RESEARCH

The Drivers of Global Government Bond Returns

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This paper examines the relation between forward rates and expected returns of global government bonds. We find that current forward rates contain reliable information about differences in future realized returns across government bonds of different maturity ranges and currencies of issuance. Motivated by these findings, we examine US and global portfolios that vary their exposures to maturity and currency of issuance by systematically emphasizing bonds with higher forward rates. We find that such dynamic yield curve selection and positioning can add value for investors over the long run and in different interest rate environments.

Introduction

Much research shows that changes in interest rates are largely unpredictable and that forward rates based on current yield curves contain reliable information about expected bond returns.[1] Therefore, we can use forward rates as proxies for expected returns to dynamically vary a portfolio's exposure to maturity ("variable maturity"), credit quality ("variable credit"), and currency of issuance ("variable currency") in pursuit of higher expected returns.

In a *recent paper*, we showed that forward rates contain reliable information about differences in expected returns of global corporate bonds, providing compelling support for the variable credit approach. In this paper, we focus on government bonds and examine the validity of the variable maturity and variable currency approaches. We first review the empirical evidence of the relation between the current forward rate and the future realized bond return using data for government bonds across different maturity ranges issued in G10 currencies.[2] We then simulate US and global portfolios that apply variable maturity and variable currency approaches and examine their performances in different interest rate environments. Our results confirm that dynamic yield curve selection and positioning based on forward rates can add value for investors.

Framework for Expected Bond Returns

For a zero-coupon risk-free bond, we can decompose its expected return over any holding period as follows:[3]

$$E_t[r_{t+\Delta t}^n] = \frac{\Delta t}{12} f_t^{n-\Delta t \to n} - \frac{n-\Delta t}{12}\left(E_t\left[y_{t+\Delta t}^{n-\Delta t}\right] - y_t^{n-\Delta t}\right). \tag{1}$$

The variable on the left-hand side of the equation, $E_t[r_{t+\Delta t}^n]$, is the expected log return on an n-month maturity bond (at time t) over the next Δt months. On the right-hand side, the first term, $f_t^{n-\Delta t \to n}$, is the continuously compounded annualized forward rate for the period from $n - \Delta t$ to n months ahead observed at time t. The second term, $E_t\left[y_{t+\Delta t}^{n-\Delta t}\right] - y_t^{n-\Delta t}$, represents the expected change in the continuously compounded annualized yield on an ($n - \Delta t$)-month maturity bond over the holding period from t to $t + \Delta t$. Because interest rate changes are largely unpredictable, i.e., the best estimate of tomorrow's interest rate is today's interest rate, we can set the second term to zero, allowing us to use the forward rate as a proxy for the expected bond return.[4]

1. For example, see Fama (1984), Fama and Bliss (1987), Campbell and Shiller (1991), and Duffee (2013).
2. The G10 currencies are AUD, CAD, CHF, EUR, GBP, JPY, NOK, NZD, SEK, and USD.
3. For more details on this decomposition, see Lee et al. (2022).
4. While the decomposition in equation (1) is exact for log returns, there is a convexity term after taking the expectation if we decompose the simple return instead. However, it is relatively small for short-term and intermediate-term bonds and typically much smaller than the forward rates.

This framework has several practical implications for how we allocate across bonds. First, it tells us that when spreads in forward rates are larger between longer-term and shorter-term bonds of the same currency of issuance, we should allocate more to longer-term bonds. This variable maturity approach based on differences in forward rates is expected to systematically add value. Second, it tells us that when comparing bonds of the same maturity but different currencies of issuance, we should allocate more to bonds with higher forward rates (hedged to the same currency). This variable currency approach based on differences in forward rates is also expected to systematically add value. Furthermore, it tells us that we can combine both the variable maturity and variable currency approaches to systematically increase a portfolio's expected return by emphasizing bonds with higher forward rates across different maturities and currencies of issuance. In the rest of the paper, we test these implications of the expected bond return framework.

Tests of the Variable Maturity Approach

One way to test the variable maturity approach is to run the following time-series regression for each currency *c* and for each maturity pair (*m, n*):

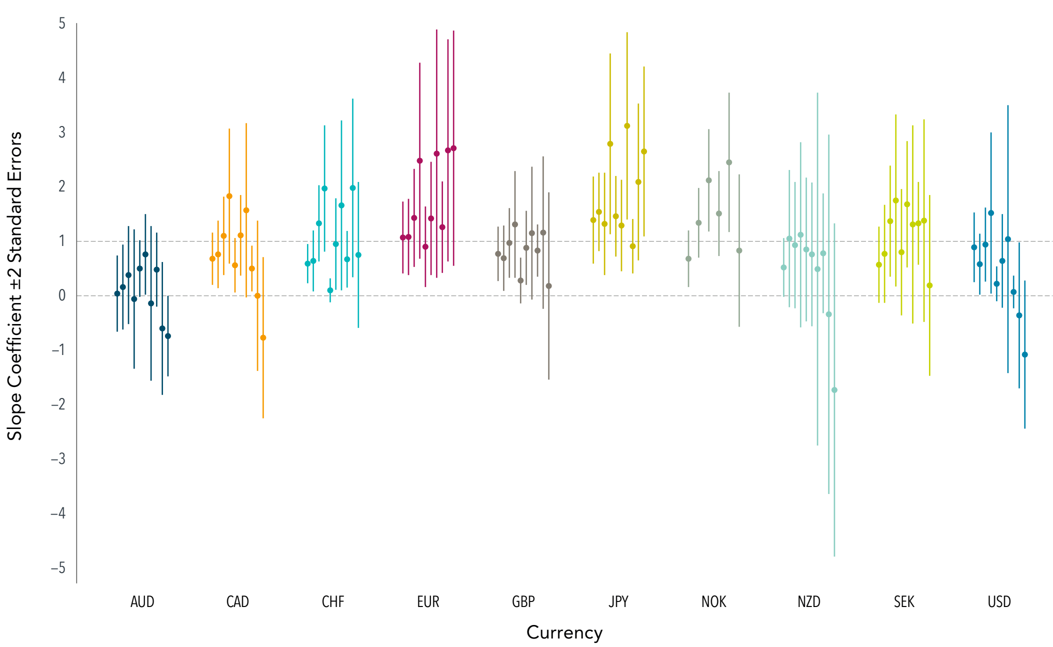
$$r^{n}_{c,t+12} - r^{m}_{c,t+12} = a + b\left(f^{n-12\to n}_{c,t} - f^{m-12\to m}_{c,t}\right) + \epsilon_{t+12}, \tag{2}$$

where *b* is the coefficient of interest and we consider a holding period of one year (Δt = 12 in equation (1)). By regressing differences in returns $(r^{n}_{c,t+12} - r^{m}_{c,t+12})$ on the differences in forward rates $(f^{n-12\to n}_{c,t} - f^{m-12\to m}_{c,t})$, we test whether differences in forward rates between longer and shorter maturity bonds of the same currency contain reliable information about differences in subsequent realized returns.

Exhibit 1 presents the results from the variable maturity regressions for each of the G10 currencies using FTSE World Government Bonds Index (WGBI) data, where the circles correspond to the estimated slope coefficients and the vertical lines correspond to ±2 standard errors.[5] For each currency, we use monthly indices for maturity buckets 1–3, 3–5, 5–7, 7–10, and 10+ years, which amount to 10 unique pairs of maturity buckets per currency.[6] Data availability depends on the currency and maturity bucket pair, and we use the longest available sample period from January 1985 to December 2023 for each index. Both returns and forward rates are hedged to the US dollar (USD) using one-month currency forwards.[7] Detailed regression results are presented in **Exhibit A.1** in the Appendix.

We find that out of the 96 estimated slope coefficients, 86 are positive. Of these, 55 are reliably positive, as indicated by the error bars sitting above 0 (i.e., t-statistic vs. 0 greater than 2). Moreover, 78 of the 96 estimates are not reliably different from 1 as indicated by the inclusion of 1 in the range of two standard errors (i.e., t-statistic vs. 1 between –2 and 2). Overall, the regression results suggest that differences in forward rates contain reliable information about differences in expected returns across bonds of different maturities.

EXHIBIT 1: **Variable Maturity Time-Series Regression Results,** *January 1985–December 2023*



Past performance is not a guarantee of future results. *This figure shows the estimated slope coefficients from variable maturity regressions (equation (2)). For each currency, the slope coefficient was estimated for each maturity bucket pair from the set of 1–3 Year, 3–5 Year, 5–7 Year, 7–10 Year, and 10+ Year monthly indices of the given currency (10 regressions for each currency except NOK) over the largest sample available. For NOK, only six slope estimates are available, because valid annual returns and yields for 10+ Year were not available. The circles correspond to the point estimates of the slope coefficient, and the lines correspond to their ±2 standard errors. Standard errors were calculated using the Newey-West method with a lag of 11. All indices are USD-hedged and sourced from FTSE WGBI with a sample period from January 1985 to December 2023.*

5. In unreported results, we ran similar regressions using zero-coupon Treasury spot curves for maturities of one, two, three, four, and five years, constructed using data from Bloomberg for G10 currencies over the sample period from January 1999 to December 2023. We obtained broadly similar results.

6. Returns over a 12-month holding period are calculated by compounding one-month returns over the same period. Annualized forward rates are calculated as $f_t^{mb^- \to mb} = (dur_{mb} * yield_{mb} - dur_{mb^-} * yield_{mb^-})/(dur_{mb} - dur_{mb^-})$, where dur_{mb} and $yield_{mb}$ are duration and yield of maturity bucket mb, respectively, and mb^- refers to the maturity bucket immediately preceding mb. For maturity bucket 1–3 Year, we use its yield as its forward rate. For NOK, only six unique maturity pairs are available because valid annual returns and yields for 10+ Year were not available.

7. Results are the same using local returns and local forward rates, as the hedging components cancel each other out in equation (2).

Tests of the Variable Currency Approach

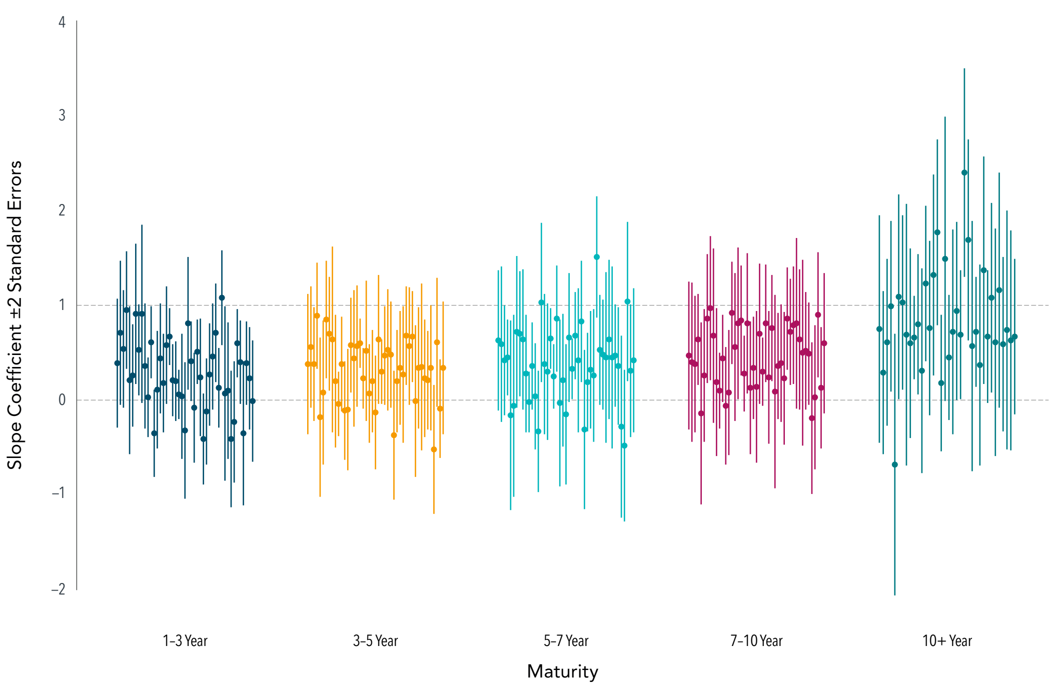
To test the variable currency approach, we run the following time-series regression for each maturity *n* and for each currency pair (*c*, *d*):

$$r_{c,t+12}^{n} - r_{d,t+12}^{n} = a + b\left(f_{c,t}^{n-12\to n} - f_{d,t}^{n-12\to n}\right) + \epsilon_{t+12}, \tag{3}$$

where both returns and forward rates are hedged to USD. We test whether differences in currency-hedged forward rates between bonds of different currencies contain reliable information about differences in subsequent realized currency-hedged returns.

Exhibit 2 presents the estimated slope coefficients from the variable currency regressions for each maturity bucket using the same USD-hedged FTSE WGBI data as before. With 10 currencies, this amounts to 45 unique currency pairs per maturity bucket.[8] Detailed regression results are presented in **Exhibit A.2** in the Appendix. We find that out of the 216 estimates, 185 are positive, of which 54 are reliably positive, and 118 are not reliably different from 1. While the estimates can be noisy for individual regressions, the evidence overall is in support of the positive relation between differences in current forward rates and differences in future returns among bonds of similar maturities but different currencies of issuance.

EXHIBIT 2: Variable Currency Time-Series Regression Results, *January 1985–December 2023*



Past performance is not a guarantee of future results. *This figure shows the estimated slope coefficients from variable currency regressions (equation (3)). For each maturity bucket, the slope coefficient was estimated for each currency pair from the set of AUD, CAD, CHF, EUR, GBP, JPY, NOK, NZD, SEK, and USD monthly indices of the given maturity bucket (45 regressions for each maturity bucket except 10+ Year) over the largest sample available. For 10+ Year, only 36 slope estimates are available because valid annual returns and yields for NOK 10+ Year were not available. The circles correspond to the point estimates of the slope coefficient, and the lines correspond to their ±2 standard errors. Standard errors were calculated using the Newey-West method with a lag of 11. All indices are USD-hedged and sourced from FTSE WGBI with a sample period from January 1985 to December 2023.*

8. For 10+ Year, only 36 unique currency pairs are available because valid annual returns and yields for NOK 10+ Year were not available.

Joint Test of the Variable Maturity and Variable Currency Approaches

We turn to panel regressions to further evaluate the validity of the variable maturity and variable currency approaches, both separately and jointly. By pooling all currency and maturity time series together, panel regressions allow us to leverage more data to obtain more precise estimates. We run the following panel regression:

$$r_{c,t+12}^{n} = a + bf_{c,t}^{n-12\to n} + FixedEffects + \epsilon_{t+12}, \quad (4)$$

where we consider month and currency fixed effects ("Month x Currency") and month and maturity fixed effects ("Month x Maturity") to test variable maturity and variable currency approaches, respectively. We also use month-only fixed effects ("Month") to test the variable maturity and variable currency approaches jointly.

Exhibit 3 presents the panel regression results using the USD-hedged FTSE WGBI data. We find reliably positive estimates for both variable maturity (1.01) and variable currency (0.49) approaches, suggesting that cross-sectional differences in forward rates contain reliable information about cross-sectional differences in expected returns across bonds of different maturities and currencies, respectively.

EXHIBIT 3: **Variable Maturity and Variable Currency Panel Regression Results,** *January 1985–December 2023*

Fixed Effects	Slope Coefficient	t-Statistic	R-Squared	Number of Observations
Month x Currency	1.01	4.87	0.79	19,913
Month x Maturity	0.49	7.32	0.77	19,913
Month	0.57	6.54	0.62	19,913

Past performance is not a guarantee of future results. *This table shows the fixed effects panel regression estimates (equation (4)). Monthly indices data of currency and maturity bucket pairs from the currency set of AUD, CAD, CHF, EUR, GBP, JPY, NOK, NZD, SEK, and USD and maturity bucket set of 1–3 Year, 3–5 Year, 5–7 Year, 7–10 Year, and 10+ Year were used. We used the largest sample available for each index. For NOK 10+ Year, valid annual returns and yields were not available. Standard errors were calculated by double clustering by currency-maturity bucket pair and month. All indices are USD-hedged and sourced from FTSE WGBI with a sample period from January 1985 to December 2023.*

In addition, the last row of Exhibit 3 shows the joint test of the variable maturity and variable currency approaches using month-only fixed effects. The reliably positive estimate of 0.57 confirms the cross-sectional relation between forward rates and bond returns, suggesting that one can target higher returns through higher forward rates across bonds with different maturities and currencies at each point in time.

All in all, the panel regression results corroborate the overall time-series regression results of the positive relation between the forward rate and future bond return, confirming the validity of both variable maturity and variable currency approaches. We now test their implications in a portfolio setting.

US Portfolio Analysis

We start with US Treasuries and simulate a "US Variable Maturity" portfolio whose term exposure varies over time depending on the forward rates. Specifically, at the beginning of each month, we calculate forward rates for one-, two-, three-, four-, and five-year US Treasury bonds and allocate 100% to the bond with the highest forward rate. For comparison, we simulate two additional portfolios: The "US Average 1–5 Year" portfolio maintains equal weights (20%) in one-, two-, …, and five-year US Treasury bonds, and the "US Static" portfolio has constant allocations to one-year and five-year US Treasury bonds such that its duration matches the average duration of the US Variable Maturity portfolio. We use US Treasury zero-coupon yield data from CRSP from July 1952 to December 2023 to simulate these portfolios.[9]

Exhibit 4 shows the annualized return, annualized standard deviation, average duration, and average forward rate of the simulated portfolios. The US Variable Maturity portfolio delivered an annualized return of 6.93%, outperforming the US Average 1–5 Year portfolio by 1.49% per annum. Given that such outperformance comes with higher volatility (4.83% vs. 3.75%) and longer duration (3.86 vs. 3.00), it is also helpful to compare the US Variable Maturity portfolio against the US Static portfolio, which has the same average duration by construction. As Exhibit 4 illustrates, the US Variable Maturity portfolio outperformed the US Static portfolio by 1.36% per annum with similar volatility (4.83% vs. 4.61%). This result further confirms the potential value-adds from varying duration based on expected return information in forward rates.

EXHIBIT 4: Simulated Performance of US Portfolios, *July 1952–December 2023*

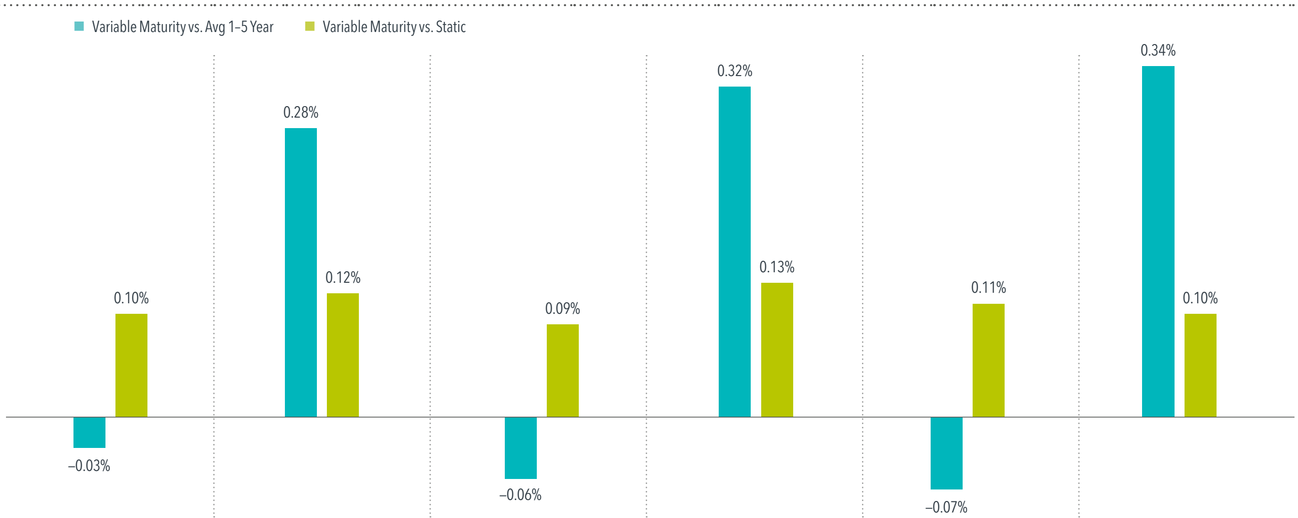
	US Average 1–5 Year	US Static	US Variable Maturity
Annualized Compound Return	5.44%	5.57%	6.93%
Annualized Standard Deviation	3.75%	4.61%	4.83%
Annualized Premium vs. Avg. 1–5 Year	–	0.12%	1.49%
Annualized Tracking Error vs. Avg. 1–5 Year	–	1.12%	2.14%
Average Duration	3.00	3.86	3.86
Average Forward Rate	5.16%	5.29%	5.86%

Past performance, including simulated performance, is not a guarantee of future results*. Simulated strategy returns are based on model/backtested performance. See Disclosures: Important information about simulated performance. In USD. This table includes simulated performance of US Average 1–5 Year, US Variable Maturity, and US Static portfolios. US Average 1–5 Year maintains equal weights (20%) in one-, two-, …, five-year US Treasury bonds throughout the whole sample period. US Variable Maturity portfolio selects the bond with the highest forward rates among one-, two-, …, five-year US Treasury Bonds at the beginning of each month, while US Static has constant allocations to one-year and five-year US Treasury bonds such that its duration matches the average duration of the US Variable Maturity portfolio. All data are monthly and sourced from CRSP from July 1952 to December 2023.*

9. We use data from CRSP to simulate portfolios because they allow us to study a longer history covering different interest rate environments. We have also performed a similar analysis based on FTSE WGBI USD 1–3 Year and USD 3–5 Year subindices from January 1985 to December 2023 for robustness checks. In unreported results, the variable maturity approach that targets the subindex with a higher forward rate delivered a higher annualized return than a static portfolio with the same average duration (5.34% vs. 5.27%).

We now examine the efficacy of the variable maturity approach in different interest rate environments, defined by months when one-year, three-year, or five-year US Treasury yields are rising vs. falling. As shown in the blue bars in **Exhibit 5**, the US Variable Maturity portfolio outperformed the US Average 1–5 Year portfolio by 28 to 34 basis points per month on average when interest rates were falling and underperformed the US Average 1–5 Year by 3 to 7 basis points per month on average when interest rates were rising. This outperformance when rates fell and underperformance when rates rose likely stemmed largely from the duration difference between the two portfolios, with the US Variable Maturity portfolio having a longer duration by about 10 months on average. To examine the benefits of the variable maturity approach controlling for duration, we can compare the US Variable Maturity and US Static portfolios. The lime bars show that the former consistently outperformed the latter, by 9 to 13 basis points per month on average, regardless of the direction of interest rate changes.[10] Since the two portfolios have the same average duration by construction, this comparison more cleanly isolates the value-adds of dynamic yield curve positioning in different interest rate environments.

EXHIBIT 5: Average Monthly Return Differences in Different Interest Rate Environments, US, *July 1952–December 2023*



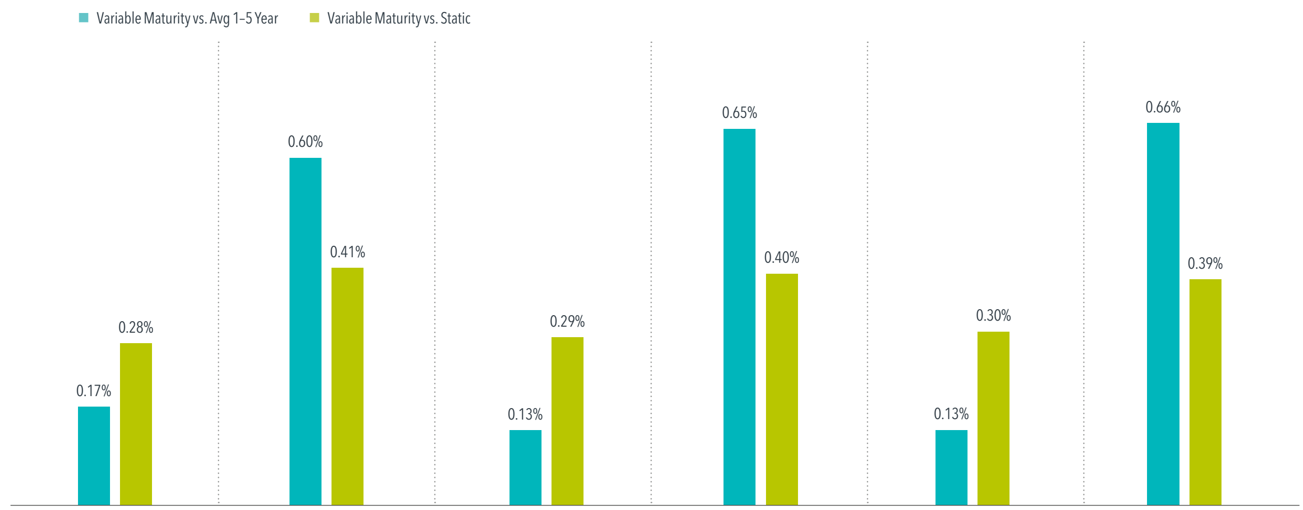
	1-Year Yield Rises			1-Year Yield Falls			3-Year Yield Rises			3-Year Yield Falls			5-Year Yield Rises			5-Year Yield Falls		
	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity
Average Monthly Return	–0.16%	–0.28%	–0.18%	1.11%	1.27%	1.39%	–0.23%	–0.39%	–0.30%	1.18%	1.38%	1.50%	–0.22%	–0.41%	–0.30%	1.19%	1.42%	1.53%
Average Forward Rate	5.00%	5.12%	5.67%	5.33%	5.46%	6.07%	4.94%	5.07%	5.61%	5.39%	5.52%	6.13%	4.97%	5.08%	5.62%	5.37%	5.51%	6.13%
Number of Months		447			411			445			413			450			408	

Past performance, including simulated performance, is not a guarantee of future results. *Simulated strategy returns are based on model/backtested performance. See Disclosures: Important information about simulated performance.*
In USD. This figure shows the average monthly returns, forward rates, and number of months of US Average 1–5 Year, US Static, and US Variable Maturity portfolios in months when one-year, three-year, and five-year US Treasury yields are rising vs. falling. All data are monthly and sourced from CRSP from July 1952 to December 2023.

10. In unreported results, we also analyze the differences in average monthly returns between the US Variable Maturity and the US Static portfolios when the yield spread between five-year and one-year US Treasury bonds increased or decreased. We find that the US Variable Maturity portfolio outperformed the US Static portfolio by an average of 11 basis points per month under both scenarios.

In addition to portfolio performance over a one-month holding period in different interest rate environments as in Exhibit 5, we also examine the average cumulative returns of the same portfolios over longer holding periods. As shown in **Exhibit 6**, over a three-month holding period, the US Variable Maturity portfolio outperformed both the US Average 1–5 Year and US Static portfolios regardless of the interest rate environment. In particular, the US Variable Maturity portfolio outperformed the US Average 1–5 Year portfolio by 13 to 17 basis points on average over a three-month period, despite its underperformance in the initial month when rates were rising. In other words, the US Variable Maturity portfolio was able to recover from its underperformance in a short period of time.[11] These results over longer holding periods suggest that a disciplined and consistent implementation of the variable maturity approach through changing interest rate environments can help investors achieve better outcomes.

EXHIBIT 6: Average Three-Month Cumulative Return Differences in Different Interest Rate Environments, US, *July 1952–December 2023*



	1-Year Yield Rises			1-Year Yield Falls			3-Year Yield Rises			3-Year Yield Falls			5-Year Yield Rises			5-Year Yield Falls		
	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity	Avg. 1-5 Year	Static	Variable Maturity
Average 3-Month Return	0.64%	0.53%	0.81%	2.13%	2.33%	2.74%	0.52%	0.36%	0.65%	2.26%	2.50%	2.90%	0.62%	0.45%	0.75%	2.16%	2.43%	2.82%

Past performance, including simulated performance, is not a guarantee of future results. *Simulated strategy returns are based on model/backtested performance. See Disclosures: Important information about simulated performance.*
In USD. This figure shows the average three-month cumulative return differences of the US Variable Maturity portfolio with respect to both the US Average 1–5 Year and US Static portfolios in different interest rate environments, defined by months where the one-year, three-year, or five-year US Treasury yield is rising vs. falling. The calculation for cumulative returns starts from the month in which the interest rate environment is defined. All data are monthly and sourced from CRSP from July 1952 to December 2023.

11. In unreported results, we find the US Variable Maturity portfolio also outperformed the two other portfolios over six-, nine-, and twelve-month holding periods, with cumulative excess returns increasing as the holding period extends.

Global Portfolio Analysis

We now extend the portfolio analysis to global government bonds. With an expanded opportunity set of multiple currencies, investors can use forward rates to inform both the exposure to maturity and the exposure to currency of issuance. To illustrate this, we use FTSE WGBI 1–3 Year and 3–5 Year indices in G10 currencies (20 maturity-currency subindices in total) to simulate dynamic portfolios that apply variable maturity and variable currency approaches. All portfolios are rebalanced monthly from January 1985 to December 2023 and hedged to USD.

The "Global Variable Maturity" portfolio invests in all 10 currencies while applying the variable maturity approach within each currency. At the beginning of each month, it invests in the maturity bucket (1–3 Year or 3–5 Year) with the higher USD-hedged forward rate for each currency.[12] The weights of chosen maturity buckets are determined by the weights of their respective currencies in the Global Government 1–5 Year Market.[13] The "Global Variable Maturity Variable Currency" portfolio applies currency selection on top of maturity selection. Each month, among the maturity buckets (one per currency) chosen by the Global Variable Maturity portfolio, it selects the currencies with higher forward rates until reaching 70% of the total market value of Global Government 1–5 Year Market.[14] Because the dynamic portfolios tend to have longer durations than the market due to positive term spreads on average, we also simulate a "Global Static" portfolio that has constant weights in FTSE WGBI 1–3 Year and FTSE WGBI 3–5 Year G10 indices such that its average duration matches the average duration of the Global Variable Maturity portfolio over the sample period.

Exhibit 7 shows the simulated performance of these portfolios. The Global Variable Maturity portfolio outperformed the Global Government 1–5 Year Market by 0.48% annualized (5.15% vs. 4.67%) with a longer average duration (3.33 vs. 2.57) and a higher volatility (2.38% vs. 1.88%). While the term premium has been positive on average over this period, with FTSE WGBI 3–5 Year outperforming FTSE WGBI 1–3 Year by 85 basis points per annum, the outperformance of the variable maturity portfolio does not only come from taking a longer duration. Indeed, the Global Variable Maturity portfolio also outperformed the Global Static portfolio with the same average duration and similar volatility. Furthermore, the Global Variable Maturity Variable Currency portfolio further improved the annualized return to 5.42% with a moderately higher volatility of 2.73%. These results confirm the effectiveness of the variable maturity approach across currencies and the benefits of applying variable currency and variable maturity jointly in a global portfolio.

12. We define the forward rates of 1–3 Year indices as their respective yields.

13. Global Government 1–5 Year Market is a market-value-weighted portfolio based on the 20 maturity-currency subindices used for simulating the Global Variable Maturity portfolio.

14. As there tends to be a tradeoff between global diversification benefits and higher expected returns, we chose 70% to strike a reasonable balance between the two. The last maturity-currency subindex chosen may be included at partial weight in order to achieve the exact value of 70%.

EXHIBIT 7: Simulated Performance of Global Portfolios, *January 1985–December 2023*

	Global Govt. 1–5 Year Market	Global Static	Global Variable Maturity	Global Variable Maturity Variable Currency
Annualized Compound Return	4.67%	5.01%	5.15%	5.42%
Annualized Standard Deviation	1.88%	2.35%	2.38%	2.73%
Annualized Premium vs. 1–5 Year Market	—	0.34%	0.48%	0.75%
Annualized Tracking Error vs. 1–5 Year Market	—	0.55%	0.72%	1.19%
Average Duration	2.57	3.33	3.33	3.42
Average Forward Rate	3.92%	4.14%	4.34%	4.85%

Past performance, including simulated performance, is not a guarantee of future results. *Simulated strategy returns are based on model/backtested performance. See Disclosures: Important information about simulated performance. In USD. Indices are not available for direct investment; therefore, their performance does not reflect the expenses associated with the management of an actual portfolio. This table includes the simulated performance of the Global Government 1–5 Year Market, Global Static, Global Variable Maturity, and Global Variable Maturity Variable Currency portfolios. Global Government 1–5 Year Market invests in FTSE WGBI 1–3 Year and 3–5 Year subindices across G10 currencies, including AUD, CAD, CHF, EUR, GBP, JPY, NOK, NZD, SEK, and USD. Global Static has constant weights between FTSE WGBI 1–3 Year and FTSE WGBI 3–5 Year G10 indices across the entire sample period, such that its duration matches the average duration of the Global Variable Maturity. Global Variable Maturity varies term exposure between 1–3 Year and 3–5 Year indices across 10 eligible currencies based on the forward rates. Global Variable Maturity Variable Currency is simulated based on Global Variable Maturity but varies both term and currency exposures. The detailed descriptions of the portfolios' constructions can be found in the preceding part of this section. All simulated portfolios are rebalanced monthly and hedged to USD. The data are sourced from FTSE WGBI from January 1985 to December 2023.*

Conclusion

Differences in current forward rates contain reliable information about differences in future bond returns across maturities and currencies. This suggests that, as global yield curves change over time, investors can position their portfolios to pursue higher expected returns by dynamically targeting segments of yield curves with higher forward rates. Our analysis shows that such systematic approaches to yield curve selection and positioning are effective in different interest rate environments and beneficial for investors in the long run.

Appendix

EXHIBIT A.1: Variable Maturity Time-Series Regressions of Differences in Returns on Differences in Forward Rates (Equation (2))
January 1985–December 2023

Currency	n	m	b	t(b)	R2	N obs
AUD	3–5Y	1–3Y	0.04	0.11	0.00	457
	5–7Y	1–3Y	0.16	0.40	0.00	457
	7–10Y	1–3Y	0.38	0.86	0.01	457
	10+Y	1–3Y	−0.06	−0.09	0.00	457
	5–7Y	3–5Y	0.50	1.92	0.02	457
	7–10Y	3–5Y	0.76	2.03	0.02	457
	10+Y	3–5Y	−0.14	−0.20	0.00	457
	7–10Y	5–7Y	0.48	1.44	0.01	457
	10+Y	5–7Y	−0.60	−0.98	0.01	457
	10+Y	7–10Y	−0.74	−2.02	0.03	457
CAD	3–5Y	1–3Y	0.68	2.76	0.08	457
	5–7Y	1–3Y	0.76	2.43	0.08	457
	7–10Y	1–3Y	1.10	3.09	0.10	457
	10+Y	1–3Y	1.83	2.97	0.09	457
	5–7Y	3–5Y	0.56	2.30	0.05	457
	7–10Y	3–5Y	1.11	3.01	0.07	457
	10+Y	3–5Y	1.57	1.96	0.03	457
	7–10Y	5–7Y	0.50	2.40	0.03	457
	10+Y	5–7Y	0.00	0.01	0.00	457
	10+Y	7–10Y	−0.77	−1.04	0.01	457
CHF	3–5Y	1–3Y	0.59	3.22	0.11	411
	5–7Y	1–3Y	0.64	2.26	0.08	385
	7–10Y	1–3Y	1.33	3.82	0.16	374
	10+Y	1–3Y	1.97	3.41	0.15	387
	5–7Y	3–5Y	0.10	0.95	0.00	385
	7–10Y	3–5Y	0.95	2.26	0.08	372
	10+Y	3–5Y	1.66	2.12	0.07	385
	7–10Y	5–7Y	0.67	2.61	0.09	373
	10+Y	5–7Y	1.98	2.41	0.08	384
	10+Y	7–10Y	0.75	1.12	0.01	386
EUR	3–5Y	1–3Y	1.07	3.27	0.15	457
	5–7Y	1–3Y	1.08	3.04	0.13	457
	7–10Y	1–3Y	1.43	3.16	0.14	457
	10+Y	1–3Y	2.48	2.75	0.14	451
	5–7Y	3–5Y	0.90	2.48	0.09	457
	7–10Y	3–5Y	1.42	2.75	0.11	457
	10+Y	3–5Y	2.61	2.29	0.10	451
	7–10Y	5–7Y	1.26	3.03	0.11	457
	10+Y	5–7Y	2.67	2.61	0.08	451
	10+Y	7–10Y	2.71	2.51	0.06	451
GBP	3–5Y	1–3Y	0.77	3.06	0.12	457
	5–7Y	1–3Y	0.69	2.29	0.06	445
	7–10Y	1–3Y	0.97	2.99	0.10	456
	10+Y	1–3Y	1.31	2.65	0.06	457
	5–7Y	3–5Y	0.28	1.32	0.01	445
	7–10Y	3–5Y	0.88	2.60	0.07	456
	10+Y	3–5Y	1.15	1.89	0.03	457
	7–10Y	5–7Y	0.83	3.49	0.09	445
	10+Y	5–7Y	1.16	1.66	0.02	445
	10+Y	7–10Y	0.18	0.21	0.00	456

Currency	n	m	b	t(b)	R2	N obs
JPY	3–5Y	1–3Y	1.39	3.48	0.21	457
	5–7Y	1–3Y	1.54	4.32	0.27	457
	7–10Y	1–3Y	1.32	2.80	0.13	457
	10+Y	1–3Y	2.79	3.36	0.21	424
	5–7Y	3–5Y	1.46	3.94	0.29	457
	7–10Y	3–5Y	1.29	3.05	0.11	457
	10+Y	3–5Y	3.12	3.61	0.18	424
	7–10Y	5–7Y	0.91	3.63	0.10	457
	10+Y	5–7Y	2.09	2.90	0.07	424
	10+Y	7–10Y	2.65	3.42	0.11	424
NOK	3–5Y	1–3Y	0.68	2.61	0.07	248
	5–7Y	1–3Y	1.34	4.20	0.16	241
	7–10Y	1–3Y	2.12	4.51	0.21	264
	10+Y	1–3Y	—	—	—	—
	5–7Y	3–5Y	1.51	3.89	0.18	255
	7–10Y	3–5Y	2.45	3.83	0.19	266
	10+Y	3–5Y	—	—	—	—
	7–10Y	5–7Y	0.83	1.18	0.02	284
	10+Y	5–7Y	—	—	—	—
	10+Y	7–10Y	—	—	—	—
NZD	3–5Y	1–3Y	0.52	1.93	0.03	277
	5–7Y	1–3Y	1.05	1.67	0.06	212
	7–10Y	1–3Y	0.93	1.59	0.04	300
	10+Y	1–3Y	1.12	1.31	0.03	243
	5–7Y	3–5Y	0.85	1.30	0.03	204
	7–10Y	3–5Y	0.76	1.16	0.02	269
	10+Y	3–5Y	0.49	0.30	0.00	203
	7–10Y	5–7Y	0.78	1.42	0.03	246
	10+Y	5–7Y	−0.34	−0.21	−0.01	170
	10+Y	7–10Y	−1.73	−1.13	0.02	230
SEK	3–5Y	1–3Y	0.57	1.59	0.03	385
	5–7Y	1–3Y	0.77	1.72	0.03	372
	7–10Y	1–3Y	1.37	2.65	0.08	383
	10+Y	1–3Y	1.75	2.21	0.06	385
	5–7Y	3–5Y	0.80	1.38	0.03	372
	7–10Y	3–5Y	1.68	2.89	0.08	383
	10+Y	3–5Y	1.31	1.43	0.02	385
	7–10Y	5–7Y	1.33	3.45	0.07	372
	10+Y	5–7Y	1.38	1.49	0.02	372
	10+Y	7–10Y	0.19	0.23	0.00	383
USD	3–5Y	1–3Y	0.89	2.76	0.10	457
	5–7Y	1–3Y	0.58	2.04	0.05	457
	7–10Y	1–3Y	0.94	2.72	0.07	457
	10+Y	1–3Y	1.52	2.07	0.05	457
	5–7Y	3–5Y	0.22	1.37	0.02	457
	7–10Y	3–5Y	0.64	1.48	0.03	457
	10+Y	3–5Y	1.04	0.85	0.01	457
	7–10Y	5–7Y	0.07	0.48	0.00	457
	10+Y	5–7Y	−0.36	−0.54	0.00	457
	10+Y	7–10Y	−1.08	−1.58	0.01	457

Past performance is not a guarantee of future results. *This table shows the variable maturity time-series regression estimates (equation (2)). For each currency, regressions were estimated for each maturity bucket pair from the set of 1–3 Year, 3–5 Year, 5–7 Year, 7–10 Year, and 10+ Year monthly indices of the given currency (10 regressions for each currency except NOK) over the largest sample available. For NOK, only six regressions are run because valid annual returns and yields for 10+ Year were not available. Standard errors were calculated using the Newey-West method with a lag of 11. All indices are USD-hedged and sourced from FTSE WGBI with a sample period from January 1985 to December 2023.*

EXHIBIT A.2: Variable Currency Time-Series Regressions of Differences in Returns on Differences in Forward Rates (Equation (3), Currency Pairs Involving USD), *January 1985–December 2023*

Maturity	Currency (vs. USD)	b	t (b)	R2	N obs
1–3Y	AUD	0.91	1.95	0.09	457
	CAD	0.58	1.85	0.04	457
	CHF	0.81	2.29	0.11	445
	EUR	−0.12	−0.42	0.00	457
	GBP	1.08	4.33	0.21	457
	JPY	−0.23	−0.71	0.01	457
	NOK	−0.35	−0.93	0.01	269
	NZD	0.23	0.85	0.01	330
	SEK	−0.01	−0.05	0.00	385
3–5Y	AUD	0.64	1.30	0.05	457
	CAD	0.57	1.79	0.06	457
	CHF	0.64	1.89	0.08	422
	EUR	0.20	0.72	0.01	457
	GBP	0.67	2.75	0.10	457
	JPY	0.23	0.73	0.01	457
	NOK	−0.52	−1.55	0.04	272
	NZD	−0.09	−0.36	0.00	299
	SEK	0.34	0.95	0.02	385
5–7Y	AUD	0.64	1.76	0.06	457
	CAD	0.30	0.82	0.01	457
	CHF	0.66	1.97	0.08	397
	EUR	0.19	0.74	0.01	457
	GBP	0.48	1.63	0.05	445
	JPY	0.47	1.73	0.03	457
	NOK	−0.48	−1.21	0.04	284
	NZD	0.31	0.87	0.02	246
	SEK	0.42	1.13	0.03	372
7–10Y	AUD	0.68	1.48	0.05	457
	CAD	0.81	2.00	0.07	457
	CHF	0.70	1.87	0.07	386
	EUR	0.36	1.29	0.02	457
	GBP	0.79	2.57	0.08	456
	JPY	0.52	1.70	0.03	457
	NOK	0.03	0.08	0.00	325
	NZD	0.13	0.41	0.00	334
	SEK	0.60	1.63	0.05	383
10+Y	AUD	0.69	1.00	0.03	457
	CAD	1.32	2.51	0.08	457
	CHF	0.94	1.99	0.06	399
	EUR	0.72	2.51	0.05	451
	GBP	1.08	2.18	0.08	457
	JPY	0.59	1.28	0.01	424
	NOK	—	—	—	—
	NZD	0.63	1.10	0.02	248
	SEK	0.67	1.66	0.04	385

Past performance is not a guarantee of future results. *This table shows the variable currency time-series regression estimates (equation (3)). For each maturity bucket, regressions were estimated for each currency pair from the set of AUD, CAD, CHF, EUR, GBP, JPY, NOK, NZD, SEK, and USD monthly indices of the given maturity bucket over the largest sample available. For simplicity, we only show regressions for currency pairs that involve USD (i.e., setting "d" in equation (3) as USD). For 10+ Year, regressions cannot be run for currency pairs involving NOK because valid annual returns and yields for NOK 10+ Year were not available. Standard errors were calculated using the Newey-West method with a lag of 11. All indices are USD-hedged and sourced from FTSE WGBI with a sample period from January 1985 to December 2023.*

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