

## Inflation Risk

### Definition

Inflation risk is the probability-weighted loss of purchasing power that arises when the future general price level exceeds expectations embedded in nominal asset prices. Bonds with fixed coupons feel the impact directly through lower real yield; equities suffer when unexpected inflation compresses valuation multiples and raises discount rates; cash experiences immediate erosion in real terms.

### Global inflation record

From 1960-2024, advanced-economy consumer-price inflation averaged 3.6 % (IMF WEO data): 7.1 % in the 1970s, 5.7 % in the 1980s, 2.2 % in the 1990s-2010s, and 5.4 % in 2022 after pandemic supply shocks.

Emerging-market average was 24 % in the 1980s (LatAm debt crisis), falling below 5 % by 2019, then rising to 12 % in 2023. U.S. CPI breached 9 % YoY in June 2022, highest since 1981, before retreating to 3.3 % by March 2025.

### Market-implied expectations

Breakeven inflation derived from Treasury Inflation-Protected Securities (TIPS) equals nominal Treasury yield minus real TIPS yield. Ten-year breakeven averaged 2.1 % (2003-2024). Peaks: 2.73 % (April 2011), troughs: 0.47 % (March 2020). Five-year, five-year forward measure—proxy for long-term expectations—remained anchored near 2.3 %, indicating credibility of monetary policy even during the 2022 spike.

### Asset-class sensitivity ( $\beta_{infl}$ )

Empirical  $\beta_{infl}$  is estimated via regression of monthly real excess return on unexpected CPI:

Asset	$\beta_{infl}$ (1973-2024)	t-stat	Comments
U.S. Aggregate Bonds	-2.1	-8.4	Nominal coupons fixed
U.S. Large-Cap Equity	-0.4	-2.2	Revenues partly inflate

Commodities (GSCI)	+4.5	9.7	Direct goods-price linkage
REITs	+0.3	0.9	Mixed; rents lag CPI
0-5 Yr TIPS	+2.0	17.1	Principal indexation

### Duration effect

Real value erosion for a bond equals duration  $\times$  unexpected inflation. A 10-year nominal Treasury (duration 8.7) hit by a 2 % CPI surprise loses roughly 17 % real value absent yield-curve shifts.

### Breakdown of nominal yield

Yield = real rate + expected CPI + term/liquidity premium. Unexpected inflation hits fixed-rate instruments because only expected CPI is compensated ex-ante.

### Hedging instruments

- **TIPS** – Principal accretes with non-seasonally-adjusted CPI-U lagged 3 m. Real yield volatile; breakeven widening benefits TIPS but hurts nominal Treasuries. Liquidity premium widened to 30 bps during 2020 dash-for-cash.
- **Inflation-swaps** – Zero-coupon swap exchanges fixed inflation for realised CPI. Standard maturities 1–30 yrs; collateralised; efficient for overlay hedging.
- **Commodities futures** – Exhibit positive  $\beta_{\text{infl}}$  but carry cost from contango; roll yield averaged  $-3\%$  annual over 2000-2024 for energy contracts.
- **Real-asset equities** – Midstream pipelines, utilities, cell-tower REITs include revenue escalators indexed to CPI or PPI. Correlation with headline CPI modest (+0.25) due to equity market beta.
- **Floating-rate notes** – Coupon resets to SOFR + spread; hedge rate risk, not inflation unless monetary authority responds fully to CPI surprises.

## **Liability context**

Defined-benefit pension plans discount liabilities at high-grade corporate yields; inflation spikes raise discount rate only partially, worsening funding gap. Liability-driven-investment (LDI) schemes often pair long credit with TIPS or inflation-swaps to match real liability growth. A 100 bp CPI surprise increases typical U.S. pension projected benefit obligation by ~6 %.

## **Historical event studies**

1973-1974 oil embargo: CPI shock 7 %-plus; 60/40 portfolio real drawdown 23 %. Gold +180 %, GSCI +120 %, TIPS unavailable. 1979-1981 Volcker tightening: CPI decelerated from 14 % to 4 %; nominal bonds lost 8 % real, but future real yields reset higher. 2021-2022 spike: 60/40 posted -17 % nominal, worst since 1937; 5-yr TIPS returned -8 % as real yields rose despite CPI compounding; commodities +26 %.

## **Inflation term structure**

Short-dated breakevens track energy; long-dated influenced by growth and policy credibility. During 2022 spike, 1-year breakeven hit 6.6 %, 10-year remained near 2.6 %, signalling transitory expectation beyond near term.

## **Real-estate pass-through lag**

Commercial leases: office 3-5 yr resets; multifamily 1-yr; self-storage month-to-month. Empirical study (NPI data 1990-2024) shows property-level NOI growth lags CPI by 4-6 qtrs, damping hedge effectiveness.

## **Cost-push channels**

Energy and wage shocks propagate differently. Wage-driven inflation embeds in services, stickier than goods inflation. Phillips-curve slope estimated at 0.2 recent years, implying 1 ppt unemployment gap moves core PCE by 0.2 ppt.

## **Monetary-policy transmission**

Taylor-rule suggests policy rate  $\approx r^* + \pi + 0.5(\pi - \pi^*) + 0.5$  output gap. If central bank adjusts fully, floating-rate instruments pass inflation; lag creates negative real rates.

## **Portfolio construction guidelines (research consensus)**

- Maintain global equity for real growth; beta -0.3 manageable at low surprise levels.
- Hold 10-25 % dedicated inflation-linked assets (TIPS, swaps).
- Add 5-10 % commodities or natural-resource equities for tail CPI shocks.
- Use tactical overlays to adjust breakevens when valuation diverges from survey expectations.

– Balance liquidity; TIPS market depth drops in crises; futures overlays preferable for large mandates.

### **Policy reforms—U.S. Treasury 2028**

Treasury borrowing advisory committee recommends increasing 5-yr TIPS auction sizes to USD 20 bn per reopening (from 17 bn) to broaden float, aiming to tighten bid-ask spreads that average 6 cents versus 2 cents for nominals.

### **Insurance-product linkage**

Annuity riders with COLAs priced at 2 % have negative duration to CPI above 2 %. COLA caps often 3 %; sustained 6 % CPI erodes purchasing power by 13 % after 3 years even with capped COLA.

### **Accounting impact (IFRS)**

IFRS-16 lease liabilities discounted at incremental borrowing rate; inflationary rate hikes raise liability PV marginally but raise right-of-use asset depreciation proportionately, net P&L neutral unless inflation feeds into variable lease payments.

### **Conclusion**

Inflation risk erodes real returns, widens funding gaps, and distorts asset correlations. Direct hedges (TIPS, swaps) neutralise CPI surprises; indirect hedges (commodities, real assets) blunt tails. Strategic allocation integrates both, calibrated to liability structure and cost tolerance. Empirical beta estimates and historical episodes confirm that portfolios lacking explicit inflation-linked assets accept higher real-return volatility.

### **Real-rate dynamics and inflation risk premium**

Nominal yield decomposes into real rate, expected inflation, and premiums. The real 10-year Treasury rate averaged 2.1 % (1998-2007), fell to –0.9 % (2012-2020), and rose back to 1.6 % by April 2025. Real-rate volatility magnifies mark-to-market swings in TIPS; duration of the 0.625 % Feb-2051 TIPS equals 22; a 75 bp jump in real yields during 2022 cut price almost 15 %, despite CPI indexation cushioning principal. Breakeven widening can offset real-rate rise, but net result depends on covariance structure. Since 2003, correlation between daily moves in real yield and breakeven stands at –0.46, implying partial offset.

## **International inflation-linked bond markets**

Outstanding global ILB market size: USD 4.2 trn (Bank for International Settlements, Dec 2024). Breakdown: United States 46 %, United Kingdom 24 %, Eurozone 14 %, Canada 5 %, Japan 4 %, others 7 %. UK indexation uses Retail Prices Index (RPI), which averages 0.7 pp above CPIH; Eurozone uses HICP ex-tobacco; Canada uses CPI-All. Cross-currency ILB baskets hedge global inflation but import currency risk; USD investors neutralise via cross-currency basis swaps or hold USD-hedged share classes offered by major asset managers. Hedging adds 15-35 bp cost per annum, depending on basis and swap-curve slope.

## **Inflation-derivative volume**

Notional outstanding in OTC inflation swaps: USD 1.7 trn (DTCC data Q4 2024), 53 % USD CPI-U, 35 % EUR HICP, 9 % GBP RPI, remainder AUD CPI, CAD CPI. Inflation-option (cap/floor) open interest equals USD 220 bn vega notional; zero-coupon floors struck at 0 % trade actively for deflation hedge. One-year zero-coupon USD CPI floor premiums widened from 7 bp (2019) to 42 bp (June 2022) before retracing to 18 bp (March 2025) as deflation risk receded.

## **Model frameworks**

Market practitioners price breakevens with a three-factor real term-structure model: factors for level, slope, curvature of real yields; combine with two inflation factors—permanent and transitory components—plus an inflation-risk premium  $\lambda(\pi)$ . Calibrations (D'Amico-Kim 2023) show  $\lambda(\pi)$  fluctuating between  $-15$  bp and  $+40$  bp; positive during commodity shocks (2008, 2022) when investors demand compensation, negative during disinflationary scares (2015) when protection is cheap. Estimated variance share: permanent factor explains 65 % of ten-year breakeven variance; transitory 20 %; residual 15 %.

## **Cross-asset hedge regression**

A 60/40 U.S. portfolio augmented with 10 % commodities and 10 % 0-5-yr TIPS shows annual real return volatility drop from 11.4 % to 9.6 % (1973-2024). Maximum real drawdown improves from  $-28$  % to  $-18$  %. Sortino ratio (real downside threshold zero) improves from 0.31 to 0.43. Data: CPI-adjusted returns, GSCI spot, ICE BofA 0-5 Year TIPS index.

## **Hyperinflation case study**

Argentina's post-convertibility era (2002-2024) averaged 37 % CPI, peaking 211 % in February 2025. Peso-denominated fixed-rate Bonos consolidated lost 85 % real value within 12 months of each new issuance. Linkers

(CER-adjusted bonds) preserved real capital but suffered liquidity discount approximated at 18 % price gap to interpolated real value during crisis intervals. Example: TX26 bond trades at ARS 58 (08-2024) versus model value ARS 71.

### **Real-asset operating leverage to inflation**

Energy pipeline master-limited partnerships have tariff escalators tied to PPI-Fuels; 2022 tariff uplift 8.7 %, driving distributable-cash-flow growth 11 % despite flat volume. In contrast, data-centre REITs index rents at 2 % fixed caps; real revenue fell 4 % after 6 % core-CPI acceleration.

### **Inflation and currency hedging**

Unexpected U.S. inflation often weakens USD due to real-rate adjustment. Correlation between DXY daily returns and one-year breakeven changes:  $-0.27$  (2010-2024). Investors buying foreign-currency ILBs gain dual hedge: real principal and potential FX appreciation. However, high correlation emerges only for large CPI surprises ( $\geq 1 \sigma$  events). Quantile regression reveals negligible linkage at median shock.

### **Life-cycle impact**

Retiree spending inflation diverges from headline CPI; medical-care CPI (CPI-M) ran 1.5 pp above headline (1990-2019) then 0.3 pp below during 2020-2024 supply normalization. Inflation risk for retirees thus includes category-mix risk. Research indicates that a spending basket 20 % healthcare, 15 % housing, 13 % food indexes 30-yr cumulative inflation 11 % higher than CPI-U. Liability hedges may therefore substitute healthcare cost-trend swaps, presently thinly traded ( $< \text{USD } 2 \text{ bn}$  notional) but quoted by select dealers.

### **Commodity sub-sector dispersion**

CPI surprises distribute unevenly across commodity groups. Energy futures  $\beta_{\text{infl}}$  5.2, industrial metals 3.1, precious metals 1.7, agricultural 1.4. Dispersion argues for sector-balanced commodity indices when targeting inflation beta, rather than energy-heavy benchmarks that embed higher roll decay.

### **Mortgage duration and inflation**

Negative convexity of agency MBS causes effective duration to extend when rates rise due to slower prepay—exacerbated under inflation shocks that push yields. March 2022-Oct 2023: current-coupon MBS OAS widened from  $-10 \text{ bp}$  to  $+35 \text{ bp}$ , price return  $-12.3 \%$ . Portfolios overweight MBS face double hit: yield up, OAS wider.

### **Tail-hedge instruments**

CPI-linked CMS spread notes pay coupon tied to difference between 30-yr and 2-yr swap yields; inflation shocks steepen curve, enhancing coupon. OTC volume modest (USD 15 bn outstanding 2024). Another niche hedge: equity-linked notes struck on CPI-adjusted earnings indices; issuance limited, liquidity thin.

### **Survey-based expectations**

University of Michigan median 1-yr inflation expectation peaked at 5.4 % (June 2022), falling to 3.0 % (Feb 2025). Long-term 5-10 yr expectation remained inside  $3 \pm 0.4$  %. Disagreement (inter-quartile range) widened to record 7 % in 2022, indicating uncertainty premium. Option-implied inflation skew steepened; 97.5-percentile CPI payers cost 40 bp vs 25 bp in 2019.

### **Institutional policy guidelines**

Typical U.S. public pension Statement of Investment Policy allows 4-10 % inflation-linked bonds, 2-6 % commodities, 3-8 % real estate, reviewed every three years. Funding agencies simulate stochastic inflation with mean-reversion half-life 8 yrs, sigma 1.4 %. Risk budget allocated to “inflation sleeve” charged at 0.65 % active-risk units against total 5 %.

### **Macro hedge-fund behaviour**

CTA trend strategies often profit from inflation spurts via long commodity/short fixed-income bias. 2022: SG Trend Index +27 % versus S&P 500 –19 %. Correlation with YoY CPI changes 0.48 (2000-2024). However, under disinflation (2014-2019) trend alpha muted, indicating asymmetric hedge.

### **Revised glide-paths**

Target-date providers adjusted 2050 vintage inflation hedge weight from 4 % (2020) to 8 % (2024). Additional allocation funded by trimming nominal core bonds. Effective real-return volatility for cohort modelled at 11.1 %, down from 12.4 % pre-change, while expected real return held at 5.3 %.