

LM02 · SECURITY MARKET INDEXES · LOS A, G

Security Market Indexes

CFA Level I · 2025 Curriculum · What an index is, how it is valued, and why it matters

Core Definition

A **security market index** consists of individual securities that represent a given *security market, market segment, or asset class*. Most indexes are constructed as a portfolio of marketable securities. The individual securities are called **constituent securities**.

An index value is calculated on a regular basis using actual or estimated prices of the constituent securities. Because a single number captures a whole market, it lets investors measure and track performance easily.

Two Versions of Every Index

VERSION 1

Price Return Index (PRI)

Reflects **only prices** of the constituent securities.
Captures capital gains/losses only.

VERSION 2

Total Return Index (TRI)

Assumes **reinvestment of all income** (dividends and/or interest) received since inception. Captures capital gains *plus* income.

Five Uses of Security Market Indexes

- 1 **Gauge of market sentiment.** Indexes serve as good indicators of the collective opinion of market participants — a simple measure to capture performance and direction of a particular market.
- 2 **Proxy for measuring and modelling returns, systematic risk, and risk-adjusted performance** (e.g., the market-risk proxy used in CAPM).
- 3 **Proxy for asset classes in asset allocation models.** Provides the historical data used to model risk/return of different asset classes.
- 4 **Benchmark for actively managed portfolios** — evaluate whether managers are adding value.
- 5 **Basis for investment products**, typically passive (index mutual funds and ETFs).

Exam Tip: A security market index is an *indicator*. Since it compresses a whole market's performance into a single number, it becomes the foundation for benchmarking, asset allocation, and passive investment products.

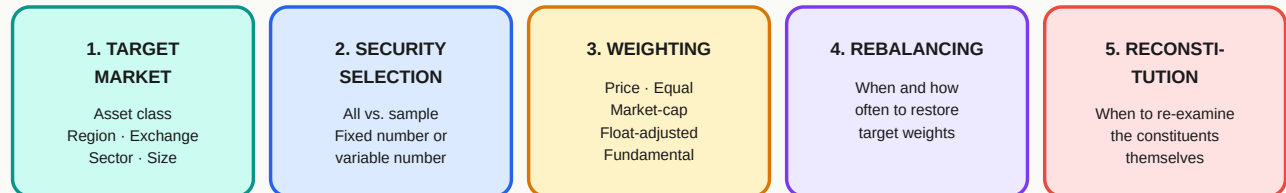
LOS C · CHOICES & ISSUES IN INDEX CONSTRUCTION

How an Index is Built — Five Decisions

Index construction and management is similar to constructing and managing a portfolio of securities. Providers must make the following decisions:

THE FIVE CONSTRUCTION DECISIONS

Five Index-Construction Decisions



Each decision shapes the index's behaviour and how closely it represents the target market.

Decision 1 · Target Market

The target market can be defined broadly (e.g., U.S. equities) or narrowly (e.g., large-cap U.S. equities). It can be based on:

- Asset class (equities, fixed-income, real estate)
- Geographic region (Japan, Mexico, Canada)
- Exchange (NY, Toronto, London)
- Sector / Industry
- Size / Market cap

Decision 2 · Security Selection

- All securities in the target market, or just a **sample**.
- Fixed number** of securities (e.g., S&P 500) or a **variable number** (e.g., TOPIX).

Decisions 3–5 · Weighting, Rebalancing, Reconstitution

Weighting determines how much of each security to include. Rebalancing restores target weights as prices change.

Reconstitution changes *which* securities belong in the index (for bankruptcies, M&A, delistings, or committee judgement).

We cover each in depth in later steps.

Exam Tip: Target market can be defined broadly (U.S. equities) or narrowly (large-cap U.S. equities). Selection may be "all" or "sample", fixed-number or variable-number.

LOS B · VALUE, PRICE RETURN & TOTAL RETURN

Calculating the Value and Return of an Index

Index Value — General Formula

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

V_{PRI} value of the price-return index

n_i number of units of security i in the index

P_i price of security i

N number of individual securities in the index

D divisor — a number initially chosen at inception so the index has a convenient initial value; adjusted over time so that changes in the index reflect price changes only

Single-Period Returns

Price Return (PR)

The percentage change in V_{PRI} .

$$PR_I = \frac{V_{\text{PRI},1} - V_{\text{PRI},0}}{V_{\text{PRI},0}}$$

Or: a weighted average of the price returns of each constituent:

$$PR_I = w_1 PR_1 + w_2 PR_2 + \cdots + w_N PR_N$$

Total Return (TR)

Price change + all income.

$$TR_I = \frac{V_{\text{PRI},1} - V_{\text{PRI},0} + \text{Inc}_I}{V_{\text{PRI},0}}$$

Or: a weighted average of the total returns of each constituent:

$$TR_I = w_1 TR_1 + w_2 TR_2 + \cdots + w_N TR_N$$

Multiple-Period Returns — link geometrically

$$V_T = V_0 \cdot (1 + R_1)(1 + R_2) \cdots (1 + R_T)$$

Consecutive period returns are compounded, not summed.

WORKED EXAMPLE

Two-Year PRI vs TRI (Mark Meldrum)

GIVEN

An equity index was created at the beginning of 2008 with $V_{\text{PRI}} = V_{\text{TRI}} = 1,000$.

	2008	2009
Price return	7.5%	8.3%
Total return	12.6%	13.4%

SOLUTION

- 1 $V_{\text{PRI}} (\text{end 2008}) = 1,000 \times 1.075 = \mathbf{1,075}$

- 2 $V_{\text{PRI}} (\text{end 2009}) = 1,000 \times 1.075 \times 1.083 = \mathbf{1,164.225}$

- 3 $V_{\text{TRI}} (\text{end 2008}) = 1,000 \times 1.126 = \mathbf{1,126}$

- 4 $V_{\text{TRI}} (\text{end 2009}) = 1,126 \times 1.134 = \mathbf{1,276.884}$

TAKEAWAY

Returns across years compound geometrically. The gap between TRI and PRI grows each year because reinvested income also earns returns.

LOS D · WEIGHTING METHODS

Comparing Index Weighting Methods

Weighting determines how much of each security to include in the index. Five methods are common:

METHOD	WEIGHT FORMULA	PROS	CONS
Price-weighted	$w_i^P = \frac{P_i}{\sum_j P_j}$	Simple	Arbitrary weights; any stock split changes the weights (divisor must be adjusted); highest-priced stocks dominate
Equal-weighted	$w_i^E = \frac{1}{N}$	Simple	Large-cap securities are under-represented; small-cap are over-represented; requires frequent rebalancing
Market-cap weighted	$w_i^M = \frac{Q_i P_i}{\sum_j Q_j P_j}$	Components held in proportion to their value in the target market	Overweights stocks that may be overvalued and underweights those that may be undervalued
Float-adjusted market-cap	w_i^F uses shares <i>available to the public</i>	Reflects investable opportunity set	Same overvaluation bias as market-cap weighting
Fundamental-weighted	$w_i^F = \frac{F_i}{\sum_j F_j}$ (F = book value, revenue, CFO, earnings, dividends...)	Uses a fundamental size proxy; avoids the overvaluation bias of market-cap; contrarian "value" tilt	Requires rebalancing

Market-Cap Weighting — Value Formula

$$V_{MCI} = \frac{\sum_i Q_i P_i}{\sum_i Q_{iB} P_{iB}} \cdot V_{BI}$$

Q_i, P_i current number of shares and price of security i

Q_{iB}, P_{iB} base-period shares and price of security i

V_{BI} base-period index value

Float-adjusted version: replace Q_i with the number of shares actually available to the investing public (excludes shares held by controlling stockholders).

Momentum vs. Contrarian Tilts

Market-cap weighting

"Momentum" effect: components whose prices have risen the most have a greater weight in the index. Leads to overweighting stocks that may be overvalued.

Fundamental weighting

"Contrarian" effect: weights favour securities that have decreased in relative value. Results in indexes with higher **fundamental / market value** ratios than their market-cap counterparts.

Exam Tip: A portfolio with *equal numbers of shares* of each index stock will match a **price-weighted** index. A portfolio with *equal dollar amounts* invested in each index stock will match an **equal-weighted** index.

LOS E · CALCULATE & ANALYZE — PRICE & EQUAL

Worked Examples: Price-Weighted & Equal-Weighted

Dataset (used across Examples 1–4, from IFT)

STOCK	NO. OF SHARES	START PRICE	END PRICE	EARNINGS	DIVIDEND / SHARE
X	200	10	8	10	1
Y	500	20	20	50	2
Z	200	3	8	20	0

EXAMPLE 1

Price-Weighted Index — Return & Stock Split

FIND

(i) Price return and total return of the price-weighted index. (ii) Impact on the divisor if stock Z splits 2-for-1.

SOLUTION — PRICE RETURN

- 1 Start index value = $(10 + 20 + 3) / 3 = 11$
- 2 End index value = $(8 + 20 + 8) / 3 = 12$
- 3 Price return = $(12 / 11) - 1 = 9.09\%$ (capital-gain return)

SOLUTION — TOTAL RETURN

- 1 Dividend yield = $(1 + 2 + 0) / (10 + 20 + 3) = 9.09\%$
- 2 Total return = $9.09\% + 9.09\% = 18.18\%$

SOLUTION — STOCK SPLIT (2-FOR-1 ON Z)

After the split, end prices become $(8 + 20 + 4) = 32$. But the ending index value must stay at 12.

$$\text{new } D : \frac{32}{D} = 12 \Rightarrow D = \frac{32}{12} = \mathbf{2.67}$$

The divisor *drops* from 3 to 2.67. *Every time a stock splits, the divisor decreases*, preventing the split from changing the value of the index.

ANSWER

Price Return	9.09%
Total Return	18.18%
New Divisor after Z's 2-for-1 split	2.67

EXAMPLE 2 Equal-Weighted Index

FIND

Price return and total return using equal weighting.

SOLUTION — PRICE RETURN (ARITHMETIC AVERAGE OF CONSTITUENT PRICE RETURNS)

- 1 X: $(8/10) - 1 = \mathbf{-20.0\%}$
- 2 Y: $(20/20) - 1 = \mathbf{0.0\%}$
- 3 Z: $(8/3) - 1 = \mathbf{166.7\%}$
- 4 Equal-weighted price return = $(-20.0\% + 0.0\% + 166.7\%) / 3 = \mathbf{48.9\%}$

SOLUTION — TOTAL RETURN

- 1 Income return X: $1/10 = \mathbf{10.0\%}$; Y: $2/20 = \mathbf{10.0\%}$; Z: $0/3 = \mathbf{0.0\%}$
- 2 Equal-weighted income return = $(10.0\% + 10.0\% + 0.0\%) / 3 = \mathbf{6.7\%}$
- Total return = $48.9\% + 6.7\% = \mathbf{55.6\%}$

ANSWER

Price Return	48.9%
Total Return	55.6%

Exam Tip: The extreme difference between the price-weighted return (9.09%) and equal-weighted return (48.9%) comes from stock Z — it has the lowest price but the largest gain. Price weighting under-weights it; equal weighting gives it the same weight as the others.

LOS E · CALCULATE & ANALYZE — MARKET-CAP & FUNDAMENTAL

Worked Examples: Market-Cap & Fundamental Weighting

EXAMPLE 3 Market-Cap Weighted Index (base = 3,000)**FIND**

(i) Price return and total return using market-cap weighting, with the index starting at 3,000. (ii) Price return if stock Z has a market float of only 60%.

PART (I) SOLUTION — PRICE RETURN

1 Start market cap = $(200 \times 10) + (500 \times 20) + (200 \times 3) = \mathbf{12,600}$

2 Base-period divisor: $12,600 / 3,000 = \mathbf{4.2}$

3 End market cap = $(200 \times 8) + (500 \times 20) + (200 \times 8) = \mathbf{13,200}$

4 End index value = $13,200 / 4.2 = \mathbf{3,142.9}$

5 Price return = $(3,142.9 / 3,000) - 1 = \mathbf{4.76\%}$

PART (I) SOLUTION — TOTAL RETURN

1 Total dividends earned = $(200 \times 1) + (500 \times 2) + (200 \times 0) = \mathbf{1,200}$

2 Income return = $1,200 / 12,600 = \mathbf{9.5\%}$

3 Total return = $4.76\% + 9.5\% = \mathbf{14.26\%}$

PART (II) SOLUTION — FLOAT-ADJUSTED (Z @ 60% FLOAT)

1 Z's float-adjusted shares = $200 \times 60\% = \mathbf{120}$

2 Start float-adjusted cap = $(200 \times 10) + (500 \times 20) + (120 \times 3) = \mathbf{12,360}$

- 3 New divisor: $12,360 / 3,000 = 4.12$
- 4 End float-adjusted cap = $(200 \times 8) + (500 \times 20) + (120 \times 8) = 12,560$
- 5 End index = $12,560 / 4.12 = 3,048.5$
- 6 Price return = $(3,048.5 / 3,000) - 1 = 1.6\%$

ANSWER

(i) Price return	4.76%
(i) Total return	14.26%
(ii) Price return, Z float-adjusted @ 60%	1.6%

EXAMPLE 4**Fundamental-Weighted Index (weights by earnings)****GIVEN**

Earnings for X, Y, Z are 10, 50, 20 respectively. Total earnings = 80. Fundamental weights = 10/80, 50/80, 20/80.

PRICE RETURN — WEIGHTED AVERAGE OF CONSTITUENT PRICE RETURNS

- 1 Constituent price returns: X = -20.0%, Y = 0.0%, Z = 166.7%
- 2 Fundamental price return = $-20.0\% \times (10/80) + 0.0\% \times (50/80) + 166.7\% \times (20/80) = 39.2\%$

TOTAL RETURN

- 1 Constituent income returns: X = 10.0%, Y = 10.0%, Z = 0.0%
- 2 Fundamental income return = $10.0\% \times (10/80) + 10.0\% \times (50/80) + 0.0\% \times (20/80) = 7.5\%$
- 3 Total return = $39.2\% + 7.5\% = 46.7\%$

ANSWER

Price Return	39.2%
Total Return	46.7%

Four returns, same three stocks, four different answers

METHOD	PRICE RETURN	TOTAL RETURN
Price-weighted	9.09%	18.18%
Equal-weighted	48.9%	55.6%
Market-cap weighted	4.76%	14.26%
Fundamental-weighted (earnings)	39.2%	46.7%

LOS F · REBALANCING & RECONSTITUTION

Rebalancing and Reconstitution

① REBALANCING

What it is

Adjusting the weights of an index's constituent securities. Weights assigned at inception drift from their target weights as prices change. Rebalancing restores the target weights.

② RECONSTITUTION

What it is

The process of **changing the securities** in the index — keeps the index representative. Part of the rebalancing cycle; frequency varies by index. Reconstitution is usually *announced prior* to the reconstitution date.

Rebalancing by Weighting Method

WEIGHTING METHOD	REBALANCING BEHAVIOUR
Equal-weighted	Frequent rebalancing required. Reduce the weights of securities that have outperformed and increase weights of those that have underperformed.
Price-weighted	No need to rebalance — the weight of each constituent is determined by price (target weights drift as prices change, which is the intended behaviour).
Market-cap weighted	Only needs to be rebalanced to reflect M&A and liquidations; otherwise weights automatically track market values.

Reasons for Reconstitution

- Securities that no longer meet the index criteria are **deleted** and replaced by securities that do.
- Reflect changes in the target market caused by **bankruptcy, liquidation, M&A, or delistings**.
- Reflect the judgement of the selection committee.

Reconstitution results in a change in all the weightings (price & market-cap).

Exam Tip: Style indexes (growth vs. value) typically require more frequent rebalancing and reconstitution, because a stock's style classification changes as its valuation multiples move.

QUIZ 1 · CHECKPOINT

Test Your Understanding: Basics, Construction & Weighting

Q1. A total return index differs from a price return index in that the total return index:

Q2. Which of the following is *not* one of the construction decisions a security market index provider must make?

Q3. In a **price-weighted** index, the weight on each security is determined by:

Q4. A 2-for-1 stock split occurs in one of the constituents of a price-weighted index. To keep the index value unchanged, the divisor will *most likely*:

Q5. A market-capitalization-weighted index most likely:

Q6. Compared to a market-cap-weighted index, a fundamental-weighted index using earnings as the factor will *most likely* have a:

LOS H · TYPES OF EQUITY INDEXES

Types of Equity Indexes

FOUR MAIN EQUITY INDEX CATEGORIES

BROAD MARKET

Measures overall
market performance

> 90% of market

e.g., Russell 3000
~99% of US equity
market cap

MULTI-MARKET

Indexes from
different countries

Weighted by:

market cap, or
fundamentally (e.g., GDP)

SECTOR

Consumer Staples,
Utilities, Energy,
Tech, Health...

Helps assess

manager performance —
stock-picking vs.
sector allocation

STYLE

Growth vs. Value;
Size (large/mid/small);
Or combinations

Requires more

frequent rebalancing
& reconstitution

1. Broad Market Index

Represents **more than 90%** of the selected market. Provides a measure of a market's overall performance.

Example: Russell 3000 covers roughly 99% of the U.S. equity market cap.

2. Multi-Market Index

Consists of security market indexes from **different countries**. Used to measure equity returns of a geographic region, markets grouped by stage of economic development, or the entire world.

Multi-market index with fundamental weighting — uses market-cap weighting for the country indexes, then weights the country index returns in the global index by a fundamental factor such as **GDP**.

(Effectively a fundamental weighting of market-cap-weighted indexes.)

3. Sector Index

Represents a particular sector — Consumer Staples, Utilities, Energy, Health Care, Financials, Tech, etc. (curriculum typically references 10–11 broad sectors).

Key use: helps assess whether a portfolio manager's returns are due to *stock picking* or *sector allocation*.

4. Style Index

Contains securities based on characteristics such as **market capitalization, value, growth, or a combination.**

The basic market-cap × value/growth matrix yields six style categories:

Large-cap value

Large-cap growth

Mid-cap value

Mid-cap growth

Small-cap value

Small-cap growth

Style indexes require more frequent rebalancing and reconstitution because a stock's style classification can change over time.

LOS 1, J · FIXED-INCOME & ALTERNATIVE-INVESTMENT INDEXES

Fixed-Income and Alternative-Investment Indexes

Why Fixed-Income Indexes are Harder to Build

- **Broader universe** of bonds than stocks — each entity issues several versions of debt.
- Universe is **constantly changing** (new issues, calls, maturities) — turnover is high, constant reconstitution needed.
- **Duration (price volatility) is constantly changing** as bonds approach maturity.
- Bonds often trade **infrequently / illiquid**; prices for many securities must be *estimated* from recent prices of similar bonds.
- Illiquidity, transactions costs, and high turnover make it **difficult and expensive** for fixed-income managers to replicate an index.

Dimensions of Fixed-Income Indexes

DIMENSION	CATEGORIES
Geographic region	Global · Regional · Country / currency zone
Type of issuer / issue	Government & agencies · Corporate (incl. convertible) · Collateralized / securitized / mortgage-backed · Inflation-protected
Type of financing	General obligation · Collateralized
Currency of payment	Single currency or multi-currency
Maturity	Short term (< 1 yr) · Medium term (1–10 yrs) · Long term (> 10 yrs)
Credit quality	Investment grade (e.g., BBB or above) · High yield · By specific ratings
Inflation protection?	Yes / no

Fixed-income indexes can be categorized as: aggregate/broad market, market-sector, style, economic-sector, or specialized (e.g., high-yield, inflation-linked, emerging markets).

Alternative-Investment Indexes

1

2

3

Commodity Indexes

Consist of **futures contracts** on one or more commodities (grains, livestock, metals, energy).

- Weighting is equal, fixed, or price-based (set by committee).
- Different weightings → different exposures and risk/return profiles.
- Index performance may **differ from that of the underlying commodity** because derivatives introduce exposure to the risk-free rate, futures price, and **roll yield**.

Real Estate / REIT Indexes

Represent the market for real estate securities and the market for actual real estate. Three main types:

- **REIT indexes** — shares of publicly traded REITs (typically commercial property).
- **Appraisal indexes** — based on appraised values.
- **Repeat-sales indexes** — based on repeat sales of the same property.

Hedge Fund Indexes

Most hedge fund indexes **equally weight** the returns of the included funds. Built at:

- **Broad global level**, or
- **Strategy level**.

Two Key Biases in Hedge Fund Indexes

- **Voluntary disclosure** — hedge funds are not required to report. Poorly performing funds often do not report, producing **survivorship / upward bias**: hedge funds appear to be better investments than they actually are.
- **Hedge funds can choose which index to report to** — the constituents effectively determine the index. Reporting is periodic (e.g., quarterly), so fewer sampling periods are available, which can **understate risk**.

Exam Tip: Commodity-index returns diverge from the underlying commodity because indexes hold *futures*, not physical barrels or bushels. The roll yield (rolling an expiring futures contract into a new one) can add or subtract from return.

QUIZ 2 · CHECKPOINT

Test Your Understanding: Rebalancing, Equity & Fixed-Income Types

Q7. Which weighting method *most likely* requires the most frequent rebalancing?

Q8. The process of *changing the securities* that make up an index — rather than adjusting their weights — is best described as:

Q9. A broad market equity index typically contains what fraction of the selected market?

Q10. A multi-market index that weights each country's market-cap-weighted index by the country's GDP is *best* described as:

Q11. Which of the following is a reason fixed-income indexes are *more difficult to construct* than equity indexes?

QUIZ 3 · APPLIED

Applied & Mixed Practice

Q12. An equity index was created with $V_{PRI} = V_{TRI} = 1,000$. Year 1 price return is 7.5% and total return is 12.6%; Year 2 price return is 8.3% and total return is 13.4%. V_{TRI} at the end of Year 2 is *closest to*:

Q13. Three stocks trade at 10, 20 and 30 at period start and 8, 20 and 8 at period end. Using *equal weighting*, the price return of the index is *closest to*:

Q14. For the same three stocks (shares: $X = 200$, $Y = 500$, $Z = 200$; prices 10, 20, 30 $\rightarrow$ 8, 20, 8), if stock Z has a market float of 60%, the *float-adjusted market-cap* price return (index base = 3,000) is *closest to*:

Q15. Upward bias in hedge fund index returns *most likely* arises from:

Q16. Commodity index returns can differ from the returns on the underlying physical commodities *most likely* because commodity indexes:

MODULE COMPLETE

Your Scorecard

0 / 16

LM02 Key Takeaways — Exam-Ready Cheat Sheet

Index Basics

- 1 **Security market index** = constituent securities representing a market, segment, or asset class. Every index has a **price return** (prices only) and a **total return** (prices + reinvested income) version.
- 2 $V_{PRI} = \sum n_i P_i / D$; $PR_I = (V_1 - V_0) / V_0$; $TR_I = (V_1 - V_0 + Inc) / V_0$. Multi-period returns compound *geometrically*.
- 3 **Five construction decisions**: target market, security selection, weighting, rebalancing, reconstitution.

Weighting Methods — memorize the trade-offs

METHOD	ADVANTAGE	DISADVANTAGE
Price	Simple	Arbitrary weights; highest-priced stock dominates; splits force divisor change
Equal	Simple	Under-represents large-caps; frequent rebalancing
Market-cap	Proportional to market value	Momentum bias — overweights overvalued stocks
Float-adjusted mcap	Reflects investable shares only	Same momentum bias as market-cap
Fundamental	Contrarian / value tilt; avoids market-cap bias	Requires rebalancing

Rebalancing vs. Reconstitution

- 4 **Rebalancing** adjusts *weights*; required most for equal-weighted; not needed for price-weighted; only for M&A/liquidations in market-cap.
- 5 **Reconstitution** changes *which* securities are in the index (bankruptcies, M&A, delistings, committee judgement). Usually announced ahead of time.

Equity Index Types

- 6 **Broad market** (>90% of market), **multi-market** (cross-country; may be GDP-weighted), **sector**, **style** (size × growth/value = 6 boxes; requires more frequent rebalancing).

Fixed-Income & Alternative Indexes

- 7 **Fixed-income challenges**: broader universe, constant reconstitution (maturities, calls), changing duration, illiquidity forcing price estimation, high turnover = expensive to replicate.
- 8 **Commodity indexes** use futures — divergence from the physical commodity comes from risk-free rate, futures price, and **roll yield**.
- 9 **Real estate** — REIT (public), appraisal, and repeat-sales indexes.
- 10 **Hedge fund indexes** — usually equal-weighted; voluntary disclosure + funds self-selecting which index to report to produce **upward (survivorship) bias**.

Last-Minute Exam Checklist

PRI vs. TRI: TRI reinvests income, PRI does not

Split in price-weighted index: divisor decreases

Needs most rebalancing: equal-weighted

Needs no rebalancing (weights from price): price-weighted

Momentum tilt: market-cap; **Contrarian tilt**: fundamental

Broad market threshold: > 90%

FI headaches: size, maturity, illiquid pricing, duration drift

Commodity return driver: futures roll yield (not the physical)

Hedge fund bias: upward / survivorship

Step 1 of 13