T.RowePrice

Capital Market Assumptions

METHODOLOGY

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Fixed Income

Basic Model

We decompose fixed income sector returns into three components: the average yield over the five-year period, the average roll-down yield over the five-year period, and the average annual return due to changes in valuation over the five-year period:

Return = average yield + roll-down + valuation change

These three components are calculated from the following inputs: current yield, forecast yield, and current duration for a given asset class.

Current Yield

The current yield is calculated using linear interpolation—matching the yield on the appropriate sovereign yield curve for the maturity that matches the current duration of the sector. For spread sectors, the current option-adjusted spread is added to the yield of the sovereign maturity that matches the duration of the spread sector.

Forecast Yield

The forecast yield is calculated similar to the current yield, with the inputs provided by the survey results. For a non-government index (e.g., credit), the five-year spread forecast from our survey is then added to the forecast sovereign yield.

Current Duration

The current duration is used in two ways. First, to find current yield through duration matching to the sovereign curve, as discussed above. Second, it is used to calculate the average annual roll-down yield and return due to valuation change. These calculations assume the sector will maintain a constant duration throughout the subsequent five-year period. Our research shows that this assumption, while not perfect, is reasonable since modified durations typically vary within +/- one year over rolling five-year windows.

Average Yield

The average yield is the simple average of the current yield and the forecast yield five years forward, incorporating expectations for spread capture ratios in non-Treasury asset classes:

Average yield = (current yield + forecast yield) / 2

Change in Yield

The change in yield is the annual average change from the current yield to the five-year forecast yield:

Yield change = (forecast yield – current yield) / 5

Roll-Down Return

The roll-down return is earned through rebalancing each year to maintain a constant duration. The return is due to the convergence of a bond's end-of-period yield to the beginning-of-period yield of an equivalent bond with a one-year shorter maturity. Thus, we estimate the roll-down return as follows:

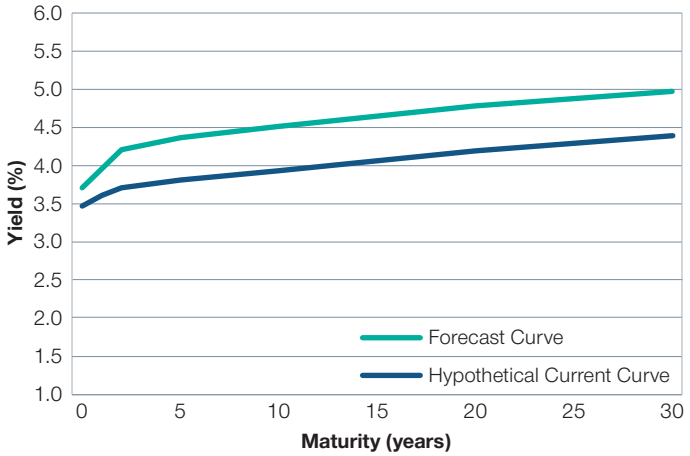
1. First, we use the same estimation methods as for the current and forecast rolled-down yields, except that we interpolate to the maturity points on the current and future yield curves that are one year less than the current average maturity of the index.

2. Second, we estimate the average rolled-down yield over the five-year period as the simple average of the current and forecast rolled-down yields from step 1:

Average rolled-down yield = (current rolled-down yield + forecast rolled-down yield) / 2

3. Third, we calculate the average annual change in yield due to rolling down the curve (roll-down change):

FORECAST SOVEREIGN CURVE



The chart is for illustrative purposes only and is not indicative of future results.

Average roll-down change = (average rolled-down yield – average yield) / 5

4. Last, we multiply the current duration by the roll-down change to get the average annual return to the index from rolling down the yield curve:

Average roll-down return = current duration x average roll-down change

Valuation Change

Valuation change has two components: the return due to changes in the level of the underlying sovereign curve and the return due to changes in the spread over the sovereign curve.

Average level change return = current duration x yield change

Comment on Durations

We use analytical modified adjusted durations to ascertain the correct point on the yield curve for interpolation. However, we use empirical durations for estimating the returns from valuation changes so that we can ensure we cleanly separate the duration due purely to level changes in the underlying sovereign curve and changes in spread levels for a sector.

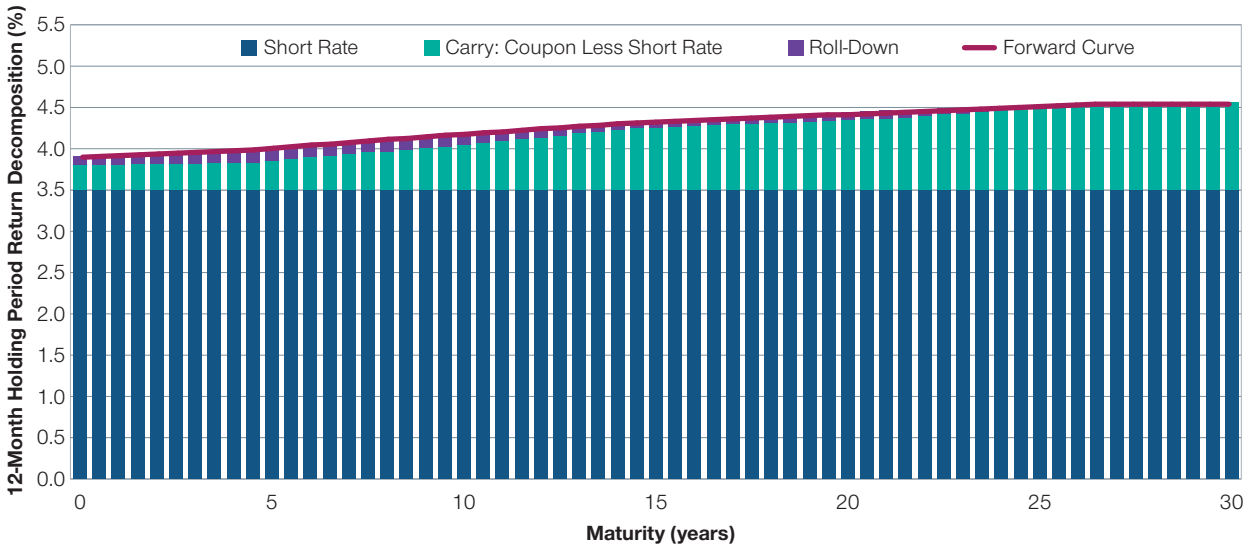
Comment on Spread Capture

Our forecasts do not explicitly require estimated default and recovery rates as inputs. Instead, to reflect credit losses from downgrades or defaults we forecast a spread capture ratio for each asset class. This spread capture ratio is the proportion of future excess returns we expect an asset classe to deliver relative to current spread levels. These forecasts are informed by each fixed income sector's current credit quality, historical spread capture ratios, and our investors' forward looking views.

Inflation-Linked Bonds

We decompose inflation-linked bond returns into two components: the portion of return due to underlying changes in the nominal sovereign curve and the portion attributable to unexpected changes in inflation. The nominal government bond return is developed using the same process as described previously. The unexpected inflation return is computed by subtracting the current five-year consensus inflation estimate from our inflation forecast and then multiplying by the current duration of the index.

CARRY AND ROLL-DOWN FOR GOVERNMENT BONDS



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Equities

The CMAs for equities provide return forecasts for the U.S., the UK, Europe, Japan, Australia, and emerging markets. U.S. returns are further broken out by large-cap and small-cap returns. Our survey process leverages the knowledge and expertise of our global equity portfolio manager and analyst teams via forecasts for each market that are combined to arrive at a global equity forecast. We blend the survey results with market data to develop our equity market assumptions.

Survey Data:

1. Expected Inflation—headline consumer price index annualized over the next five years

2. Real earnings per share (EPS) growth—arithmetic average over the next five years

3. Future price/earnings ratio (P/E)—multiple in five years' time

Market Data:

1. Dividend yield—historical average percentage yield

2. Current P/E—Last 12-month P/E

For each equity asset class, the above inputs are used to calculate expected average annual returns, according to the equation:

Expected Inflation + Real EPS Growth + Dividend Yield + ΔValuation

Where annual ΔValuation for each of the next five years is given by:

$$\left(\frac{\text{Future P/E}}{\text{Current P/E}}\right) \times \frac{1}{5}$$

Real Asset Equity

The returns for real asset equities reflect the three components that make up the underlying benchmark: inflation-sensitive equities, real estate investment trusts (REITs), and physical commodities. Returns for the asset class reflect a 50% MSCI ACWI ex-USA equity, 25% REITs, and 25% commodities weighting. MSCI ACWI ex-USA Index returns were selected to give higher notional weight to commodities-producing countries at the expense of the U.S.

Impacts of Buybacks and New Issuance

Two components purposefully absent from our equity-return model are share buybacks and net issuance. When companies buy their own stock, the remaining outstanding shares each represent a larger ownership percentage and should, therefore, appreciate in price. However, the positive effects of share buybacks may be offset by initial and secondary stock offerings. Published academic literature has been inconclusive on the net effect at the market level.

In favor of a negative buyback effect, on the order of -2% per year, William Bernstein and Rob Arnott argue that share issuances and initial public offerings have consistently outpaced buybacks. Their observation that the market capitalizations of global stock markets consistently grow faster than the price level of indexes that follow the same markets supports this argument. On the other side of the debate, Philip Straehl and Roger Ibbotson have argued for a positive buyback effect on the order of +1.5%, based on aggregating net issuance at the individual company level divided by beginning market capitalization for all stocks in the S&P 500 Index from 1970–2014.

Rather than align directly with either side of the debate, we have chosen a middle ground by assuming no net change in return due to buybacks and new issuance.

Alternatives

To forecast the returns of alternative investments, we use a factor regression model with the following premia used as the predictive variables:

- Equity risk premium (Equity return in excess of cash)
- Small-cap premium (Small-cap return in excess of large-cap)
- Investment-grade credit premium (Investment grade credit return in excess of duration matched government bonds)
- Duration premium (Government bonds return in excess of cash)

We use historical data to help estimate the exposure of each asset class to the premia. Additionally, investments such as hedge funds and private equity/real estate have a non-negligible active management component that is a foundational portion of the value proposition.

Based on our survey results, we quantify each premium and apply investments' beta to the premia to calculate an expected return.

Commodities
In addition to the factor model described above, for commodities we also use gold and oil forecasts from our sector specialists as inputs into our estimates.

Additional Methodology

Survey
The foundation of our CMAs is a survey provided to a wide range of senior T. Rowe Price portfolio managers, economists, and analysts across our equity, fixed income, and multi-asset divisions. The survey requests forecasts for many inputs: inflation, commodity prices, equity valuations, earnings growth, fixed income yields, slopes of yield curves, and spread levels. Respondents are asked to offer insights for their respective areas of expertise and are invited to add thoughts for other categories. After all surveys are collected, baseline forecasts are developed for each asset class. The Capital Market Assumptions Governance and Investment Committee then reviews the results for internal consistency and reasonableness.

Correlations and Volatility
Empirical research has shown that over short time horizons (days and months), volatility regimes tend to cluster—i.e., today's volatility environment is highly correlated to that which investors are likely to experience in the near future. However, these results are less conclusive over longer time horizons. Similarly, certain asset classes, like EM debt, have experienced significant structural declines in volatility over the past decades, while others, like developed market investment-grade debt, recently have increased in volatility as the duration of the asset class has extended.

Our volatility and correlation matrix is based on approximately 15 years of historical data, making adjustments as necessary to reflect recent developments within each asset class. We "unsmooth" return histories of alternative investments, which have significant auto-correlation, to better reflect the economic volatility of the underlying assets.

Currency Treatment
Estimating returns for assets domiciled in a different currency than the base currency invites several questions:

- Should currency movements be hedged and does that view change by asset class?
- What is a reasonable approach for estimating currency return?

We presume that developed market currencies contribute no return relative to each other. This approach contrasts with uncovered interest rate parity — essentially the difference in nominal interest rates between two countries is equal to the expected depreciation of one currency relative to the other. Although intuitive, empirically uncovered interest-rate parity does not hold well, so our currency approach reflects this evidence. We do expect depreciation in emerging market currencies, reflecting the higher economic growth, inflation expectations, and cash yields available in those markets.

In terms of hedging considerations, historical data demonstrates that better risk-adjusted returns potentially can be earned by investors hedging high-quality fixed income versus leaving investment-grade foreign bond exposures unhedged. This is generally true for investors domiciled across the globe. The data is less conclusive for equities and the results are more country specific. We have elected to forecast returns for global aggregate bonds and global investment-grade corporates with hedging, while leaving all other foreign currency exposures unhedged. The difference between our hedged and unhedged return expectations are driven by differences between our interest-rate views and the five-year forward cash rate implied by the market.

Longer-Term Expectations
Many, if not most, investors have a time horizon longer than the five-year forecasts included in this document. As examples, the T. Rowe Price Target Date and Target Allocation franchises offer strategies targeted to investors with 40+ year accumulation and 30+ year retirement cycles. We are often asked for the forecasts we use to inform the construction and design of those portfolios. While we strongly advise against using any single set of assumptions for portfolio construction, investors with a longer-term or perpetual time horizon should consider market conditions beyond the current market environment, which, admittedly, heavily influences many of the forecasts we share here. Included below are several of the risk premia we believe the markets tend to reward over long investment horizons, along with estimates of their average magnitudes over multiple market cycles. By definition, these are long term and relatively stable over time, but they are subject to revisions and revalidation as necessary. The table below includes the same premia we use for estimating alternative asset class returns, but are just a subset of the premia potentially available over long investment horizons.

Premia	Forecasted Value Over Market Cycles (Arithmetic Averages)
Equity Risk	5.5%
Small-Cap	1.0%
Investment-Grade Credit	0.5%
Duration	1.0%

REFERENCE INDEXES

	ASSET CLASS	REPRESENTATIVE INDEX
EQUITY	Global Equity	MSCI ACWI Index
	Global ex-U.S. Equity	MSCI ACWI ex-USA Index
	Global ex-Japan Equity	MSCI Kokusai Index
	Global ex-Australia Equity	MSCI ACWI ex-Australia Index
	DM Equity	MSCI World Index
	DM ex-U.S. Equity	MSCI World ex-USA Index
	U.S. Equity	Russell 3000 Index
	Europe ex-UK Equity	MSCI Europe ex-UK Index
	UK Equity	FTSE 100 Index
	U.S. Large-Cap Equity	Russell 1000 Index
	U.S. Small-Cap Equity	Russell 2000 Index
	Canada Equity	S&P/TSX Composite Index
	Europe Equity	MSCI Europe Index
	Asia ex-Japan Equity	MSCI Asia ex-Japan Index
	Japan Equity	MSCI Japan Index
	Australia Equity	S&P/ASX 200 Index
	China Equity	MSCI China Index
	EM Equity	MSCI Emerging Markets Index
	Real Asset Equity	S&P Real Assets Index
FIXED INCOME	Global Aggregate	Bloomberg Global Aggregate Index
	Global Aggregate (Hdg)	Bloomberg Global Aggregate (Hdg) Index
	Global Agg ex-U.S.	Bloomberg Global Aggregate ex-U.S. Index
	Global Agg ex-U.S. (Hdg)	Bloomberg Global Aggregate ex-U.S. (Hdg) Index
	Global IG Corporate (Hdg)	Bloomberg Global-Aggregate Corporate (Hdg) Index
	Global High Yield	Bloomberg Corporate High Yield Index
	U.S. Cash	Bloomberg 1–3M Treasury Bills Index
	U.S. TIPS	Bloomberg Global Inflation-Linked U.S. TIPS Index
	U.S. Short TIPS	Bloomberg Global Inflation-Linked 1-5 Year U.S. TIPS Index
	U.S. Treasury	Bloomberg U.S. Treasury Index
	U.S. IG Corporate	Bloomberg U.S. Aggregate Corporate Index
	U.S. IG Coporate (Hdg)	Bloomberg U.S. Aggregate Corporate (Hdg) Index
	U.S. Long Credit	Bloomberg U.S. Long Credit Index
	U.S. Long Treasury	Bloomberg U.S. Long Treasury Index
	U.S. Aggregate	Bloomberg U.S. Aggregate Bond Index
	U.S. High Yield	Bloomberg U.S. Corporate High Yield Index
	U.S. Bank Loans	S&P/LSTA Leveraged Performing Loan Index
	U.S. Securitized	Bloomberg U.S. Securitized Index
	UK Cash	Bloomberg Sterling Treasury Bills 0-3 Month Index
	UK Gilts	Bloomberg UK Gilts Index
	UK IG Corporate	Bloomberg UK Aggregate Corporate Index
	Europe Cash	Bloomberg EUR Treasury Bills 0-3 Month Index
	Europe Treasury	Bloomberg EUR Treasury Index
	Europe IG Corporate	Bloomberg EUR Aggregate Corporate Index
	Europe IG Corporate (Hdg)	Bloomberg EUR Aggregate Corporate (Hdg) Index
	Europe High Yield	Bloomberg EUR High Yield Index
	Japan Cash	Bloomberg Japan Treasury Bills 1-3 Months Index
	Japan Treasury	Bloomberg Japan Treasury Index
	Japan IG Corporate	Bloomberg Japan Aggregate Corporate Index
	Australia Cash	Bloomberg Ausbond Bank Bill Index
	Australia Bonds	Bloomberg Ausbond 0+ Composite Index
	Canada Bonds	Bloomberg Canada Aggregate Index
	Asia Bonds	JP Morgan Asia Credit Index
	EM Sovereign Local	JP Morgan GBI – EM Global Diversified Index
	EM Sovereign	JP Morgan EMBI Global Diversified Index
	EM Corporate	JP Morgan CEMBI Index
ALTERNATIVES	Hedge Funds	HFRI Fund of Funds Composite Index
	Distressed Debt	ICE BofA CCC & Lower Index
	CLOs - Senior	Palmer Square Senior CLO Index
	CLOs	Palmer Square CLO Index
	Private Credit	Cliffwater Direct Lending Index
	Private Equity	Cambridge Associates LLC Global Private Equity Index
	Commodities	Bloomberg Commodity Index
	Gold	S&P GSCI Gold Total Return Index
	Global Private Real Estate	NCREIF Property Index
	REITs	FTSE EPRA/NAREIT Developed Index

Hdg = Hedged currency treatment. EM =Emerging Markets. DM = Developed Markets.

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Key Risks, Additional Disclosures, and Important Information

Key Risks

Forecasts are based on subjective estimates about market environments that may never occur. Some of the factors that could impact these forecasts include, but are not limited to:

Political and economic conditions
Performance of financial markets
Interest rate levels
Changes to laws or regulations

Investments in equities are subject to the volatility inherent in equity investing, and their value may fluctuate more than investing in income-oriented securities. Certain asset classes are subject to sector concentration risk and are more susceptible to developments affecting those sectors than broader classes. Investment in small companies involves greater risk than is customarily associated with larger companies, since small companies often have limited product lines, markets, or financial resources. Transactions in securities denominated in foreign currencies are subject to fluctuations in exchange rates, which may affect the value of an investment. Debt securities could suffer an adverse change in financial condition due to a ratings downgrade or default, which may affect the value of an investment. Investments in high yield involve a higher element of risk. Investments in less developed regions can be more volatile than other, more developed markets due to changes in market, political, and economic conditions. Investments are less liquid than those that trade on more established markets.

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