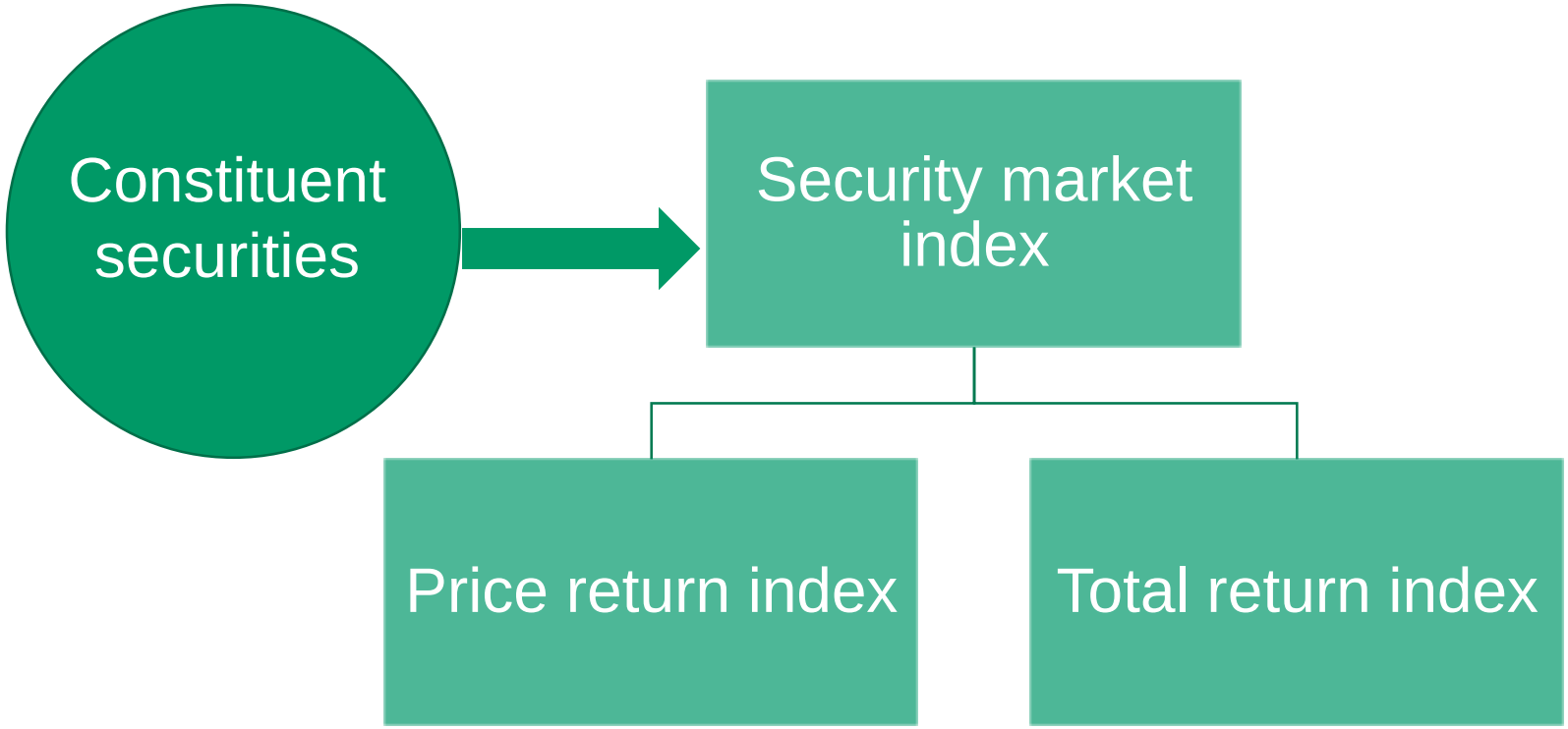
CHAPTER 2
SECURITY MARKET INDICES

Presenter
Venue
Date

CFA Institute

DESCRIPTION OF A SECURITY MARKET INDEX



VALUE OF A PRICE RETURN INDEX

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

V_{PRI} = the value of the price return index
n_i = the number of units of constituent securities in the index
N = the number of constituent securities in the index
P_i = the unit price of constituent security i
D = the value of the divisor

CALCULATION OF SINGLE-PERIOD PRICE RETURN

$$PR_I = \frac{V_{PRI1} - V_{PRI0}}{V_{PRI0}} = \sum_{i=1}^{N} w_i PR_i = \sum_{i=1}^{N} w_i \left(\frac{P_{i1} - P_{i0}}{P_{i0}} \right)$$

PR_I = the price return of index portfolio I

PR_i = the price return of constituent security i

w_i = the weight of security i

P_{i1} = the price of constituent security i at the end of the period

P_{i0} = the price of constituent security i at the beginning of the period

EXAMPLE: CALCULATION OF SINGLE-PERIOD PRICE RETURN

Security	Beginning of Period Price (€)	Ending of Period Price (€)	Dividends per share (€)	Shares Outstanding
LMN	10.00	12.00	0.50	200
OPQ	25.00	24.00	1.00	100
RST	15.00	18.00	0.25	400
Divisor = 100				

$$V_{PRI0} = \frac{(200 \times 10) + (100 \times 25) + (400 \times 15)}{100} = 105.00$$

$$V_{PRI1} = \frac{(200 \times 12) + (100 \times 24) + (400 \times 18)}{100} = 120.00$$

$$PR_I = \frac{120.00 - 105.00}{105.00} \approx .1429 \approx 14.29\%$$

CALCULATION OF SINGLE-PERIOD TOTAL RETURNS

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

$$TR_I = \sum_{i=1}^{N} w_i TR_i = \sum_{i=1}^{N} w_i \left(\frac{P_{1i} - P_{0i} + Inc_i}{P_{0i}} \right)$$

TR_I = the total return of the index portfolio
Inc_I = the total income from all securities in the index
TR_i = the total return of the constituent security *i*
Inc_i = the total income from security *i*

EXAMPLE: CALCULATION OF SINGLE-PERIOD TOTAL RETURN

Security	Beginning of Period Price (€)	Ending of Period Price (€)	Dividends per share (€)	Shares Outstanding
LMN	10.00	12.00	0.50	200
OPQ	25.00	24.00	1.00	100
RST	15.00	18.00	0.25	400
Divisor = 100				

$$\text{Inc}_I = [(200 \times 0.50) + (100 \times 1.00) + (400 \times 0.25)] \div 100 = 3.00$$

$$\text{TR}_I = \frac{120.00 - 105.00 + 3.00}{105.00} \approx .1714 \approx 17.14\%$$

CALCULATION OF INDEX VALUES OVER MULTIPLE TIME PERIODS

The calculation of index values over multiple time periods requires geometrically linking the series of index returns.

$$V_{PRIT} = V_{PRI0}(1+PR_{I1})(1+PR_{I2})\ldots(1+PR_{IT})$$
$$V_{TRIT} = V_{TRI0}(1+TR_{I1})(1+TR_{I2})\ldots(1+TR_{IT})$$

EXAMPLE: CALCULATION OF INDEX VALUES OVER MULTIPLE TIME PERIODS

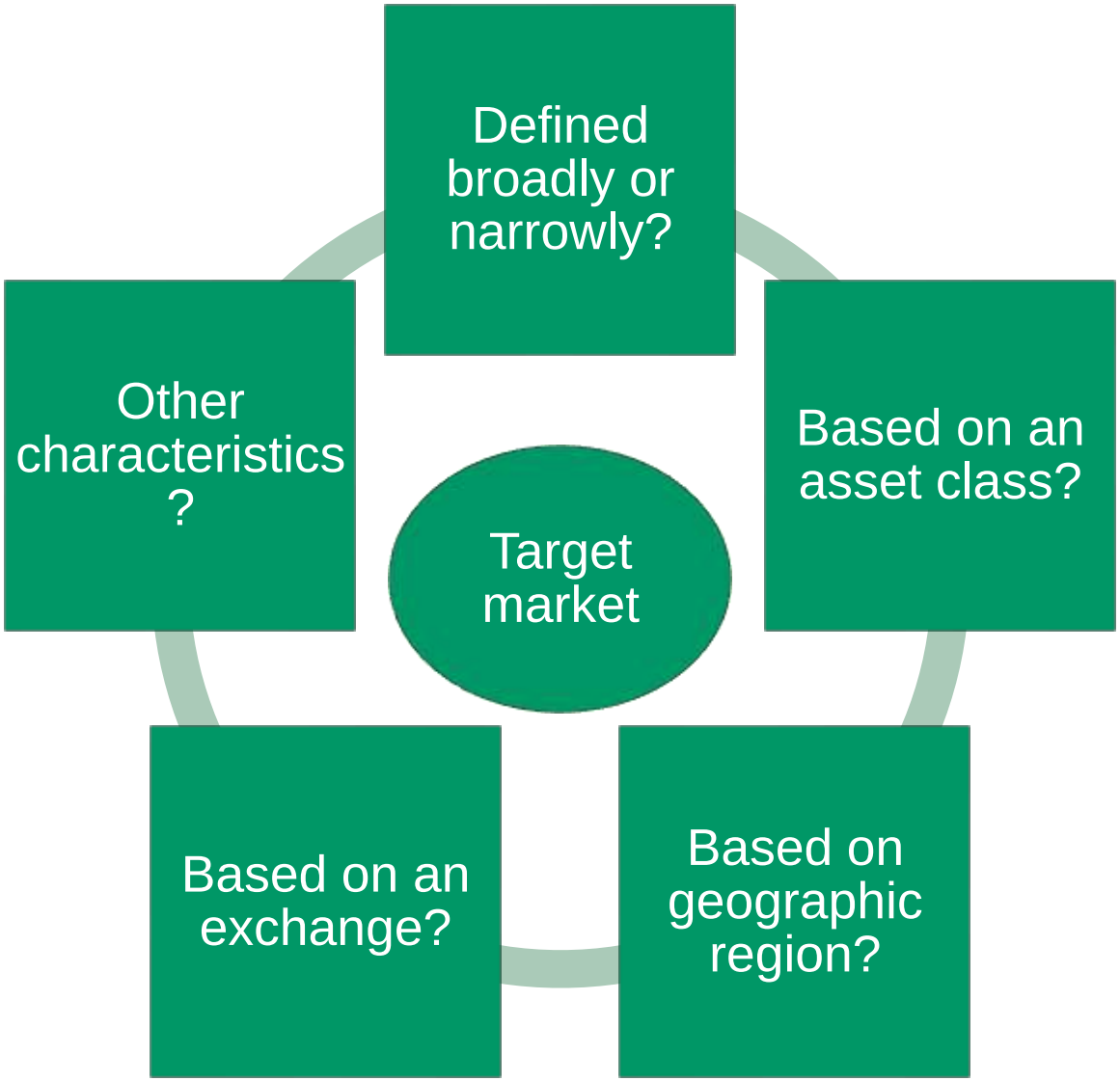
For an index with an inception value set to 1,000 and price returns of 5 percent and 3 percent for Periods 1 and 2 respectively, the values of the price return index would be calculated as follows:

Period	Return (%)	Calculation	Ending Value
0		1,000(1.00)	1,000.00
1	5.00	1,000(1.05)	1,050.00
2	3.00	1,000(1.05)(1.03)	1,081.50

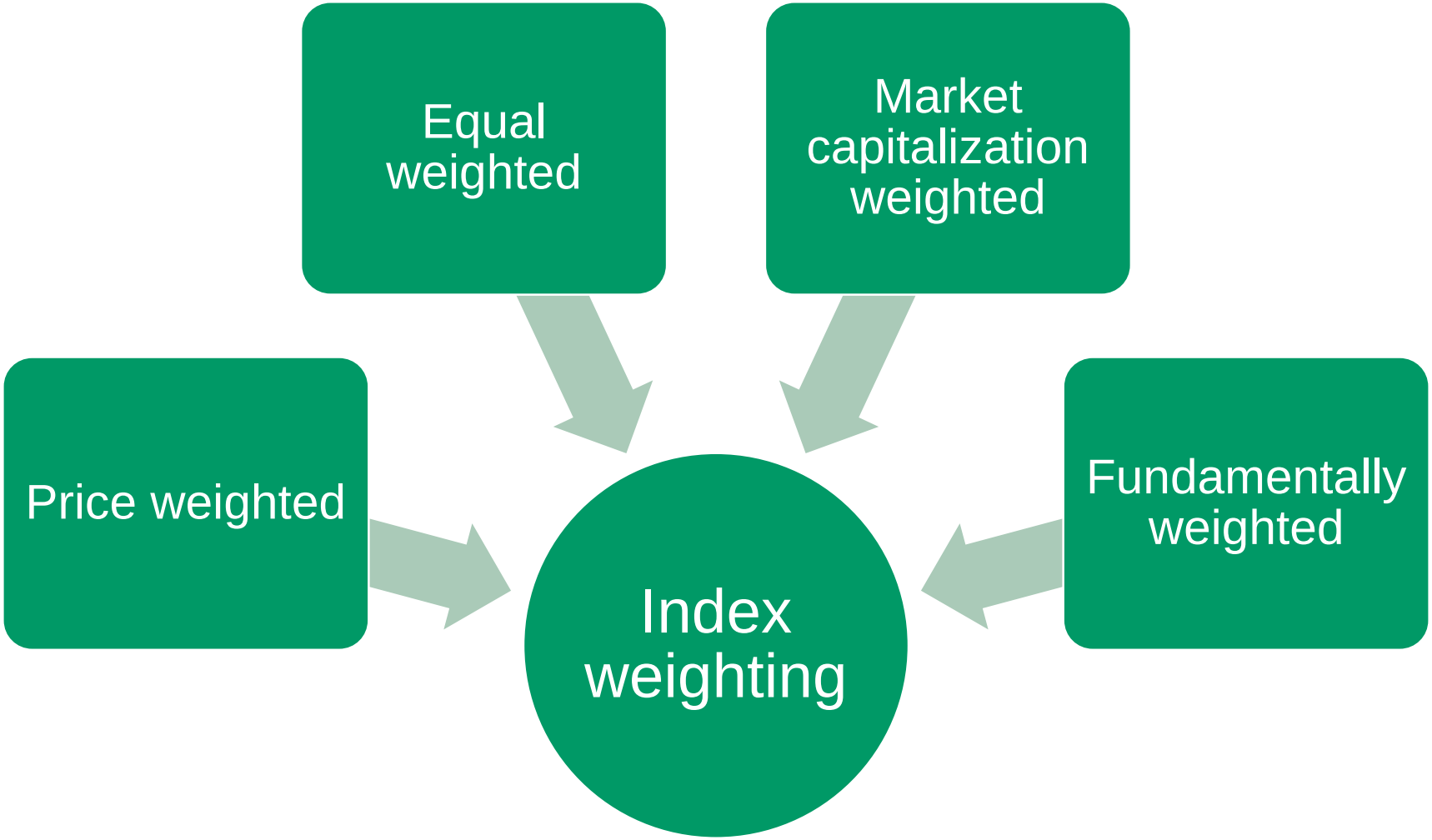
CHOICES IN INDEX CONSTRUCTION AND MANAGEMENT

- Which target market should the index represent?
- Which securities should be selected from that target market?
- How much weight should be allocated to each security in the index?
- When should the index be rebalanced?
- When should the security selection and weighting decision be re-examined?

TARGET MARKET SELECTION



DIFFERENT WEIGHTING METHODS USED IN INDEX CONSTRUCTION



WEIGHTING SCHEMES

Price weighted:

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

Market capitalization weighted:

$$w_i^M = \frac{Q_i P_i}{\sum_{j=1}^{N} Q_j P_j}$$

Equal weighted:

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

Factor weighted:

$$w_i^F = \frac{F_i}{\sum_{j=1}^{N} F_j}$$

EXHIBIT 2-1 EXAMPLE OF A PRICE-WEIGHTED INDEX

Security	Shares in Index	BOP Price	Value (Shares x BOP Price)	BOP Weight %	EOP Price	Dividends Per Share	Value (Shares x EOP Price)	Total Dividends	Price Return %	Total Return %	BOP Weight x Price Return %	BOP Weight x Total Return %	EOP Weight %
A	1	50.00	50.00	49.26	55.00	0.75	55.00	0.75	10.00	11.50	4.93	5.66	52.38
B	1	25.00	25.00	24.63	22.00	0.10	22.00	0.10	–12.00	–11.60	–2.96	–2.86	20.95
C	1	12.50	12.50	12.32	8.00	0.00	8.00	0.00	–36.00	–36.00	–4.43	–4.43	7.62
D	1	10.00	10.00	9.85	14.00	0.05	14.00	0.05	40.00	40.50	3.94	3.99	13.33
E	1	4.00	4.00	3.94	6.00	0.00	6.00	0.00	50.00	50.00	1.97	1.97	5.72
Total			**101.50**	**100**			**105.00**	**0.90**			**3.45**	**4.33**	**100.00**
Index Value			**20.30**				**21.00**	**0.18**	**3.45**	**4.33**			

Divisor = 5
BOP = Beginning of period
EOP = End of period

Type of Index	BOP Value	Return %	EOP Value
Price Return	20.30	3.45	21.00
Total Return	20.30	4.33	21.18

EXHIBIT 2-3 EXAMPLE OF AN EQUAL-WEIGHTED EQUITY INDEX

Security	Shares in Index	BOP Price	Value (Shares x BOP Price)	Weight %	EOP Price	Dividends Per Share	Value (Shares x EOP Price)	Total Dividends	Price Return %	Total Return %	Weight x Price Return %	Weight x Total Return %	EOP Weight %
A	40	50.00	2,000	20.00	55.00	0.75	2,200	30	10.00	11.50	2.00	2.30	19.93
B	80	25.00	2,000	20.00	22.00	0.10	1,760	8	–12.00	–11.60	–2.40	–2.32	15.94
C	160	12.50	2,000	20.00	8.00	0.00	1,280	0	–36.00	–36.00	–7.20	–7.20	11.60
D	200	10.00	2,000	20.00	14.00	0.05	2,800	10	40.00	40.50	8.00	8.10	25.36
E	500	4.00	2,000	20.00	6.00	0.00	3,000	0	50.00	50.00	10.00	10.00	27.17
Total			**10,000**	**100.00**			**11,040**	**48**			**10.40**	**10.88**	**100.00**
Index Value			**1,000**				**1,104**	**4.80**	**10.40**	**10.88**			

Divisor = 10
BOP = Beginning of period
EOP = End of period

Type of Index	BOP Value	Return %	EOP Value
Price Return	1,000.00	10.40	1,104.00
Total Return	1,000.00	10.88	1,108.80

EXHIBIT 2-4 EXAMPLE OF A MARKET-CAPITALIZATION-WEIGHTED EQUITY INDEX

Stock	Shares Out-standing	BOP Price	BOP Market cap	BOP Weight %	EOP Price	Dividends Per Share	EOP Market cap	Total Dividends	Price Return %	Total Return %	BOP Weight x Price Return %	BOP Weight x Total Return %	EOP Weight %
A	3,000	50.00	150,000	26.29	55.00	0.75	165,000	2,250	10.00	11.50	2.63	3.02	28.50
B	10,000	25.00	250,000	43.82	22.00	0.10	220,000	1,000	–12.00	–11.60	–5.26	–5.08	38.00
C	5,000	12.50	62,500	10.96	8.00	0.00	40,000	0	–36.00	–36.00	–3.95	–3.95	6.91
D	8,000	10.00	80,000	14.02	14.00	0.05	112,000	400	40.00	40.50	5.61	5.68	19.34
E	7,000	4.00	28,000	4.91	6.00	0.00	42,000	0	50.00	50.00	2.46	2.46	7.25
Total			**570,500**	**100.00**			**579,000**	**3,650**			**1.49**	**2.13**	**100.00**
Index Value			**1,000**				**1,014.90**	**6.40**	**1.49**	**2.13**			

Divisor = 570.50
BOP = Beginning of period
EOP = End of period

Type of Index	BOP Value	Return %	EOP Value
Price Return	1,000.00	1.49	1,014.90
Total Return	1,000.00	2.13	1,021.30

COMPARISON OF FUNDAMENTAL WEIGHTING WITH MARKET-CAPITALIZATION WEIGHTING

Assume a 2-stock Index, consisting of Stock A and Stock B:

Stock A	Stock B
Earnings = €20	Earnings = €20
Market cap = €200	Market cap = €800
Market cap weight = 20%	Market cap weight = 80%
Fundamental weight = 50%	Fundamental weight = 50%

ADVANTAGES AND DISADVANTAGES

Price weighted

- Simple
- High price stocks have greater impact
- Stock splits result in arbitrary changes

Equal weighted

- Simple
- Under- and over-representation
- Frequent rebalancing

Market capitalization weighted

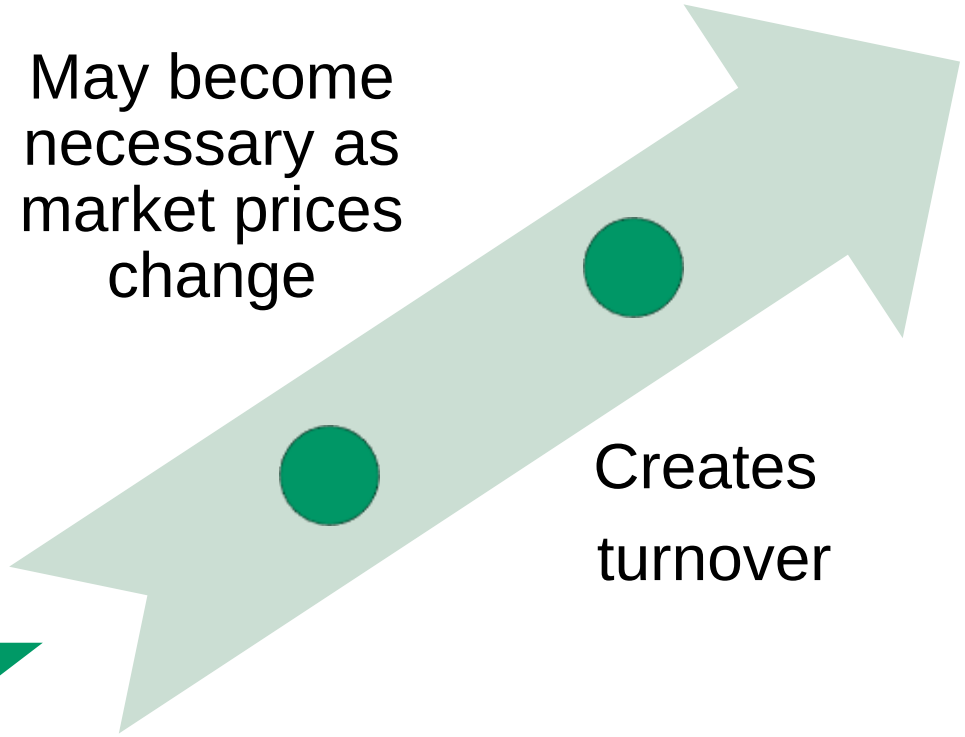
- Securities held in proportion to their value
- Similar to a momentum strategy

Fundamental weighted

- Ensures a value or contrarian tilt
- Data intensive

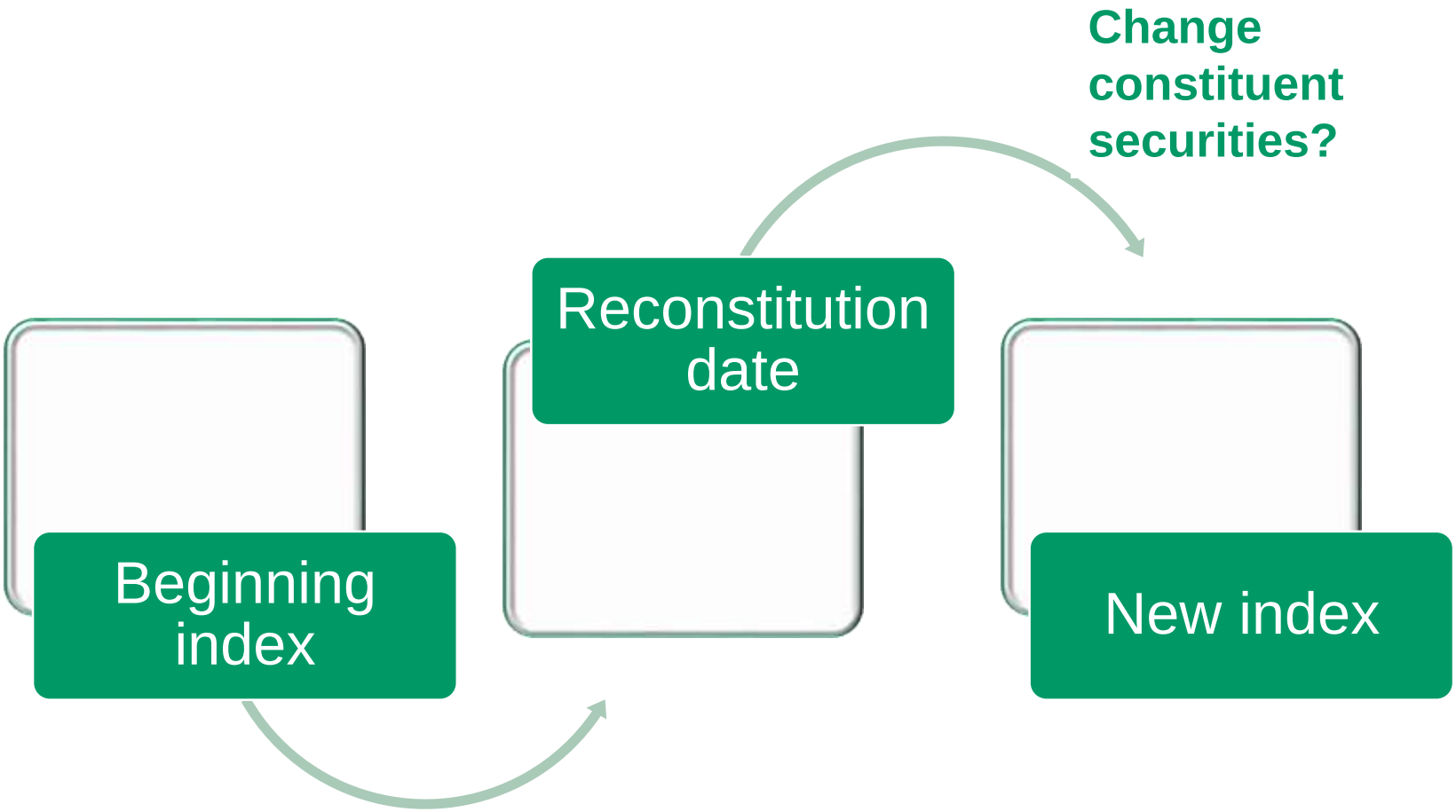
REBALANCING

May become necessary as market prices change



Creates turnover

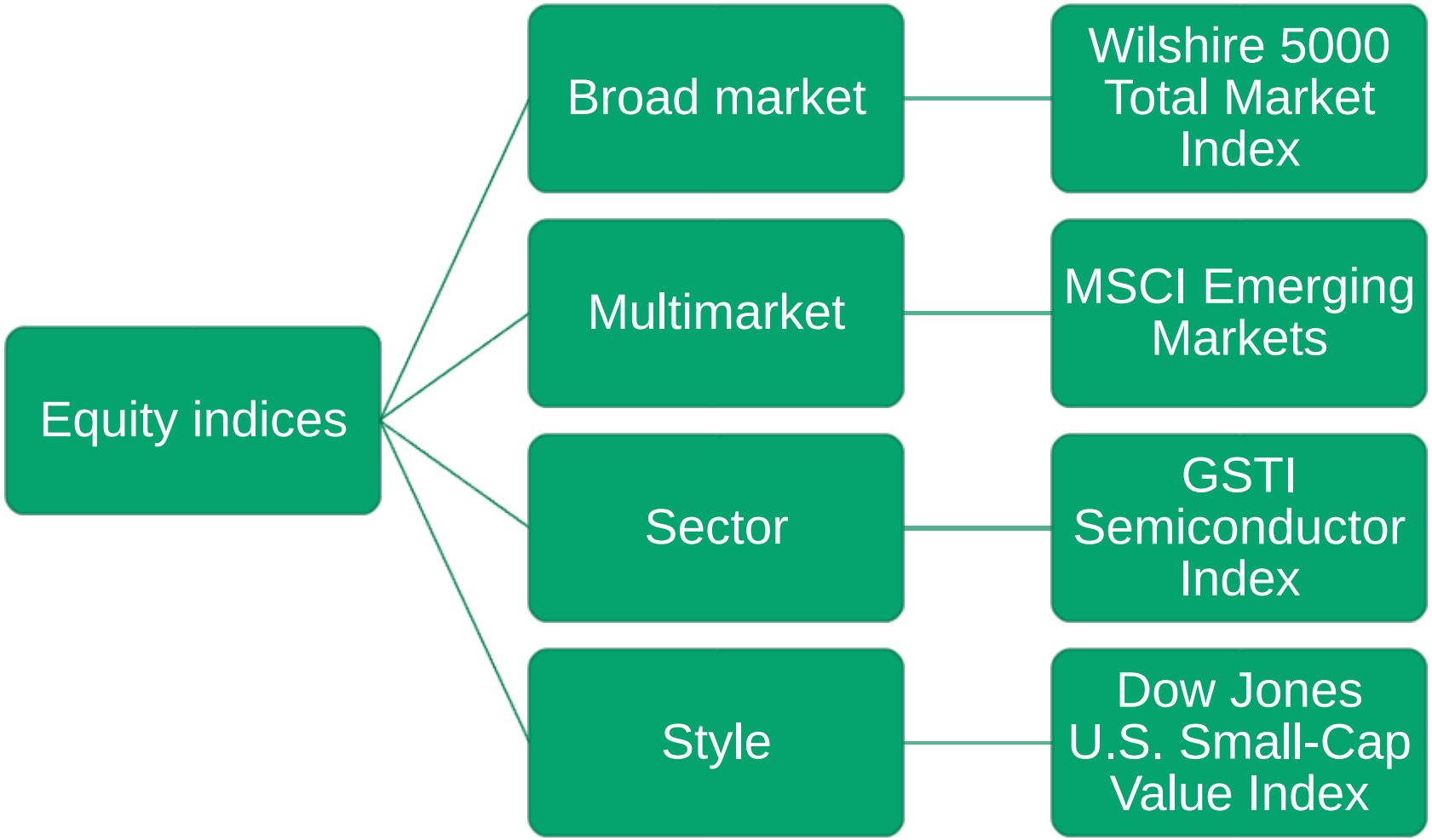
RECONSTITUTION



USES OF MARKET INDICES

- Gauges of market sentiment
- Proxies for measuring and modeling returns, systematic risk, and risk-adjusted performance
- Proxies for asset classes in asset allocation models
- Benchmarks for actively managed portfolios
- Model portfolios for such investment products as index funds and exchange-traded funds (ETFs)

EQUITY INDICES



CHALLENGES FACING FIXED INCOME INDEX CONSTRUCTION

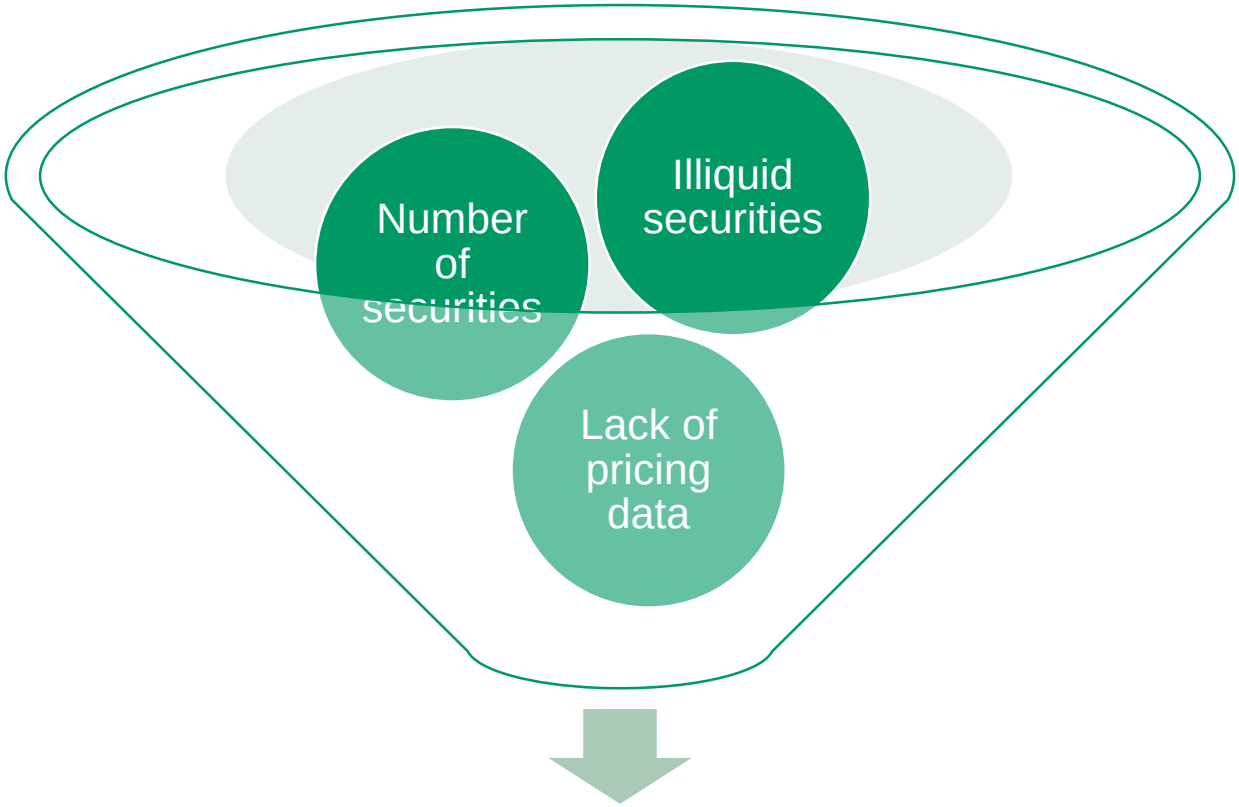
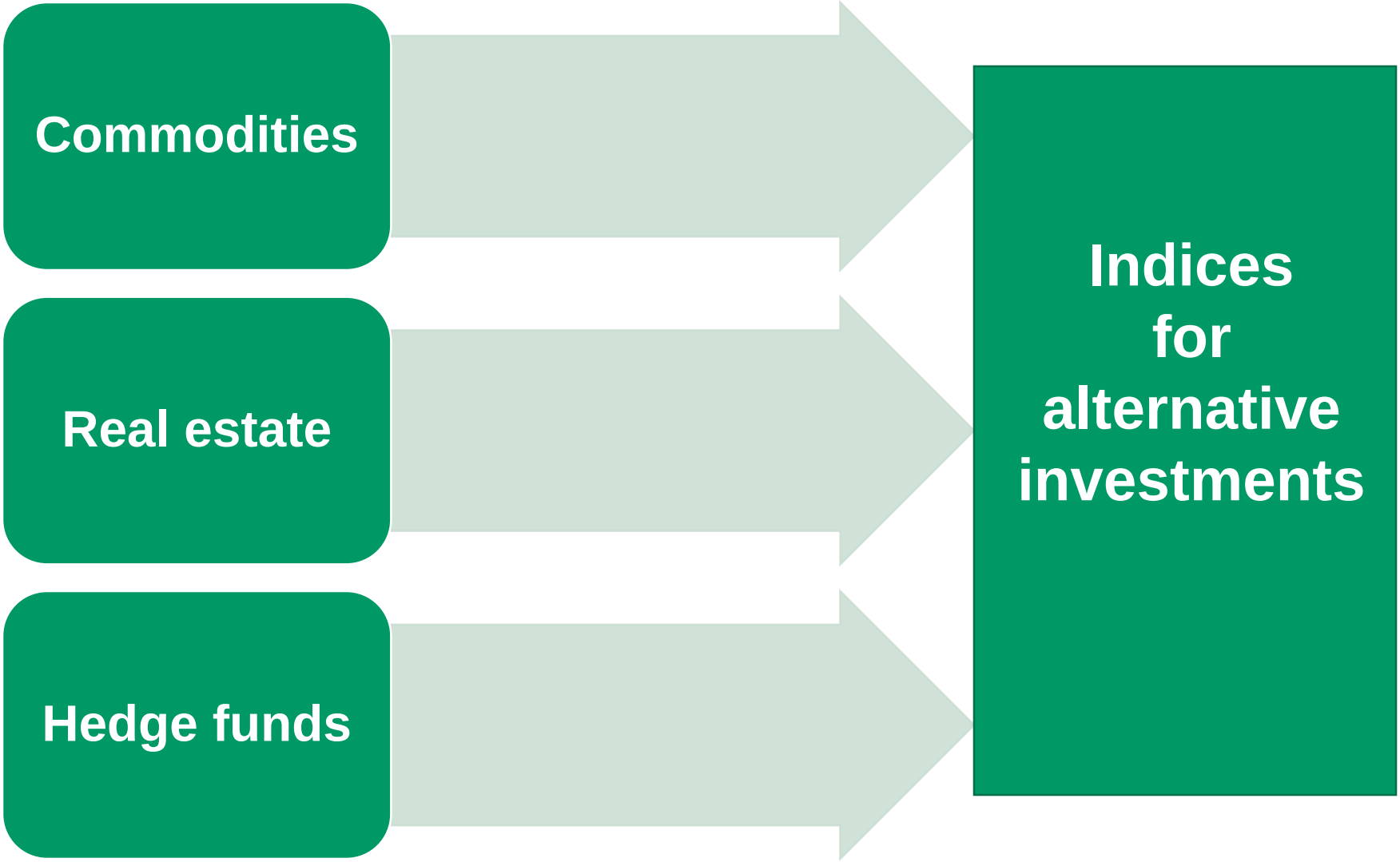


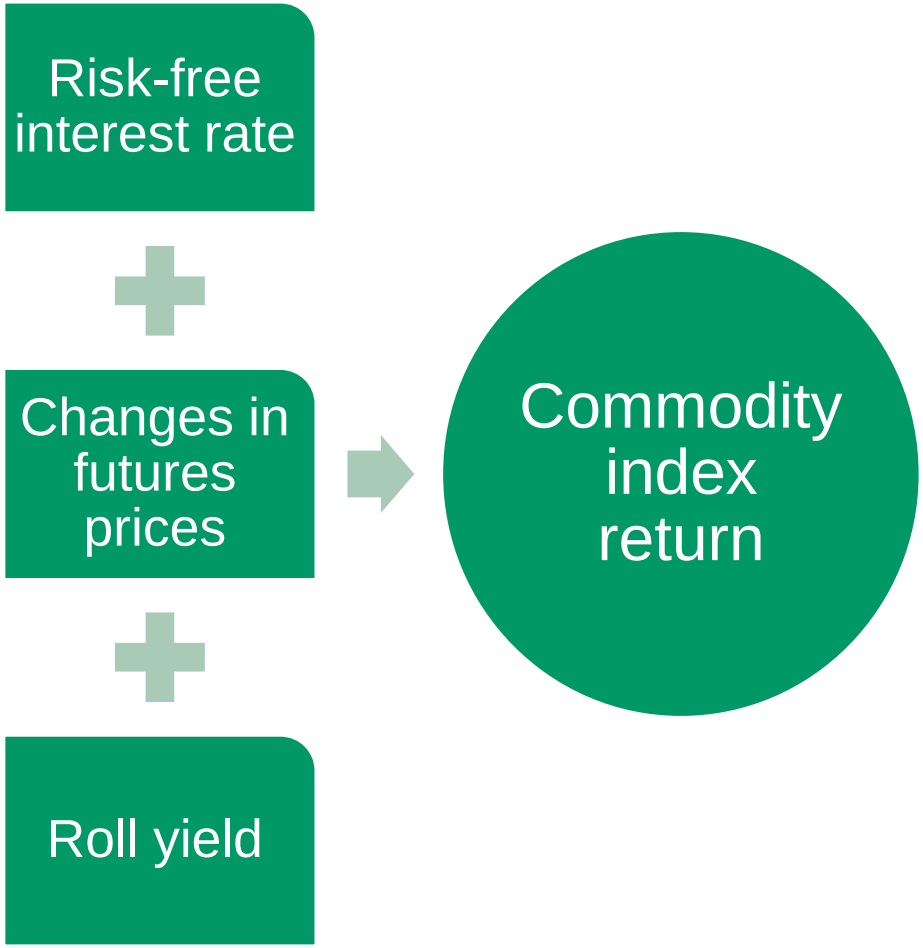
EXHIBIT 2-9 DIMENSIONS OF FIXED-INCOME INDICES

Market	Global			
	Regional			
	Country or currency zone			
Type	Corporate	Collateralized Securitized Mortgage-backed	Government agency	Government
Maturity	For example, 1–3, 3–5, 5–7, 7–10, 10+ years; short-term, medium-term, or long-term			
Credit quality	For example, AAA, AA, A, BBB, etc.; Aaa, Aa, A, Baa, etc.; investment grade, high yield			

INDICES FOR ALTERNATIVE INVESTMENTS

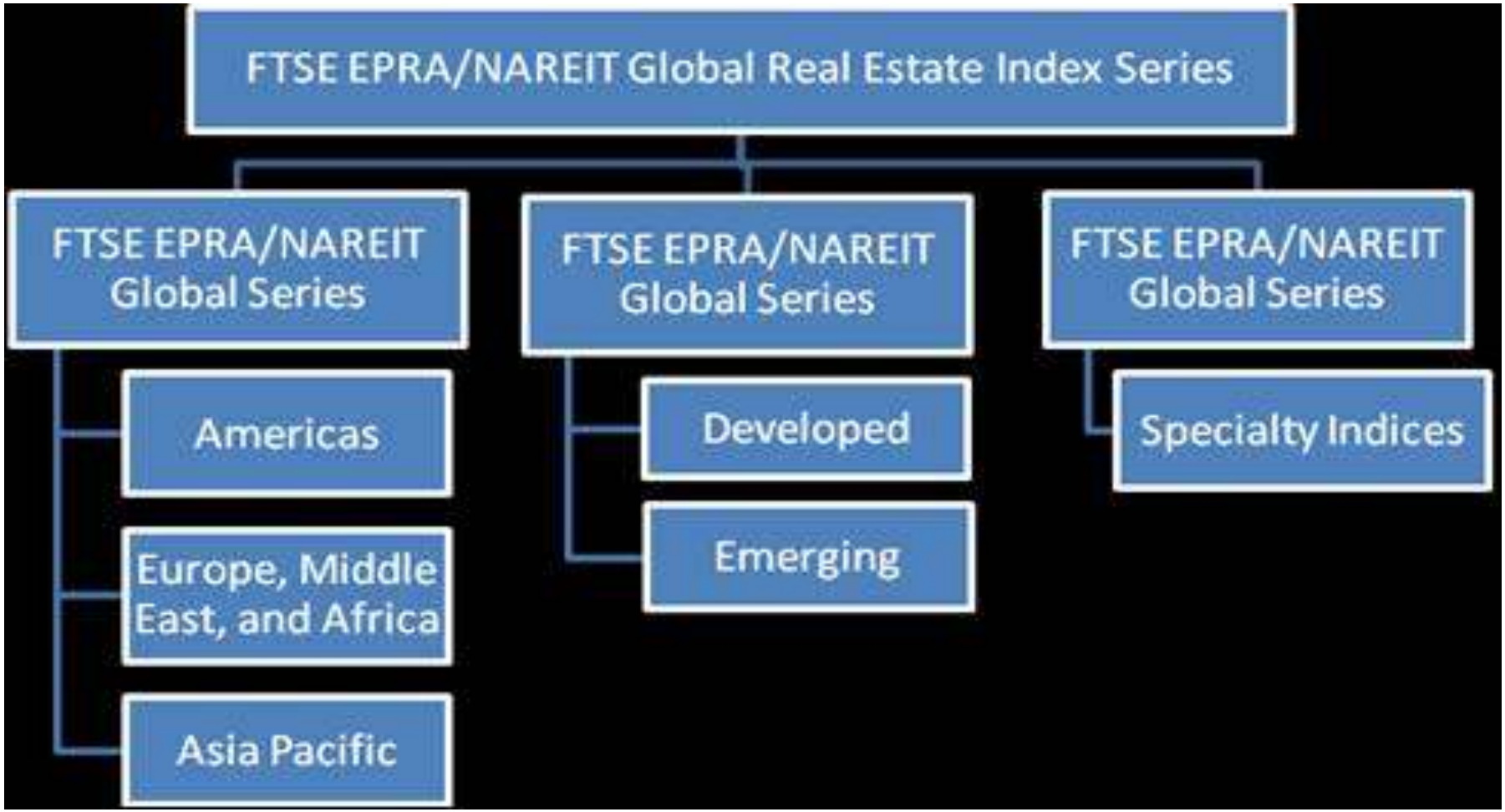


COMMODITY INDICES



REAL ESTATE INDICES

EXHIBIT 2-12 THE FTSE EPRA/NAREIT GLOBAL REIT INDEX FAMILY



Source: FTSE International, "FTSE EPRA/NAREIT Global & Global Ex US Indices" (Factsheet 2009).

HEDGE FUND INDICES

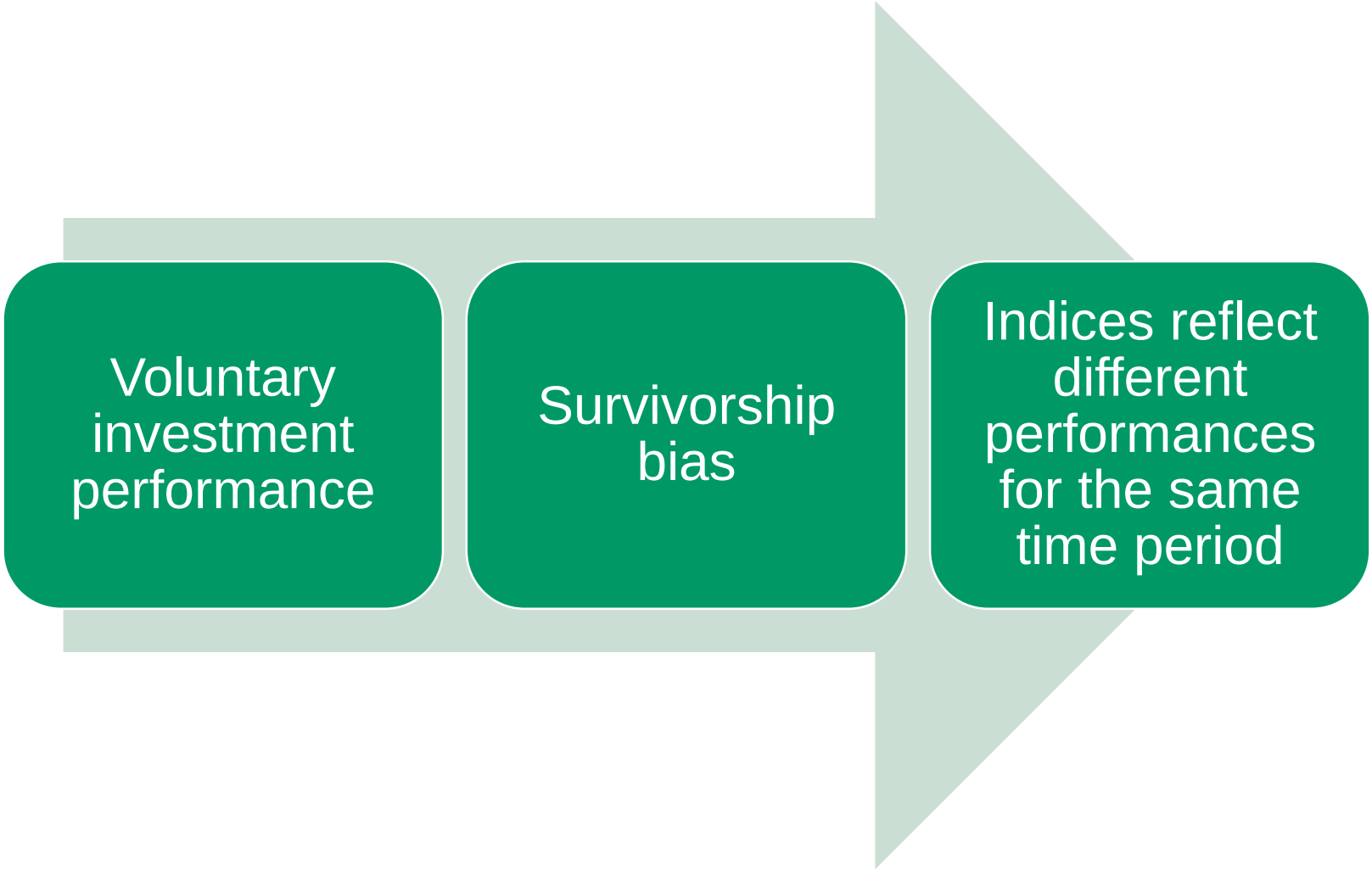
Hedge funds are private investment vehicles that typically use leverage and long and short investment strategies.

Research organizations maintain databases of hedge fund returns and summarize these returns into indices.

Most indices reflect performance on a broad global level or on a strategy level.

Most indices are equal weighted.

PROBLEMS CAUSED BY VOLUNTARY INVESTMENT REPORTING



SUMMARY

- Price return index
- Total return index
- Choices in index construction and management
- Advantages and disadvantages of different weighting schemes
- Rebalancing and reconstitution
- Uses of market indices
- Equity, fixed income, and alternative investment indices