

# **New Approach to Strategic Capital Market Assumptions for Long-Horizon Institutional Portfolios**

*A cash-flow anchored, structurally adjusted forward-looking framework for fixed income and public equity return and risk modeling*

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## **Introduction**

This document lays out a detailed framework for building capital market assumptions that I use in my project about Distributionally Robust SAA for Life Insurers. The approach is grounded in empirical observations but driven by a forward-looking perspective. The intention is not to mirror traditional methods, which often rely heavily on backward-looking averages or mechanical volatility estimates, but to offer a more structurally sound way to think about long-term returns and risks.

Life insurers, in particular, face a unique investment environment. They operate under regulatory capital rules, invest to match long-dated liabilities, and often hold fixed income assets for the bulk of their portfolios. Their investment horizon isn't one or two years, it's closer to ten or twenty. That long view demands an approach to capital market expectations that reflects the structural drivers of markets: the shape and evolution of the yield curve, inflation dynamics, credit behavior, and macroeconomic shifts like demographics and fiscal policy. Simply averaging past returns or assuming constant volatilities is not enough, or sound, in my opinion.

What I'm doing here is stepping back from the usual toolkit and asking a more relevant question: what do we really need to know about returns and risks over a strategic horizon? For fixed income, this means focusing on starting yields as a predictor of future returns, not because it's a convenient proxy, but because the evidence shows that it's by far the most reliable predictor at multi-year horizons. And for equities, I apply the same logic later: build return expectations from the ground up using actual cash flows of companies like dividends and buybacks, alongside reasonable views on long-term growth and valuation adjustment.

Instead of leaning on volatility or standard deviation as the main measure of risk, I shift the emphasis to uncertainty around return forecasts, how wrong we might be, and why. That distinction matters when you're building a portfolio to maximize surplus for a life insurer over ten years. You're not worried about mark-to-market noise, you're worried about the possibility that your long-term assumptions are off by enough to throw your plan off course.

So the framework here is designed to be practical, forward-thinking, and combine historical data, structural views, and thoughtful simplifications that help rather than hinder decision-making. The rest of this report walks through the full modeling structure: index selection, return forecasting by maturity bucket, reinvestment logic, yield curve assumptions, spread behavior, and finally, how we handle risk in a way that actually matches the investment problem we're trying to solve.

## **Fixed Income**

### **Data**

All data used is sourced from Bloomberg, capturing flexible yet relatively constant maturity index time series data. Yield to Worst (YTW) series data were collected monthly from 1980 up to June 30, 2025. I specifically chose YTW as a base for expected returns as they represent conservative and realistic starting yields. This approach eliminates the need to adjust for systematic biases between initial yields and realized returns (such as downgrades or negative convexity effects in corporates and mortgages).

### **Index Universe and Typical Maturity Structure**

My analysis covers various representative bond indices with typical maturity ranges:

- US Intermediate Treasuries (~4–5 years)
- US Long Treasuries (~15+ years)
- US TIPS (~7–10 years)
- US IG Corporates: 5–7Y, 7–10Y, 10Y+
- US HY: Intermediate (~5 years), Long (~15 years)
- CMBS IG (~4 years)
- ABS IG (~4 years)

Given a strategic investment horizon of 10 years, I segment indices into three distinct (approx.) maturity categories:

1. Intermediate bond (~5Y maturity) indices: US Intermediate Treasuries, IG 5–7Y, HY Intermediate, CMBS IG, ABS IG
2. Long-Term bonds (~10Y+ maturity) indices: Long Treasuries, IG 10Y+, HY Long
3. Benchmark horizon bonds (~7–10Y maturity) indices: IG 7–10Y, TIPS

Detailed methodology on return and risk estimations for those buckets separately are given later in the document.

### **Cash**

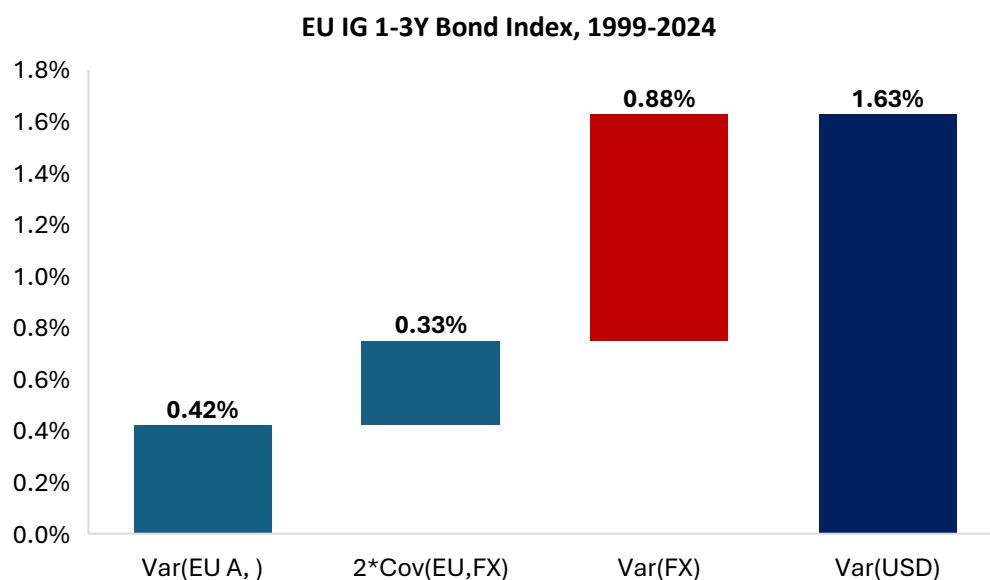
In this analysis, I intentionally exclude cash from the expected return modeling framework. Although cash is essential for liquidity management, it does not function as a strategic return driver over extended investment horizons. Empirical and industry research consistently demonstrates that cash historically underperforms risk-bearing assets such as bonds and equities across multi-year periods. Several factors underpin this long-term underperformance:

- **Structural return deficiency:** bonds allow reliable long-term return forecasting based on starting yields and embedded term premia. Cash, however, lacks such reliability, with short-term interest rates subject to significant fluctuations driven by central bank policy decisions rather than structural macroeconomic drivers such as long-term growth, inflation trends, or persistent risk premia.
- **Forecasting limitations:** empirically, the autocorrelation of cash return time series (1999-2025) is around 70% vs -10% for longer indices (long UST and corporate IG), the volatility and policy-dependent nature of short-term interest rates severely limits the stability and reliability of long-term cash return projections. Unlike longer-duration assets, cash has no term premium and responds predominantly to short-term monetary cycles rather than fundamental macroeconomic conditions.
- **Portfolio role:** from a portfolio construction standpoint, cash primarily serves as a liquidity buffer rather than a strategic asset. Institutional investors, particularly life insurers, typically maintain only minimal cash holdings (around 1–2%) to facilitate operational liquidity, meet transactional needs, or temporarily hold funds awaiting deployment into productive assets.

Given these factors, I set a fixed minimal cash allocation of 1%, acknowledging its tactical liquidity role but excluding it from surplus-optimizing strategic decisions. This aligns with typical life insurance investment practices that prioritize capital efficiency and liability matching over unproductive cash holdings.

## Foreign Currency Bonds

Foreign currency bonds are excluded due to their additional uncompensated currency volatility. Strategic inclusion is only considered if the domestic bond market is small, illiquid, or has a pegged currency against a more stable foreign market.



The chart above shows the portion of foreign bond (in this case EU IG) risk that comes from the variance of the index itself, the variance coming from FX, and the covariance between them. It is obvious that FX volatility makes up most of the risk in foreign currency bonds, and this is the case for all of the foreign fixed income indexes I tested, which is why I do not include them in my SAA.

One might make a diversification argument when a sell-off in domestic assets also depresses the currency and thus creates gains on foreign currency holdings, but I'm not convinced such offsets are stable and can be relied upon, because 1) I checked and the correlation between EU bond and FX returns have around 0.25 correlation, which is not that high to justify and include them in the SAA, and 2) even if it was high enough, correlation does not guarantee causation.

## Yield Curve

The yield forecasting framework leverages structural, cycle-neutral projections from J.P. Morgan's Long-Term Strategist, highlighting key projections:

- **10-year US Treasury real yields:** Expected to reach ~2.5% by 2035, equating to nominal yields of approximately 5.5% assuming a 3% inflation rate.
- **Aggregate bond real yields:** Projected at ~3.0%, implying nominal yields close to 6.0%.

Yield curve assumptions applied are:

Maturity	Current Yield	Yield in 5 Years	Yield in 10 Years	Error (5Y)	Error (10Y)
1 Year	3.98%	4.20%	4.30%	0.40%	0.80%
2 Year	3.75%	4.50%	4.60%	0.40%	0.80%
5 Year	3.83%	5.00%	5.00%	0.40%	0.80%
10 Year	4.28%	5.50%	5.50%	0.40%	0.80%
30 Year	4.84%	6.00%	6.00%	0.40%	0.80%
22 Year (Interp)	-	-	5.80%	-	0.80%
16 Year (Interp)	-	-	5.65%	-	0.80%

0.40% Error for 5Y horizon reflects moderate uncertainty about monetary policy shifts and inflation forecasts over a medium-term horizon, encompassing potential deviations due to gradual economic structural shifts and moderate cyclical fluctuations. 0.80% Error (10-Year Horizon) incorporates greater uncertainty over a longer-term horizon, capturing the heightened probability of macroeconomic structural changes, policy regime shifts, and unforeseen economic cycles that substantially impact yield movements. An inflation expectation of 3% over the coming decade is assumed consistently across yield curve modeling and return forecasts.

5-year reinvestment rates are derived by interpolating current market-implied forward yields and 10-year projected targets, converging towards ~1.5% real yields (~4% nominal) at the midpoint, while 10-year capital gain/loss projections directly utilize the 2035 yield targets to assess potential capital appreciation or depreciation over the 10-year horizon.

In constructing forward-looking expected returns for fixed income assets across various maturities, it is essential to build a yield curve that reflects a credible, long-term outlook on interest rates. Rather than relying on mechanical extrapolations, such as historical averages or market-implied forward rates—which have repeatedly demonstrated poor predictive performance over long horizons—I anchor my 10-year yield curve assumptions in a fundamentally grounded macro-structural framework. This approach aligns with JPMorgan’s “Long-term Strategist” research, specifically the analysis by Wise and Loeys (2023), which provides a robust projection of real yields along the full maturity spectrum of the U.S. Treasury curve out to the early 2030s.

JPMorgan’s framework is especially compelling for long-term strategic asset allocation because it derives real yield projections not from recent cyclical movements or spot market pricing, but from a weighted assessment of eleven persistent structural forces. These include key macroeconomic dynamics such as:

- Demographic aging and the shift toward dissaving,
- Rising public debt levels,
- Increased climate-related capital investment,
- De-globalization and declining foreign demand for Treasuries,
- Sectoral shifts toward lower investment intensity industries like healthcare,
- Persistently higher macroeconomic volatility, which raises term premia.

By linking each of these forces to historical precedents and then applying weighted average yields from past decades with similar characteristics, JPMorgan builds a real yield curve that reflects long-run capital supply-demand fundamentals. This method accounts for the secular evolution of saving and investment behavior in the U.S. economy, which is ultimately what determines real interest rates over time.

Their central forecast is for a **2.5% real yield on the 10-year U.S. Treasury** by the early 2030s. To convert these real yields into nominal yield forecasts, JPMorgan applies a structurally grounded inflation assumption. While the conventional 2% inflation target remains a reference, they argue that a **3% long-term inflation scenario** is more realistic going forward. I adopt this view in my model as well. Accordingly, I assume that nominal yields over the next 10 years will gradually converge toward these real yields **plus 3% inflation**. This implies, for example, a **nominal 10-year yield of 5.5%** and a **nominal 2-year yield of 4.5%** by the early 2030s.

Critically, JPMorgan’s projections are not just useful for point forecasts; they also provide insight into the expected *shape* of the yield curve. The research forecasts:

- A **steeper curve** at the short end (3mo–3Y) than in the 2000s and 2010s, driven by normalization of real short rates;
- A **flatter long end** (3Y–30Y), reflecting moderating term premia and preferred-habitat effects from liability-driven investors.

This projected shape informs my reinvestment rate assumptions, especially for intermediate bond buckets that will require rolling over capital midway through the 10-year horizon. For example, I use the 5Y forward yield for 2Y Treasuries as the reinvestment rate for maturing 5-year bonds, adjusted by projected credit spreads for non-government assets.

## Spreads

Given the anticipation of at least one recession in the upcoming decade, spreads are calculated based on a conservative 15-year historical average (which includes COVID), avoiding distortions from extreme crises (like GFC):

Instrument	Historical Average Spread	Error	Correlation of changes in spread and UST
IG Intermediate	1.11%	0.63%	-41.22%
IG Long	0.87%	0.29%	-39.52%
HY Intermediate	5.71%	2.69%	-38.57%
HY Long	4.32%	1.72%	-41.07%
CMBS Intermediate	1.75%	1.76%	-24.65%
ABS Intermediate	0.87%	1.29%	-33.20%
MBS Intermediate	1.49%	0.66%	-12.43%

## Return Estimation

The expected return for each fixed income index is modeled according to its maturity bucket. These return estimations incorporate yield structure, reinvestment dynamics, and capital gain/loss sensitivity based on duration. I adopt a structurally grounded, forward-looking approach rather than relying solely on historical averages, in alignment with industry best practices and empirical research (e.g., JPMorgan's Long-Term Strategist).

**Intermediate Bonds (~5-Year Maturity)** – these indices have maturities that are significantly shorter than the 10-year horizon, meaning the initial bonds will mature midway through the investment period. Therefore, the expected return includes two components: the return from holding the bond over the first five years and the reinvestment return over the remaining five years.

The expected 10-year return is calculated as:

$$\text{Expected Return} = ((1+Y_0)^5 \times (1+Y_5)^5)^{(1/10)} - 1$$

Where:

- $Y_0$  is the starting yield (typically the current YTW of the index)
- $Y_5$  is the reinvestment yield assumed in year 5, which is forecasted using the 5Y forward yield implied by my yield curve assumptions plus the average spread (for non-Treasury bonds) over the past 15 years

This reinvestment yield reflects expected structural shifts in rates and credit spreads, informed by macroeconomic outlook rather than forward curves alone (which have shown poor historical predictive power).

**Long-Term Bonds (~10+ Year Maturity)** – these indices are held for the full duration of the strategic horizon. Because the bond's duration typically approximates the horizon itself, return outcomes are highly sensitive to capital gain/loss effects from changes in yields over the 10-year period.

The return is estimated as:

$$\text{Expected Return} = Y_0 - D \times \Delta Y$$

Where:

- $Y_0$  is the starting yield (YTW at  $t=0$ )
- $D$  is the effective duration of the index
- $\Delta Y = Y_{10} - Y_0$  is the change in yield over the 10-year horizon, based on structural macro forecasts

This formula accounts for capital re-pricing through the bond's sensitivity to rate changes (i.e., duration), assuming a linear yield shift over the holding period. Any potential reinvestment component beyond 10 years is ignored, as these bonds are typically matched with the full horizon.

### 3. Benchmark Horizon Bonds (~7–10 Year Maturity)

For indices with maturities close to the 10-year horizon, returns are predominantly determined by their starting yield. Historical data shows that for such maturities, the realized total return over 10 years closely tracks the initial YTW, with minimal sensitivity to yield curve shifts or reinvestment dynamics.

Thus, the return estimate simplifies to:

$$\text{Expected Return} = Y_0$$

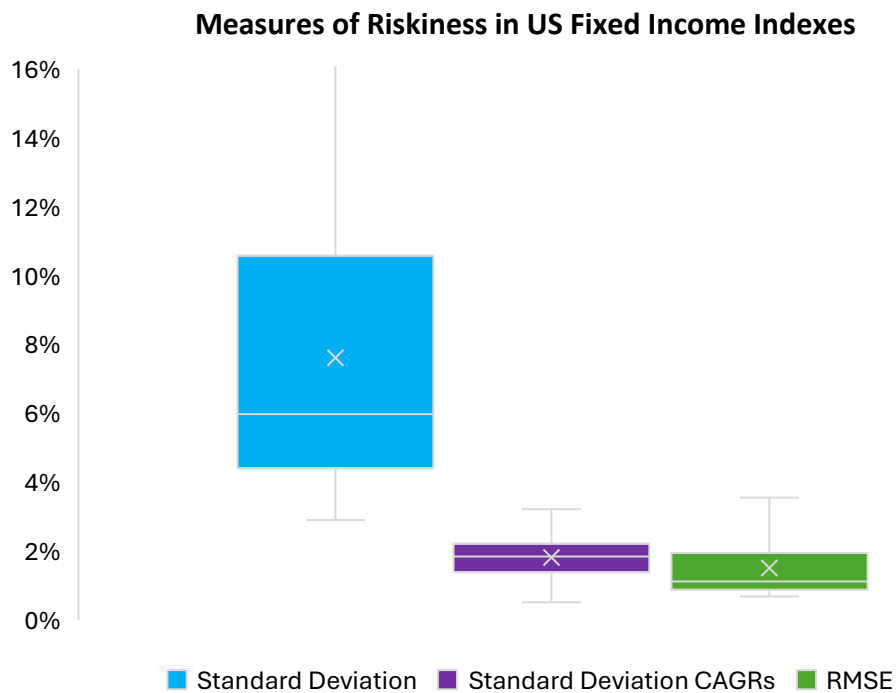
Where  $Y_0$  again denotes the starting yield to worst. This assumption leverages empirical findings that yield-based models exhibit lower root mean squared errors (RMSE) compared to models relying on historical CAGR or forward rates at this maturity band.

## Risk Estimation

Risk estimation forms a crucial component of the capital market assumptions that inform SAA. I compute three distinct risk metrics for each bond index in my investment universe:

1. **Traditional Standard Deviation of Returns:** Represents the volatility based on the typical yearly fluctuations in bond returns.
2. **Standard Deviation of Long-Term CAGR:** Calculated by multiplying the standard deviation of Compound Annual Growth Rates (CAGRs) by the square root of the index's maturity, enabling direct comparability with the annualized standard deviation.
3. **Root Mean Square Error (RMSE):** Derived from the historical forecasting errors of yield-based return predictions, multiplied by the square root of maturity to align comparably with annualized standard deviation.

The charts below show the relative levels of three different types of risks (distributions for all the FI instruments tested).

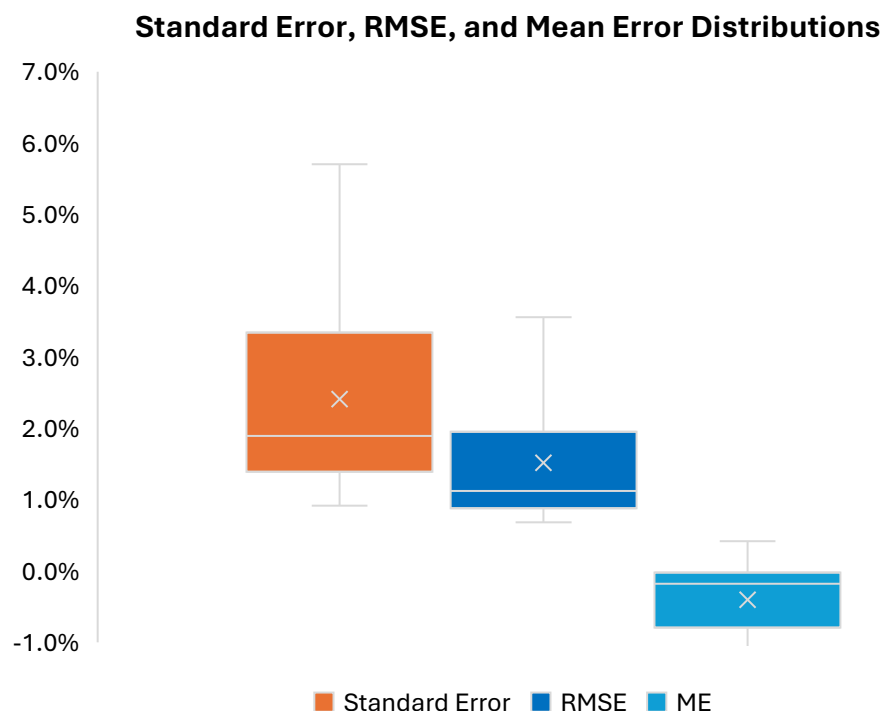


**RMSE is a superior risk measure** across all bond indices, consistently yielding RMSE lower estimates of uncertainty compared to traditional standard deviations. Notably, RMSE is slightly lower than the standard deviation of long-term CAGRs and significantly lower than the traditional standard error commonly used in industry practices. This indicates RMSE provides a more reliable and realistic measure of long-term forecast uncertainty. Also, maturity has an impact predictability – the longer the maturity of an index, the more effectively the starting yield predicts actual returns over a 10-year



investment horizon. Shorter-term indices face greater reinvestment risk and yield curve uncertainty due to more frequent rollovers, necessitating robust yield forecasting methods.

In addition, if we compare the traditional (standard error) vs novel (RMSE) approaches to how wrong we could be in average return estimation, RMSE beats the Standard error estimation here too, with both considerably lower average level and interquantile range:



It should also be noted that the mean error is positive for long-term indexes, which is because the sample period starts from 2000, and the very low interest rate regime started after like 10 years from 2000, and that decreasing interest rates makes bonds perform better so from the beginning the actual 10-year CAGR returns are higher than the starting yields. Capital gains from falling rates get locked in for longer because short-term bonds mature quickly, prices pull back to par fast, so gains fade quickly, while long-term bonds don't mature soon, so price gains stick and investors enjoy elevated returns longer.

### Time Diversification and Mean Reversion

In the context of long-horizon institutional investing, the concepts of **time diversification** and **mean reversion** have often been underappreciated or misunderstood, particularly in traditional finance theory. However, for strategic asset allocation (SAA) decisions spanning 10 years or more, these phenomena can play a critical role in risk estimation and portfolio design. My analysis adopts a

nuanced view of risk – one that distinguishes between short-term market volatility and long-term forecast uncertainty – and integrates empirical findings, academic theory, and practical insights.

### Time Diversification and Mean Reversion

The dominant model in classical finance assumes that asset returns are independent and identically distributed (i.i.d.). Under this assumption, the volatility of multi-year returns is derived from short-term volatility by applying the square root of time rule. For example, the standard deviation of a 10-year return is often modeled as  $\sigma_{10Y} = \sigma_{1Y} \times \sqrt{10}$

This rule forms the backbone of models like the Samuelson Invariance Theorem, which implies that optimal asset allocation does not depend on investment horizon. However, this approach ignores several empirically observed patterns:

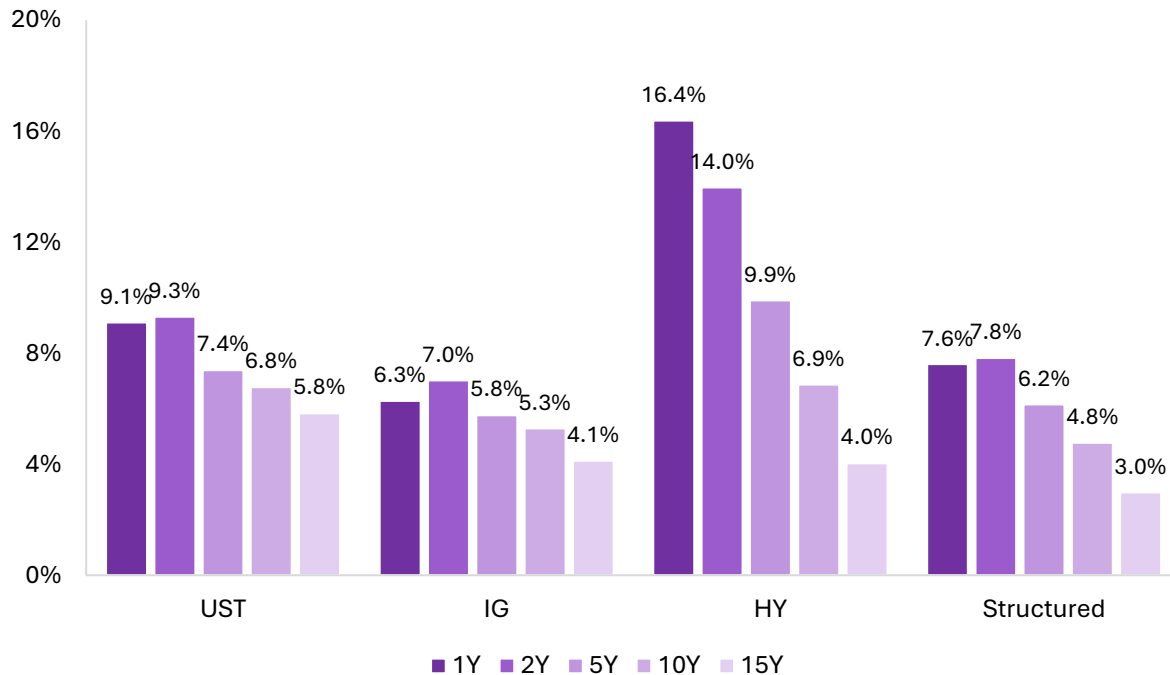
- Returns are not i.i.d., but they are partially predictable using valuation measures like yields.
- Short-term volatility does not capture long-term uncertainty accurately.
- Certain asset classes, especially hybrid assets like high-yield bonds, preferreds, and REITs, exhibit mean reversion.

My empirical analysis strongly supports the existence of mean reversion, particularly in high-yield and structured fixed income asset classes.

- The RMSE measure was **significantly lower** than traditional volatility estimates across all bond categories.
- Long-maturity bonds had **lower forecast error**, consistent with theory that starting yield explains more of long-term returns.
- HY and structured bonds showed particularly strong **mean-reversion behavior**, where short-term volatility was high, but long-term return variability was muted

The chart above illustrates the concept of time diversification by showing how the annualized volatility of compounded U.S. bond returns declines as the investment horizon lengthens, from 1 to 15 years, across four major fixed income categories: U.S. Treasuries (UST), Investment Grade credit (IG), High Yield credit (HY), and Structured products. The steepest decline is seen in HY and Structured bonds, which exhibit markedly lower volatility at longer holding periods. For instance, HY volatility compresses from 16.4% at a 1-year horizon to just 4.0% over 15 years, a fourfold reduction.

**Annualized volatility of compound US returns by holding period**



This empirical behavior is not just statistical coincidence but reflects structural features of credit markets. High yield returns tend to be driven by recurring income streams and cyclical credit re-rating patterns that cancel out over time, producing strong mean-reversion dynamics. Meanwhile, interest rate exposure in structured bonds (often backed by amortizing loans or mortgages) introduces a similarly smoothing mechanism via cash flow-driven price anchoring. In contrast, Treasuries, though lower in absolute volatility, display more muted time diversification, as their returns are tightly tethered to evolving rate expectations with less income cushion.

The declining risk at longer horizons does not stem from serially correlated returns, as classical theory would suggest, but from the fact that long-horizon outcomes are more accurately forecastable based on current yields, reducing forecast dispersion. This phenomenon underscores a profound insight for strategic asset allocators: not all short-term risk translates linearly into long-term risk. Especially in HY and structured credit, the compounding of stable income over time and partial mean-reversion of spread shocks deliver disproportionately lower long-term volatility, supporting higher allocation weights in strategic portfolios with long-duration surplus objectives.

These results illustrate how holding period drastically alters perceived risk: short-term volatility paints a much riskier picture than long-term uncertainty justifies. High-yield and structured bonds, often dismissed as too volatile, emerge as attractive candidates for strategic allocations due to their return stabilization over time.

## Strategic Implications for SAA

1. **Risk should not be estimated by volatility alone** – the square-root-of-time method overstates long-term risk. RMSE is a better proxy for actual return uncertainty over strategic horizons.
2. **Mean reversion creates opportunities** – HY and structured credit instruments exhibit risk behaviors more consistent with equities over long holding periods. Their inclusion in a life insurer's portfolio can enhance long-term Sharpe ratios.
3. **Duration enhances forecast accuracy** – the predictive power of starting yield strengthens with bond maturity. This justifies overweighting longer-duration assets in liability-aware frameworks.
4. **Time diversification is real but conditional** – the benefits are most pronounced when:
  - Starting valuations (e.g., yields) are used to forecast returns;
  - Investors are not forced to liquidate prematurely (i.e., drawdown-insensitive);
  - Leverage is managed conservatively.
5. **Policy implication** – a rational, forecast-driven allocator should **redefine risk** as “uncertainty of hitting long-term targets,” not year-to-year volatility. This redefinition justifies strategic allocations that might appear aggressive under traditional risk metrics.

Based on all of the above, the final return and risk estimation figures are given below:

Index	Matur.	Starting yield	Reinvestment rate after 5Y	Capital gain/loss at 10Y	RMSE (until maturity)	Uncertainty (from reinvest. to matur.)	Expected return (nominal)	Risk (RMSE)
UST, interm.	4	3.83%	5.00%		1.21%	1.27%	4.41%	2.77%
UST, long	22	4.80%		-2.00%	1.28%		2.80%	2.05%
US TIPS	7	1.61%			2.60%	2.63%	4.61%	5.85%
US, IG 5-7Y	6	4.43%	6.11%		1.04%	1.20%	5.27%	2.51%
US, IG 7-10Y	9	4.82%			0.89%		4.82%	2.83%
US, IG 10Y+	21	5.20%		-2.80%	0.83%		2.39%	1.70%
US, HY int	5	7.04%	10.71%		3.73%	4.52%	8.86%	9.26%
US, HY long	16	7.87%		-3.15%	2.57%		4.72%	3.11%
CMBS IG,	4	4.69%	6.75%		1.38%	2.19%	5.71%	4.10%
ABS IG,	4	4.41%	5.87%		1.22%	1.73%	5.13%	3.34%
MBS IG,	8	4.93%			1.52%		4.93%	4.80%

## Equity

This section provides a comprehensive explanation of the methodology, rationale, and data inputs used to estimate strategic long-term expected returns for U.S. equities within the Strategic Asset Allocation (SAA) framework. Unlike traditional top-down approaches, which often rely on index-level heuristics or aggregate macro projections, this analysis adopts a granular bottom-up structure, designed to be both cash-flow based and valuation-sensitive, while integrating structural economic insights and historical data patterns. Each step of the equity CMA construction reflects an effort to align financial modeling with the actual behaviors of public companies, equity markets, and sector-specific business models over time.

To begin with, the scope of the equity analysis is intentionally narrowed to U.S. large-cap equities only, and more specifically, to the eleven GICS sectors within the S&P 500 index. The rationale for this focused approach stems from both methodological and operational considerations:

- Bottom-up equity modeling at the sector level requires extensive historical data collection for constituent firms, including detailed variables such as dividends, buybacks, and growth estimates.
- Expanding this framework to multiple geographies or indices would have proven logistically prohibitive and would risk compromising the rigor of the estimation.
- Restricting the analysis to the U.S. large-cap equity universe avoids the complications of FX forecasting and cross-border tax and liquidity assumptions.

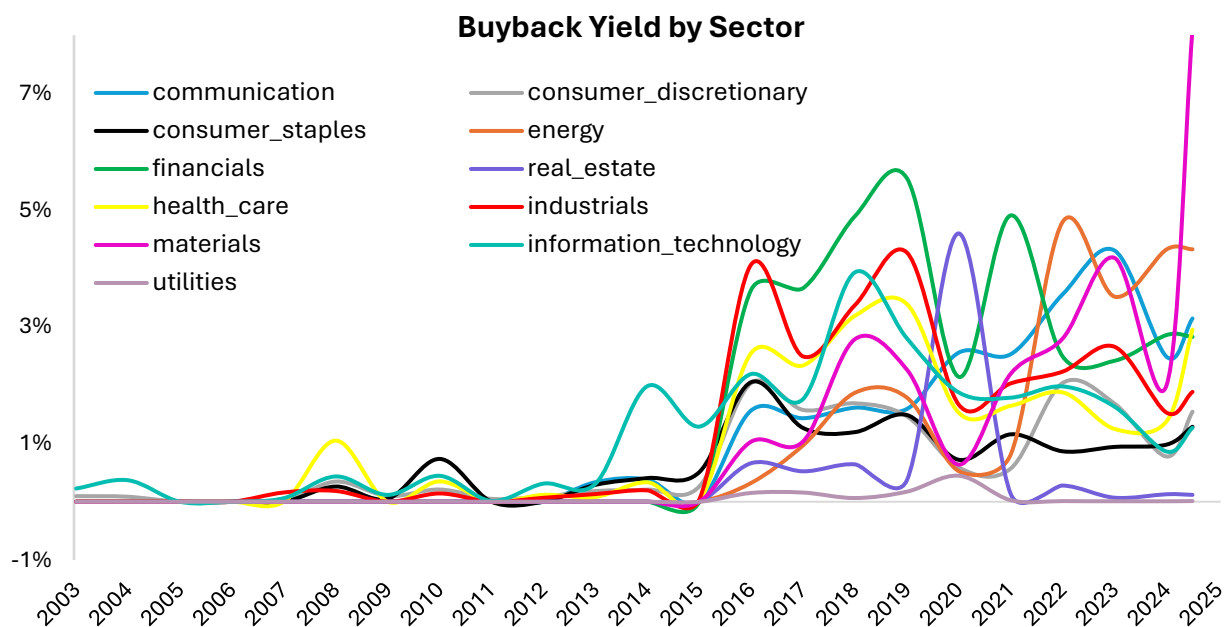
Historical data from Bloomberg were collected for all eleven sector-specific equity indices from 2003 to 2025, specifically the Bloomberg tickers corresponding to each sector such as B500CT (Consumer Staples), B500E (Energy), B500I (Industrials), and so forth. The monthly time series included index level prices, dividend yields, trailing-twelve-month (TTM) earnings per share (EPS), price-to-earnings (P/E) ratios, and net profit margins. This multi-decade data foundation ensures a sufficiently long observation window to capture both cyclical and structural patterns, including periods of economic expansion, contraction, and crisis.

The foundational component of the expected return estimation is the concept of a "cash yield," the equity market's closest analog to a bond's starting yield. Accounting earnings can be systematically manipulated and often diverge from the underlying economic reality that investors should rely on, making cash-based measures significantly more robust. Academic literature and regulatory commentary consistently highlight that companies frequently engage in earnings management through accrual adjustments, one-off items, or strategic timing of expenses and revenues, which distorts reported earnings quality. Earnings may reflect accounting judgment rather than actual cash flows, rendering traditional P/E or EPS-based return models vulnerable to these distortions. In contrast, empirical evidence suggests that shareholder yield components, dividends and buybacks, are harder to manipulate and better reflect real cash returned to investors. Dividend-paying stocks,

on average, exhibit lower return volatility, even when controlling for firm size, indicating that cash distributions are associated with greater stability and transparency. Moreover, accrual-based earnings quality improves only when internal controls are strong, otherwise companies may still distort earnings figures even in ostensibly well-governed firms. These findings reinforce the superiority of using cash-based yields as forward return anchors in your equity return modeling framework, dividends and buybacks cannot be fabricated, they reflect real value returned to shareholders, and they are less subject to managerial discretion or manipulation.

For equities, this is defined as the sum of dividend yield and share buyback yield. While dividend yield data are readily available at the sector index level, buyback data is not directly accessible in aggregated form. To overcome this, a bottom-up methodology was employed:

- For each year-end, the constituent companies of every sector index were retrieved via Bloomberg's Excel API.
- Key data included market capitalization, share prices, shares outstanding, and actual buyback amounts.
- These values were used to compute market-capitalization-weighted buyback yields at the sector level, creating a robust and replicable proxy for shareholder yield.



Over the past two decades, share buybacks have become a structurally important component of shareholder return policy across nearly all U.S. equity sectors. As illustrated in the chart, buyback yields were negligible or even negative during the early 2000s but began rising meaningfully post-2010, with an especially sharp acceleration following the 2017 corporate tax reform and the COVID-19 recovery period. By 2022–2025, many sectors, including Financials, Technology, and Industrials, consistently delivered buyback yields in the 3% to 6% range, rivaling or exceeding their dividend

yields. This shift reflects a broader transformation in corporate capital allocation strategies, where buybacks have become the preferred mechanism for returning cash to shareholders due to their flexibility, tax efficiency, and perceived signaling value. The growing prominence and persistence of buyback activity underscore the need to incorporate them explicitly into any forward-looking equity return model, particularly for sector-level strategic allocation analysis.

An important technical adjustment was made to both dividend and buyback yields to better reflect the timing of cash distributions. Specifically, raw dividend yield figures, which are calculated based on the year-end index level, were adjusted by dividing by the average index level over the course of the preceding year. This correction accounts for the fact that dividends and buybacks are distributed throughout the year rather than as a single lump sum at year-end, improving the fidelity of the cash yield as an annualized figure.

To estimate forward growth, 5-year consensus EPS growth forecasts were constructed using Capital IQ data. As these forecasts were not available in aggregate at the sector index level, another bottom-up process was employed:

- For each year-end in the historical period, EPS growth expectations were retrieved for all constituent companies in each sector, if available (they were available for majority of index constituents all of the time).
- These forecasts were then market-cap weighted to arrive at a sector-level forward growth rate.
- It is assumed that the growth in cash yield (dividends and buybacks) matches the EPS estimated growth rate.

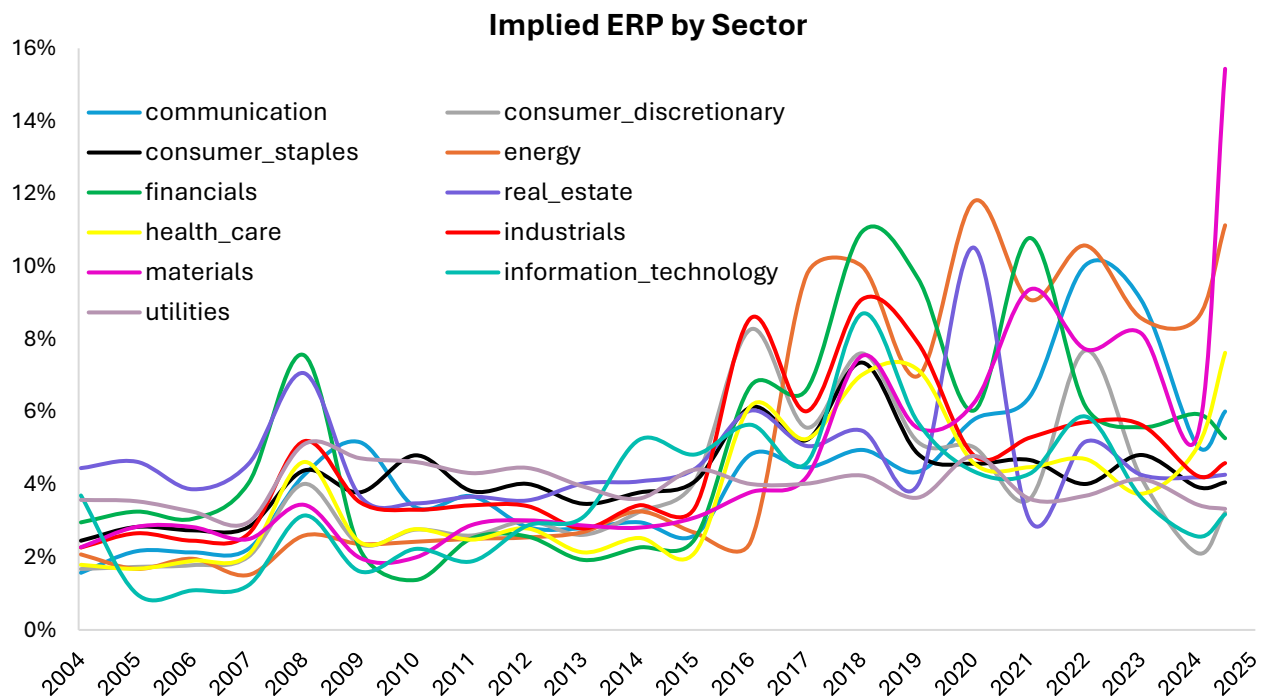
With both cash yield and expected growth in hand, the next step involved computing the implied cost of equity for each sector at each year using a two-stage dividend discount model, a version of the Gordon Growth Model. The structure of the model includes an initial five-year phase of elevated growth, followed by a perpetual growth phase at a lower terminal rate. The formula applied is as follows:

$$P = \sum_{t=1}^5 \frac{D_0(1+g)^t}{(1+r)^t} + \frac{D_0(1+g)^5(1+g_{term})}{(r-g_{term})(1+r)^5}$$

Where:

- P is the index level at year-end
- $D_0$  is the current cash yield (dividends + buybacks)
- g is the 5-year EPS growth rate
- rfr is the terminal growth rate (set equal to the long-term risk-free rate)
- r is the cost of equity to be solved for

This nonlinear equation was solved using a VBA-automated goal-seek macro to determine the implied cost of equity for each sector and year. After obtaining the implied cost of equity, the long-term risk-free rate was subtracted to derive the implied equity risk premium (ERP), the primary input into the SAA model. The choice of using the long-term rate (long treasury index) as the discount rate and terminal growth assumption is consistent with equity's long-duration nature, as equities represent claims on a very long stream of future cash flows.



The chart below plots the evolution of implied ERP by sector over the 2004–2025 period. The series are highly dynamic, influenced by fluctuations in valuation, payout behavior, and forward growth expectations. Notably, a pronounced upward shift in implied ERP levels is visible post-2015 across most sectors, with a further spike during periods of market stress, including 2020 and late 2023. These ERP movements capture not just investor sentiment and risk appetite, but also cyclical inflections in fundamentals and pricing.

Beliefs about market efficiency inherently shape how equity risk premiums are estimated. For long-horizon allocators, the choice of methodology reflects underlying assumptions about whether markets are efficiently priced. If one believes that public markets are broadly efficient over time, or at least that their direction is inherently unpredictable, then the current implied equity risk premium (ERP), derived from prevailing market prices and cash flows, offers the most rational anchor for return expectations. However, if one sees recurring valuation dislocations or structural inefficiencies at the sector or macro level, then using longer-term average implied ERPs or even historical realized



premiums may be more appropriate. Survey-based ERPs, while occasionally used, may be preferred only by those who lack confidence in market-based signals altogether.

Since this framework is designed primarily with institutional allocators in mind, and I believe in general market efficiency with some sector-level inefficiencies, the implied ERP is adopted as the core signal, which is then refined through valuation-aware and structurally-informed adjustments, as described in the subsequent CAPE-based and profitability-based enhancements.

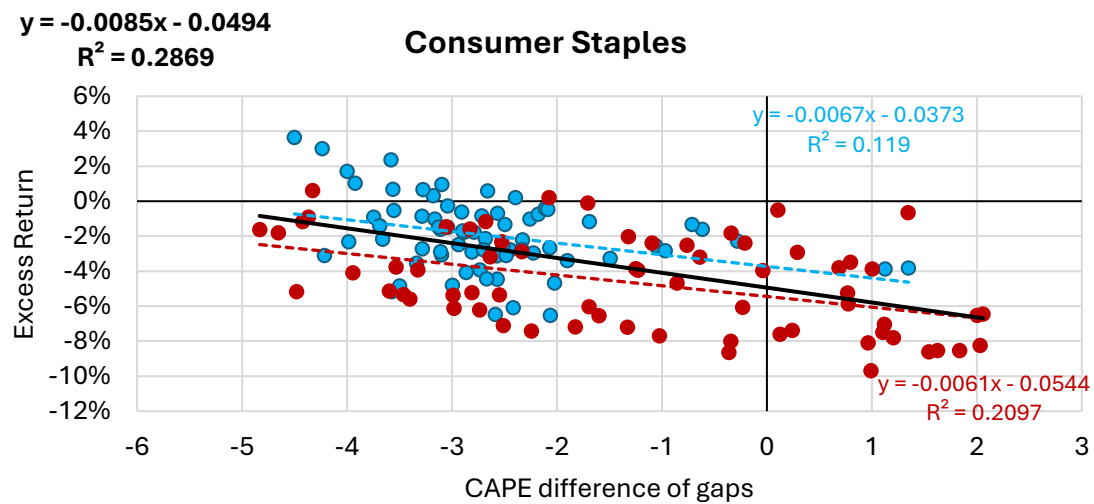
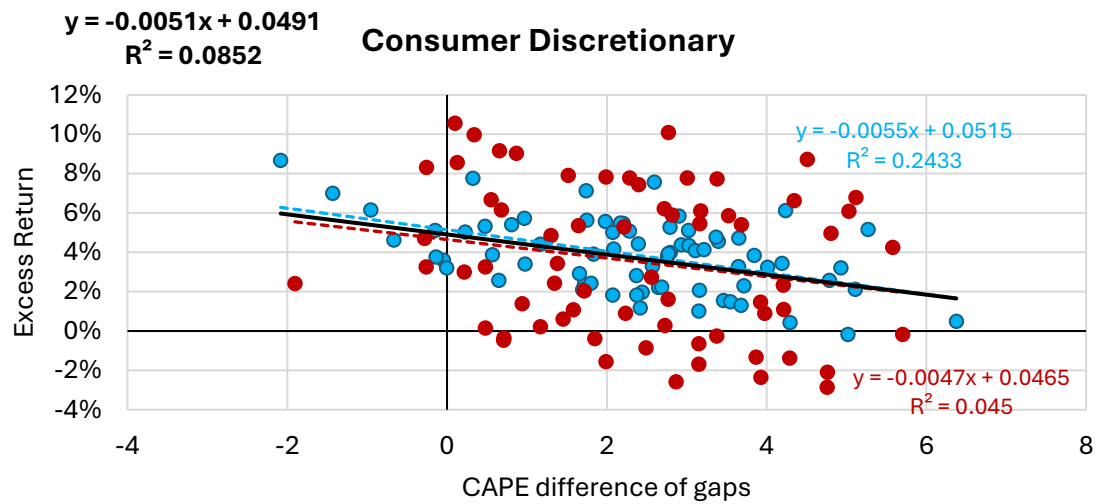
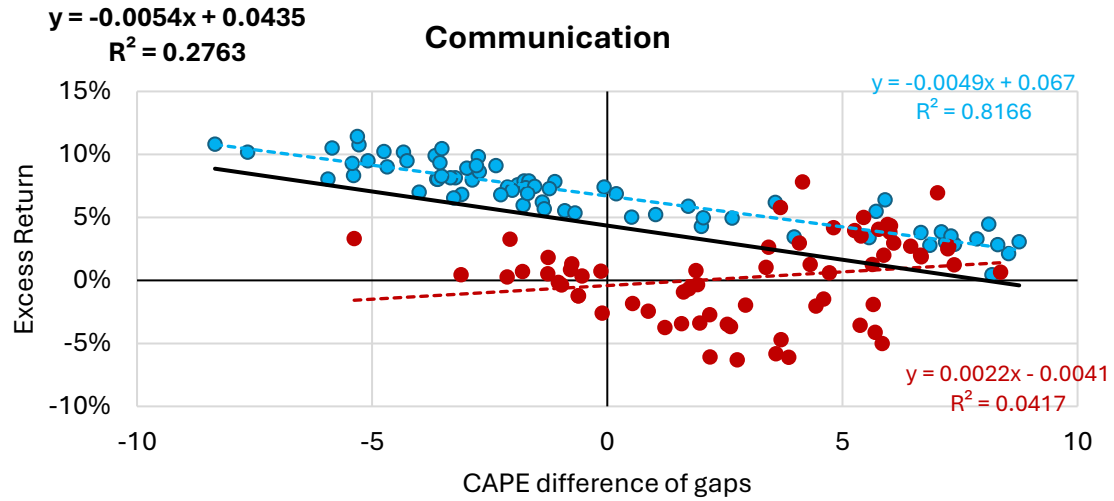
Having established base return expectations using implied cost of equity, the next step introduces a valuation-sensitive overlay via sector-specific CAPE adjustments. The cyclically adjusted P/E ratio (CAPE) serves as a signal of valuation deviation from historical norms. The methodology here avoids simplistic valuation heuristics and instead uses a regression-based framework to determine whether CAPE ratios have explanatory power for future sector-level excess returns. Rolling regressions were performed for each sector, regressing subsequent 5-year excess returns on CAPE deviations from historical norms. Three sub-periods were evaluated:

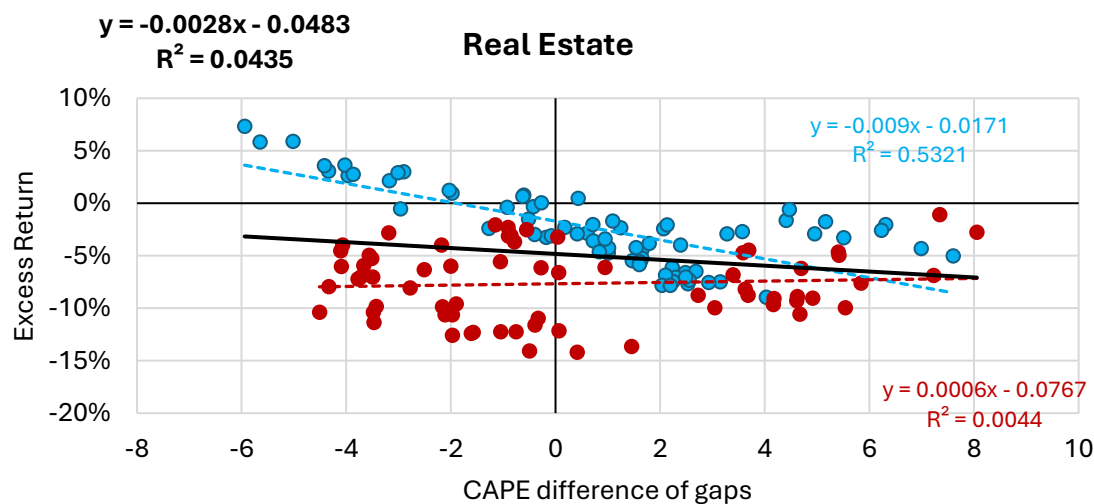
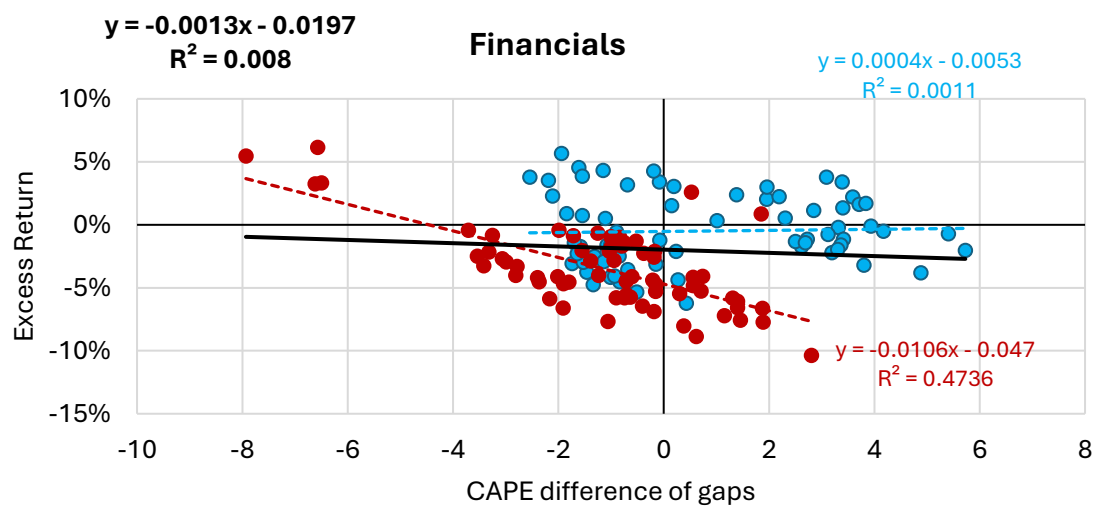
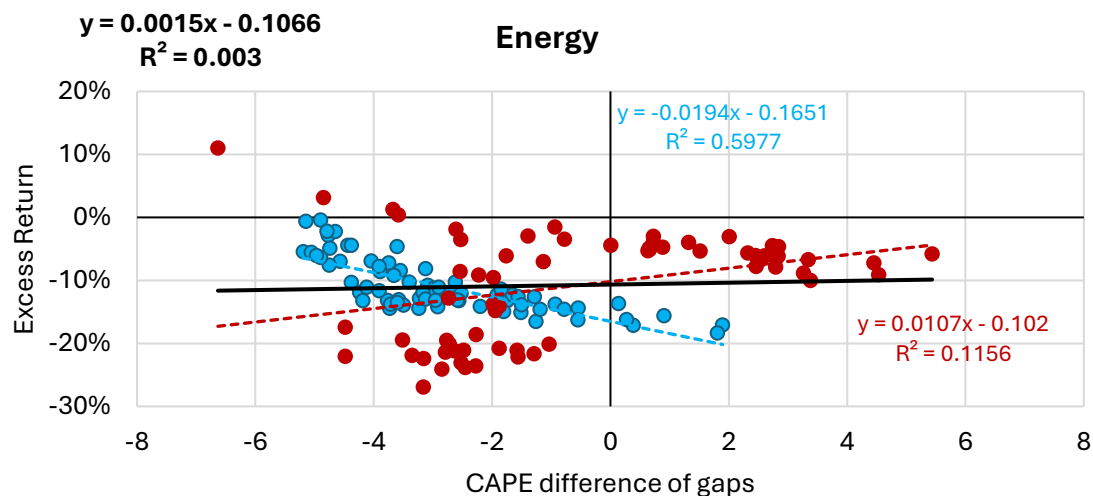
- The full historical sample
- The post-GFC expansion (2009–2015)
- The more recent cycle (2015–2020)

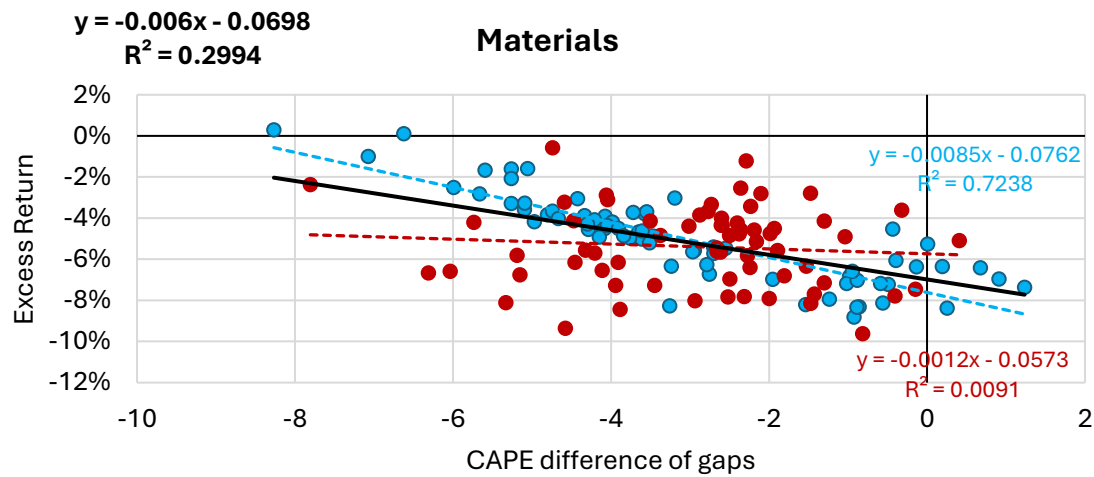
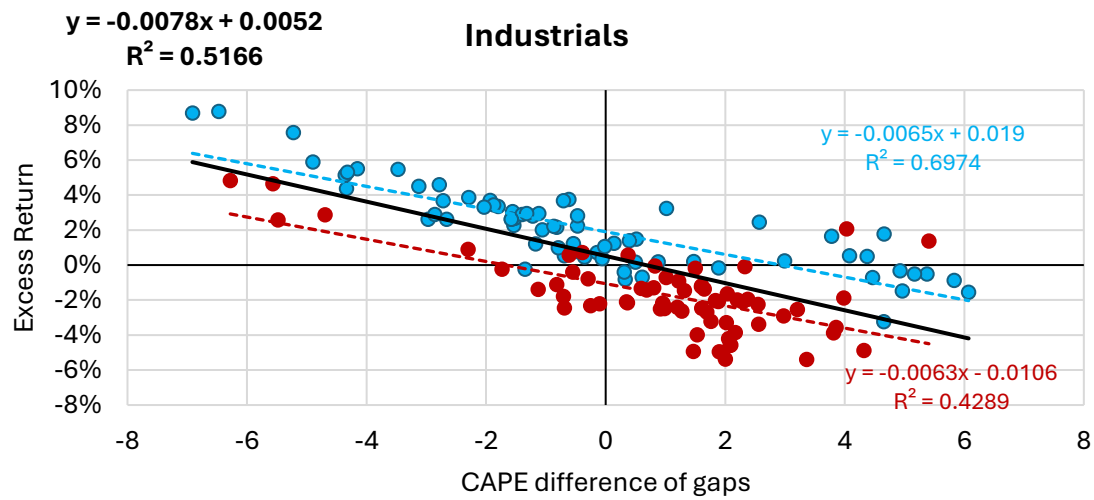
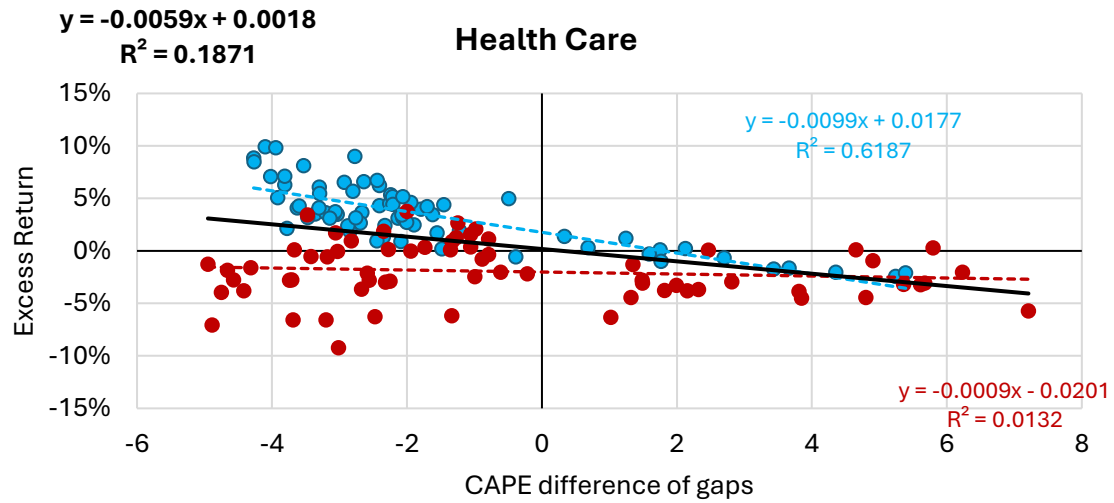
Only when these regressions exhibited meaningful explanatory power, defined as an R-squared above 0.2 in at least one sub-period, was an adjustment applied. The size of the adjustment was proportional to the statistical significance and stability of the relationship:

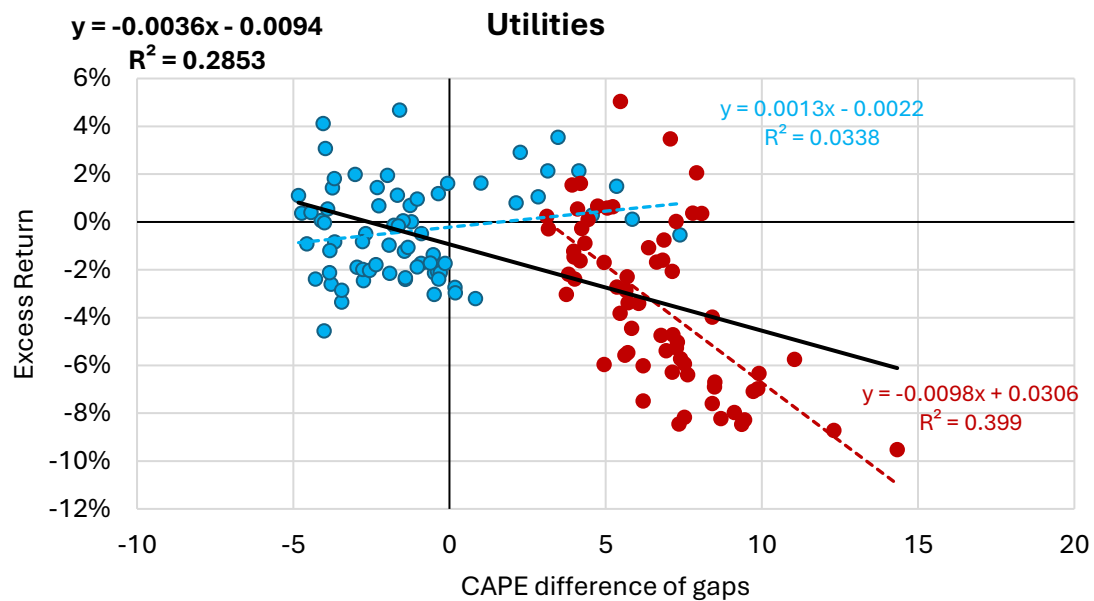
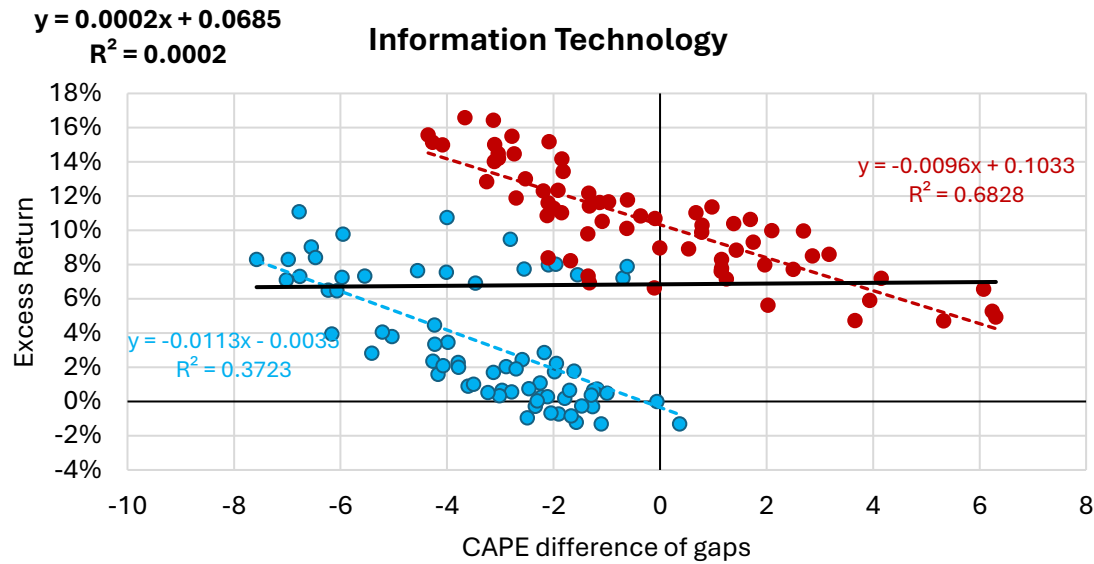
- If both long- and short-term regressions showed strong fit, a full adjustment of the implied excess return was imposed.
- If only one period met the criteria, a smaller 25 to 50 percent adjustment was applied.
- In sectors where CAPE-return linkages were weak or unstable, no adjustment was made.
- In sectors undergoing structural change, such as Information Technology, greater emphasis was placed on recent regressions to reflect evolving valuation paradigms.

The regression charts for each sector are given below (blue dots represent time period 2009-2015, while red dots are for 2015-2020).









The CAPE adjustment process led to intuitive modifications:

- Technology received a significant upward adjustment due to persistent undervaluation relative to realized performance.
- Consumer Staples received a modest positive adjustment, reflecting a stable valuation-return linkage.
- Industrials and Utilities saw downward adjustments due to persistent overvaluation and a historically robust connection between high CAPEs and poor forward returns.

2009-2015	consumer_staples	industrials	information_technology	utilities
Alpha	-0.0373	0.0190	-0.0035	-0.0022
p-value	0.0000	0.0000	0.6075	0.3927
Beta	-0.0067	-0.0065	-0.0113	0.0013
p-value	0.0027	0.0000	0.0000	0.1227
R-squared	0.119	0.697	0.372	0.034
CAPE deviation (x)	0.00	0.00	0.00	0.00
<b>Implied excess return (y)</b>	<b>-3.73%</b>	<b>1.90%</b>	<b>-0.35%</b>	<b>-0.22%</b>

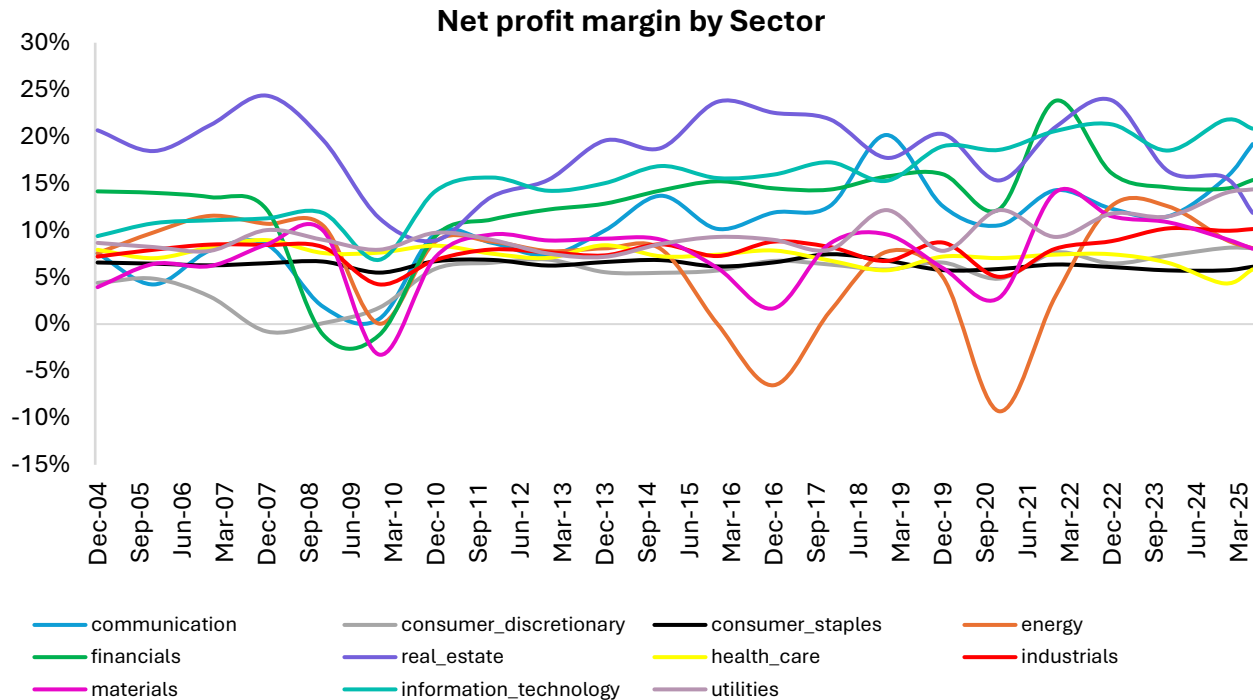
2015-2020	consumer_staples	industrials	information_technology	utilities
Alpha	-0.0544	-0.0106	0.1033	0.0306
p-value	0.0000	0.0000	0.0000	0.0042
Beta	-0.0061	-0.0063	-0.0096	-0.0098
p-value	0.0001	0.0000	0.0000	0.0000
R-squared	0.210	0.429	0.683	0.399
CAPE deviation (x)	0.00	0.00	0.00	0.00
<b>Implied excess return (y)</b>	<b>-5.44%</b>	<b>-1.06%</b>	<b>10.33%</b>	<b>3.06%</b>

Entire period	consumer_staples	industrials	information_technology	utilities
Alpha	-0.0494	0.0052	0.0685	-0.0094
p-value	0.0000	0.0038	0.0000	0.0005
Beta	-0.0085	-0.0078	0.0002	-0.0036
p-value	0.0000	0.0000	0.8855	0.0000
R-squared	0.287	0.517	0.000	0.285
CAPE deviation (x)	-9.84	9.84	9.71	7.46
<b>Implied excess return (y)</b>	<b>3.41%</b>	<b>-7.12%</b>	<b>7.06%</b>	<b>-3.63%</b>

Finally, a third layer of refinement was applied to expected returns based on structural sector-specific trends in profitability and margins. These adjustments recognize that valuation-based models such as CAPE, while informative, do not always capture evolving fundamentals, particularly when sector economics are undergoing transformation or degradation.

- Real Estate was adjusted downward by 50 basis points due to a sustained decline in sector-wide net profit margins, which have fallen to levels last seen during the Global Financial Crisis. Net margins now hover around 11.9 percent—down nearly 12 points from their 2015 peak, with a negative annual trend of minus 1.83 percent. Structural pressures include higher interest rates compressing cap rate spreads and secular weakening of office and retail segments.
- Communication Services received a 50 basis point upward adjustment. Net margins have expanded consistently, reaching 19.2 percent in 2025, nearly double the average from a decade prior. This improvement stems from a sectoral shift toward scalable, digital platform companies.

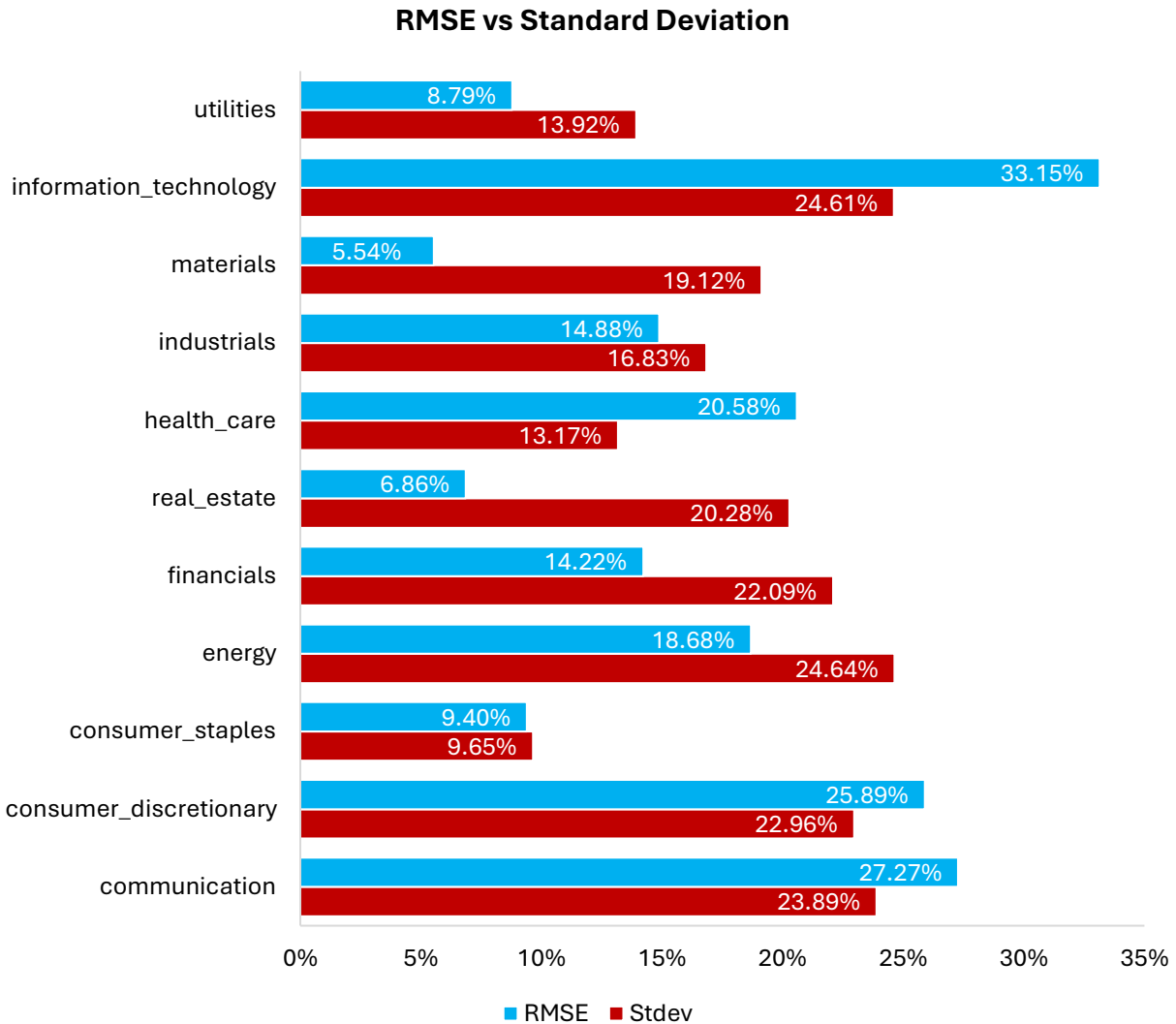
- Utilities were adjusted upward by 25 basis points, supported by a secular rise in profitability to 14.4 percent, driven by inflation-linked rate bases, electrification demand, and renewable energy investment.



Together, the methodology outlined above represents a rigorous, data-intensive, and forward-looking approach to equity return forecasting. By anchoring expectations in actual cash flows, layering in valuation and structural considerations, and avoiding reliance on simplistic heuristics or backward-looking averages, this framework aims to produce credible, institutionally relevant return forecasts for use in long-horizon strategic allocation decisions.

## Risk Estimation

The chart below compares the 10-year scaled root mean square error ( $RMSE \times \sqrt{10}$ ) of return forecasts to the historical standard deviation of total returns for each sector. RMSE here is calculated based on the forecast error between the modeled expected return and the realized return over rolling 5-year periods, and then scaled by  $\sqrt{10}$  to represent volatility over a strategic 10-year horizon, consistent with the time frame of our SAA optimization. This scaling adjusts for the fact that forecast errors over time are not necessarily i.i.d., but it still offers a more forward-looking, model-anchored estimate of risk than raw historical volatility.



Notably, in some sectors, specifically Communication Services, Consumer Discretionary, Health Care, and Information Technology, the RMSE actually exceeds the observed standard deviation of returns. This counterintuitive outcome suggests that for these sectors, return forecasts have historically exhibited higher miss errors than the typical annual price fluctuation, which may reflect structural shifts, model misspecification, or simply the inherent difficulty in forecasting sectors undergoing rapid transformation. Conversely, more stable sectors like Consumer Staples, Utilities, and Real Estate exhibit RMSEs that are meaningfully lower than their historical volatilities, underscoring the higher accuracy and reliability of forecast models in those segments.

Despite these nuances, RMSE remains the preferred measure of risk in this SAA framework. It directly reflects the historical uncertainty of our modeled expected return inputs, rather than backward-looking price fluctuations, making it more consistent with a forward-driven optimization approach. This methodological choice ensures internal consistency between return assumptions and risk estimates.



Based on all of the above, the final return and risk estimation figures are given below:

Sector	Implied ERP	CAPE adjustment	Structural (subjective) adjustment	Expected return	Risk (RMSE)
communication	6.01%	0.00%	0.50%	6.51%	27.27%
consumer_discretionary	3.22%	0.00%	0.00%	3.22%	25.89%
consumer_staples	4.06%	0.85%	0.00%	4.91%	9.40%
energy	11.13%	0.00%	-0.50%	10.63%	18.68%
financials	5.27%	0.00%	0.00%	5.27%	14.22%
real_estate	4.27%	0.00%	0.00%	4.27%	6.86%
health_care	7.62%	0.00%	0.00%	7.62%	20.58%
industrials	4.59%	-3.56%	0.00%	1.03%	14.88%
materials	15.44%	0.00%	0.00%	15.44%	5.54%
information_technology	3.18%	5.16%	0.00%	8.34%	33.15%
utilities	3.33%	-0.91%	0.25%	2.67%	8.79%