodity Indices

These indices consist of futures contracts on one or more commodities. Although some commodity indices may include the same commodities, returns may differ based on the weighting method. Since there is no clear way to weigh indices of futures contracts, commodity index providers create their own methods. For instance, some indices contain a fixed number of equally-weighted commodities, a combination of liquidity measures and world production values, or have a committee to determine index weights.

Due to significant variance in weighting methods between indices targeting the same markets, commodity index portfolios may exhibit very different risk and return profiles. Also, price changes within a commodities index will differ significantly from the prices of underlying assets.

Real Estate Indices

Real estate indices include the highly illiquid market for real estate and the highly liquid market for real estate securities. Real estate indices are categorized as appraisal, repeat sales, or real estate investment trust (REIT) indices.

Hedge Fund Indices

These indices track hedge funds – private investment vehicles that use leverage, long-short strategies, and charge additional performance-based fees. Since hedge funds are only required to report performance to their investors, their inclusion in these indices is usually voluntary. As a

result, hedge fund indices typically struggle with performance differences between similar indices (due to hedge funds reporting to one index, but not the other) and survivorship bias (exclusion of poorly performing and/or closed funds).

Question

The performance of which of the following can be easily duplicated by an index fund?

A. REITs.
B. Real estates.
C. Hedge funds.

Solution

The correct answer is **A**.

REITs are highly liquid securities and there are a number of REIT indices in existence that accurately track the performance of REITs.

A is incorrect. A real estate index would be very difficult, if not impossible, to replicate due to the illiquid and heterogeneous nature of real estate investments.

B is incorrect. Hedge fund indices would be similarly difficult to replicate due to their illiquidity, limited access, and the inherent biases of hedge fund indices.

LOS 2k: compare types of security market indices

Investors can choose from security market indices representing various asset classes, including equity, fixed-income, commodity, real estate, and hedge fund indices. While proper use of any index is dependent on understanding their construction and management, it is also important to note the significant differences between asset class indices.

Equity indices are the easiest to implement as they are based on securities that are typically highly liquid and easily priced. On the other hand, fixed-income indices pose more of a problem due to limited liquidity, a massive universe of fixed-income securities, and imprecise value estimates.

Commodity indices are usually based on baskets of futures contracts instead of actual commodity prices and thus lack an obvious weighting method. Additionally, commodity indices with the same target markets often vary dramatically in composition.

Real estate indices track illiquid and unique properties, while REIT indices track highly liquid securities that often correlate with price changes in other marketable securities. Finally, hedge fund indices lack the information to effectively track the broad hedge fund universe and often struggle with survivorship bias.