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Exploiting non-parallel risk premia in the South African sovereign bond market

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Authors:
Sanveer Hariparsad[1]
Eben Maré[2]

Affiliations:
[1]Department of Actuarial Science, Faculty of Natural and Agricultural Sciences, University of Pretoria, Pretoria, South Africa

[2]Department of Mathematics and Applied Mathematics, Faculty of Natural and Agricultural Sciences, University of Pretoria, Pretoria, South Africa

Corresponding author:
Sanveer Hariparsad, sanshimmy@yahoo.com

Background: This study focuses on diversifying fixed income attribution beyond yield and duration by identifying new risk premia applicable to various investment strategies.

Aim: To identify cross-sectional bond risk factors in the South African sovereign bond market, capitalising on non-parallel shifts during high-risk macroeconomic events, developing a strategy to extract persistent alpha from higher order interest rate risks and disproving the strong efficient market hypothesis.

Setting: This study finds that during high-risk macro events, non-parallel shifts increase in frequency. Empirical evidence suggests that post the 2008 financial crisis, there have been increased occurrences of risk-on/off events and researchers believe high risk macro events will increase in prominence. As such, most active US fixed income managers have reduced duration risk (from parallel shifts) in favour of alternative risk premia.

Method: This study exploits slope and curvature risks, by utilising a butterfly strategy. Ten bond risk factors are back-tested and analysed during interest rate cycles, curve scenarios and risk-off periods from 1998 to 2023.

Results: The top-ranked strategies displayed strong and persistent outperformance over the bottom-ranked strategies for most of the bond factors especially during risk-on episodes. The Bond All-Factor Rank demonstrated improved diversification by balancing upside and downside risks. Trade costs are an important factor that requires pragmatic management.

Conclusion: Geopolitical risks are increasing in frequency and developing a strategy to exploit non-parallel risk premia is an attractive proposition.

Contribution: This study identified new bond risk factors beyond the conventional spread factor to extract non-parallel risk premia.

Keywords: fixed income strategies; factor investing; risk premia; slope; curvature; non-parallel shifts; curve scenarios.

Introduction

Risk premia is the reward for taking on risk and is defined as the expected return over a known risk-free asset. Fixed income investing based on factor risk premia has centred on duration and credit. Initial research was conducted by Fama and French (1993) who suggested that factors driving stock returns could also drive bond returns of the same company assuming frictionless markets. Factors such as size, value, momentum, low risk and carry were used to explain high yield and investment grade bond returns. Research conducted by Houweling and Van Zundert (2017), Dekker, Houweling and Muskens (2021) and Henke et al. (2020) also expands on this concept by using issuer accounting ratios to define credit factors that are responsible for corporate bond returns. This research study distinguishes itself by identifying cross-sectional fixed income factors within the South African (SA) sovereign bond market and developing a strategy to exploit them. We show in this study that during risk-off periods, non-parallel curve shifts increase in frequency. Our fixed income strategy aims to profit from non-parallel risk premia during these risk-off periods.

The Efficient Market Hypothesis (EMH) posits that asset prices reflect all available information, so consistently outperforming the market on a risk-adjusted basis is near impossible. Fama (1970) introduced weak, semi-strong and strong forms of EMH based on liquidity, investor sophistication and information access. Historical evidence from the early 1900s supported strong EMH but post the 2008 financial crisis, market efficiency improved because of information and technology. Research by Martineau (2021) questions long-term predictability, citing post-earnings

announcement effects and attributing them to time-varying risk premia or behavioural biases. Our analysis challenges the strong EMH idea, identifying bond risk premia as a source of consistent excess returns over the study period.

South African sovereign bonds are represented on the yield curve which is a graph that plots the sovereign bond yield of several fixed income instruments against the time to maturity of those instruments. To extract the slope and curvature risk premia from the yield curve we employ a fixed income butterfly or fly strategy which takes an active position on the yield curve shape by selecting three specific points: a short-, medium- and long-dated point. The medium-dated point is known as the body while the short- and long-dated points are known as the wings. A long fly strategy entails taking a long position in the body and a short position in the wings, while a short fly strategy involves a short position in the body and a long position in the wings. The fixed income fly strategy is commonly applied to hedge funds because of the leverage and short positions required. However, it can also be adapted to manage higher-order interest rate risk in a liability-driven investment approach and to identify over- and under-valued areas of the yield curve for active, long-only funds. For our purposes, we will assume that the fixed income fly strategy is applied to hedge funds.

The wings in both the long and short fly strategies are set such that they are duration-neutral and immune to parallel curve shifts but exposed to slope and curvature changes. Duration-neutral means that the fly strategy is not affected by uniform (up or down) yield curve changes; thus, there will be no capital gain or loss for a duration-neutral strategy. However, if yields across the curve move by varying amounts, a duration-neutral strategy will be exposed to changes in slope and curvature, resulting in capital gains or losses. A popular fixed income fly strategy (which is also used in our analysis) is a reversion strategy which identifies when three points on the yield curve deviate from their fair values and are expected to revert to these values to generate a profit. While fly strategies offer lower return potential compared to parallel curve shifts (also known as duration risk), this can be addressed by leveraging position sizes, making it a portable alpha overlay to existing duration strategies.

Fly strategies can also be used to take advantage of idiosyncrasies in the SA bond market via the Market Segmentation Theory (MST). Market Segmentation Theory states that the demand and supply of bonds at each maturity are driven by current and future expectations for interest rates. Bond investors have preferred maturities to manage their risks and will only invest outside these maturities if the expected returns on other maturities are more attractive. In the SA context, liability-driven investors and pension funds prefer long-dated bonds as they provide an efficient hedge against their long-term liability risks. Commercial banks have short-term liabilities in the form of customer deposits, so they prefer to hedge these risks with short-term bonds.

The Government's funding strategy is also an important consideration, which in SA has been to issue long-dated bonds resulting in a steepening of the yield curve. As such, the belly of the SA curve is least impacted by institutional demand and supply characteristics and a better reflection of economic fundamentals. Thus, fly strategies that emphasise medium-dated bond exposure provide attractive opportunities to exploit non-parallel risk premia.

This study expands on the literature by Hariparsad and Maré (2023) by adapting their swap butterfly factors to the SA sovereign bond market with new definitions for the bond risk factors and beyond the conventional spread factor. The structure of this study is as follows: We present principal component analysis applied to the SA sovereign curve, and then delve into the literature review of non-parallel curve shifts. We discuss the methodology and define ten bond factors to be considered under non-parallel curve scenarios in the SA sovereign market. We evaluate the absolute and risk-adjusted performance of the bond factors over the entire period, curve scenarios, interest rate cycles, and major risk-off events. We then relate the bond factor performances to several financial and economic variables to understand their real-world prominence, and provide a summary with suggestions for further research to enhance the results.

Government bond curve principal component analysis

A succinct definition of PCA, as provided by Jolliffee and Cadima (2015), characterises it as a linear technique for reducing dimensionality. It achieves this by computing the covariances within a dataset and determining orthogonal eigenvectors and eigenvalues. These eigenvectors and eigenvalues describe dependent variables with a condensed set of independent variables, thus simplifying interpretability and minimising the loss of information. Thus, PCA identifies the most influential independent variables that account for variations in the dependent variable. We use PCA on the SA sovereign bond curve and highlight the proportion of yield curve changes attributable to both parallel and non-parallel shifts.

To evaluate the principal components, monthly bond yield (short-, medium- and long-dated) changes are employed with PCA being conducted over rolling 1-year periods (by using the past 11 monthly bond yield changes). The first principal component typically represents duration or parallel adjustments in the yield curve, while the second and third principal components signify changes in slope and curvature, respectively (referred to as non-parallel curve changes). Bauer and Hamilton (2018) expand on Litterman and Scheinkman's (1991) work, by introducing fourth- and fifth-order principal components and identifying macroeconomic variables responsible for driving yield curve shifts. Our analysis reveals that, since 1990, approximately 90% of SA sovereign bond yield changes can be attributed to parallel shifts. This observation is corroborated by Brooks

and Moskowitz (2017), who affirm that 99.9% of yield changes in sovereign bonds across multiple countries are explained by the first three principal components, which encompass level, slope and curvature.

Upon closer examination of the first principal component of SA sovereign bond yield changes in Figure 1, it becomes apparent that there are periods during which parallel shifts account for only 60%–70% of total sovereign bond yield changes. We notice that these periods correspond with major macroeconomic events characterised by elevated risk, such as the Asian financial crisis, the collapse of Long-Term Capital Management, the 9/11 terrorist attacks, the global financial crisis and the coronavirus disease 2019 (COVID-19) pandemic. Consequently, non-parallel shifts in the sovereign bond curve contribute 30%–40% of curve changes, which are greater than their historical average of 9% during these high-risk macroeconomic events. These non-parallel shifts are predominantly slope and curvature changes. Thus, developing a strategy to capitalise on non-parallel shifts becomes more feasible when high-risk macroeconomic events are prominent. Rakotondratsimba and Jaffal (2012) note that after the global financial crisis, non-parallel shifts increased in frequency. Caldara and Iacoviello (2019) find that increased geopolitical risks are likely to induce financial market volatility, uncertainty and delay investment decisions. According to their custom geopolitical index, Caldara and Iacoviello (2019) find that geopolitical risk rose dramatically during both World Wars, was elevated in the early 1980s and has risen since the beginning of the 21st century increasing the likelihood of negative macroeconomic events in the future.

The International Monetary Funds (IMF)'s Global Financial Stability Report by Catalán et al. (2023) cites concerns about rising geopolitical tensions among major nations. The effect of this will be a reversal of capital flows with a flight to quality assets, increased funding costs, reduced profitability and increased default risks. The effects are anticipated to be more pronounced for emerging markets such as SA. The World Economic Forum (2024) report surveyed in September 2023 had 54% of respondents anticipating instability and moderate global catastrophes over the next 2 years and 63% of respondents anticipating a turbulent outlook in the next 10 years. The prominent risks specified were extreme weather, AI misinformation, social and political polarisation, cost of crisis living, economic downturns, disrupted supply chains and interstate armed conflict.

Predicting these high-risk macroeconomic events is a formidable challenge. However, it is evident that they are rising in frequency and amplitude because of escalating geopolitical tensions between the East and West, the emergence of modern monetary theory resulting in uncoordinated monetary and fiscal policies, mounting debt issuances and fiscal deficits, uncensored media leading to sensationalism and a widening wealth inequality gap, resulting in social unrest. These temperamental trends are likely to persist, increasing the likelihood of non-parallel sovereign bond curve movements relative to their historical norms.

The grey shaded blocks represent global risk-off environments where the proportion of parallel bond curve shifts is below its long-term average of 90%.
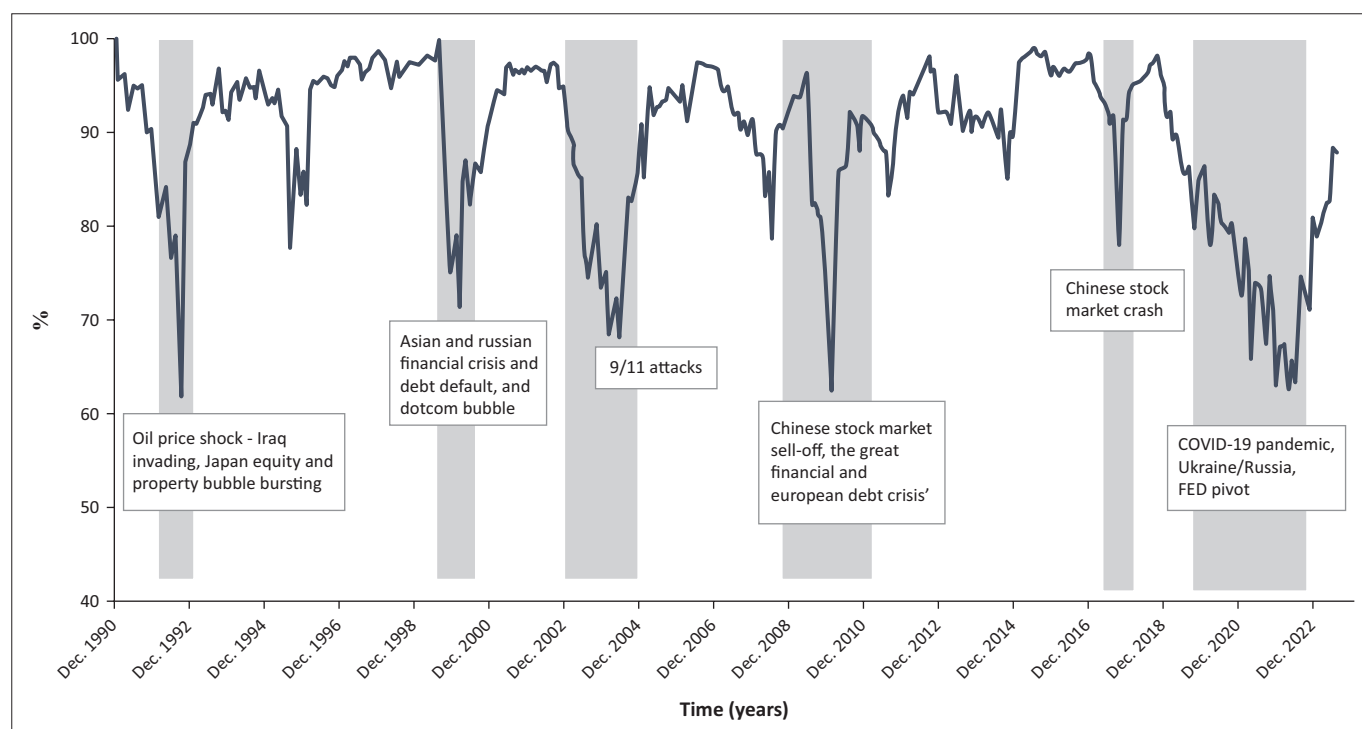
SA, South African; Dec., Decmeber.

FIGURE 1: One-year moving average of the first principal component of a principal component analysis on the South African sovereign curve using monthly closing bond yields from January 1991 to May 2023.

Literature review

There has been extensive research that dissects bond yields or returns into multiple factors. Principal component analysis has been a powerful tool for attributing yield curve movements and bond returns into various factors. In their seminal work, Litterman and Scheinkman (1991) estimate a linear five-factor model using PCA to explain 96% of international bond returns across the US, Japan and Germany. They identify key factors, including level, steepness and spread changes between bond yields. This study demonstrates the applicability of PCA in understanding cross-country yield curve dynamics, the influence of multiple factors and improved duration-based hedging strategies with diminished residuals.

Maitland (2002) explores the variability of SA sovereign bond yields using zero-coupon curves, by focusing on level and slope changes and showcases the importance of level-related factors in bond yield analysis. Thomas (2008) also tests the SA sovereign bond curve using PCA and identifies four significant factors over the 2000–2007 period that contribute to the understanding of SA yield curve variability.

Applying PCA to the US treasury curve, Hautsch and Ou (2008) use the Nelson and Siegel (1987) model and highlight the significance of slope and curvature factors in determining future excess returns. Their study highlights the potential of PCA in decomposing yield curve dynamics and linking them to economic indicators such as inflation, monetary policy and employment growth. Phoa (2000) applies a PCA approach to US treasuries and identifies that the level factor contributes 90% of sovereign bond yield changes followed by slope and curvature factors. Phoa also noted that the level factor increased in importance over time relative to the slope and curvature factors.

Relating level, slope and curvature changes to macroeconomic variables is a well-researched area. Morita and Bueno (2008) find that the level, slope and curvature factors are correlated with inflation and Gross Domestic Product (GDP) growth. According to their study, the level, slope and curvature coefficients display stability during economic calm and volatility during turbulent periods like the 2007/2008 global financial crisis. Patel, Mohamed and Van Vuuren (2018) analyse US and SA sovereign bond yields, demonstrating how monetary policy shocks and volatile market conditions distort yield curve shape and smoothness. For instance, during the 2008 global financial crisis, SA level shifts were substantially influenced by US level shifts, while SA slope and curvature shifts were heavily influenced by emerging market risks, volatility, as well as political and monetary policy instability. Thiagarajan et al. (2016) use PCA to decompose US treasury and credit returns into rate, growth and volatility factors. The rates factor was found to impact US treasury returns, while the growth and volatility factors had a stronger influence on credit returns.

Cochrane and Piazzesi (2005) show that lagged forward rates can forecast bond returns with R-squares of up to 44% with level, slope and curvature variables being the dominant factors that influence bond returns. Sarno et al. (2016) combine statistical and economic models to predict bond returns and yields. Their approach of statistical forward rates and economic variables improves predictions of bond excess returns compared to economic-only models in times of high macroeconomic uncertainty. Piazzesi and Swanson (2004) find that US non-farm payroll employment is a strong predicator of excess returns on US short rates by using federal funds futures contracts. Bikbov and Chernov (2005) provide an extension to the work by Ang and Piazzesi (2003) by using explicit joint dynamics of yield curve factors, real activity and inflation as part of an affine term structure model. They conclude that macro variables explain 80% of the variation in the short rate, 50% on the slope and 54%–68% of the term premia.

Considering the extensive literature on yield curve drivers using non-financial and macro-economic variables, this study can be viewed as an extension of this knowledge, focusing on non-parallel yield curve movements through fixed income fly strategies. Pal (2007) tests fly strategies on the Australian bond market, employing duration-neutral (exposing slope and curvature risk) and duration and slope-neutral (exposing curvature risk only) strategies. The spread of each fly strategy is predicted using a vector autoregressive (VAR) model, and those with the highest expected returns based on predicted yield changes are retained and rebalanced over several holding periods. Pal's strategy, rooted in mean reversion and efficient markets, yields positive results with net excess average annual returns of 1.2% and 0.72% for duration-neutral and duration and slope-neutral strategies, respectively. Pal's findings underscore that returns and volatility are higher for duration-neutral fly strategies, particularly for upward-sloping curves. A drawback of Pal's study is that it is over a short timeframe (January 2004 to May 2005) so does not encompass a complete interest rate cycle.

Fabozzi, Martellini and Priaulet (2005) assess five duration-neutral fixed income fly strategies on the US treasury market over a 9-year span with a VAR approach, a Nelson, Siegel and Svensson (NSS) model (Svensson 1994) and various economic variables. The level factor showed limited predictability over monthly forecast horizons, while the slope and curvature factors produced better forecasts and higher hit rates. Vector autoregressive processes that use lagged economic variables can be helpful in this regard. Promising VAR predictive studies from Audrino and Serwart (2022), Fabozzi et al. (2005), Pal (2007), Morita and Bueno (2008) and Patel et al. (2018) may be used, and these are recommended for further research. There is also the possibility of removing the cash-neutral constraint and using various duration-only weights within fly strategies as in Martellini et al. (2002).

Chin and Tang (2020) assess factor timing strategies in US fixed income funds by regressing fund returns on strategic, tactical and security selection factors. Their findings reveal that active US bond funds had persistent credit exposure which contributed positively to performance over the past

two decades as credit spreads narrowed but detracted during risk-off periods like the 2008 financial crisis. Strategic and tactical duration was kept close to the benchmark for most funds. Tactical factors have on average detracted from performance over the period but for the cohort that had positive tactical contributions, there was persistence, that is managers with positive trailing tactical alpha continued to exhibit positive tactical contributions. The security selection factor contributed positively for most funds, but fees negated this benefit for the median manager.

Parallel shifts associated with duration risk are a significant return contributor but can lead to underperformance if not effectively implemented. Empirical evidence by Chin and Tang (2020) suggests that duration risk is kept to a minimum by most active US fixed income funds that prefer to exploit credit and security selection risk premia.

Kung and Liu (2024) define a yield curve that can generate a wide variety of shapes and use this to simulate yield curve scenarios with Monte Carlo methods and assess the performance of four fixed income strategies. The fixed income strategies include riding the yield curve, contingent immunisation, rolling shorter-dated discount bonds and a simple money-market account. Because of mean reversion in the yield curve model, when the short rate is above the long-term average, returns for all strategies are lower relative to when the short rate is below its long-term average. Also, when longer-dated bonds are used, returns for all strategies are higher especially for the contingent immunisation and riding the yield curve strategies. Carry and Roll is a bond factor, with positive results that we utilise in this study which is supported by the research of Kung and Liu (2024).

As discussed, PCA has been a powerful tool, but researchers have also highlighted limitations related to factor selection and interpretation. Overall, these studies highlight the significance of PCA in the interpretation of fixed income markets and the factors driving yield curve changes. Thus, the focus of this study is on defining SA sovereign bond factors that extract slope and curvature risk premia (non-parallel shifts). While no curve predictions are employed, we analyse the performance of these SA sovereign bond risk factors across distinct curve scenarios, monetary policy cycles and risk-off periods.

Methodology

This section focuses on quantifying SA sovereign bond risk factors using monthly SA nominal bond data from January 1998 to May 2023, sourced from Bloomberg and IRESS. Several fixed-rate government bonds with maturities exceeding 1 year were considered. Trade costs, which are influenced by market liquidity, risk appetite and counterparty relationships are addressed towards the end of the section.

Data integrity was ensured by identifying anomalies and outliers using Z-Scores based on the last six observations of each data series. If the Z-Score was within a [-2.5 to +2.5] interval, it was assumed acceptable. Scores outside this range were investigated further to decide if it was an unacceptable outlier or acceptable anomaly. Ten bond factors were used to select long fly strategies on a duration and cash-neutral (DN+CN) basis with descriptions provided in Table 1. These bond factors were Bond Spread Duration (BSD), Bond Absolute Spread (BAS), Bond Term Spread (BTS), Bond Convexity (BCVX), Bond Risk Premium (BRP), Bond Carry and Roll (B/C+R), Bond Nelson, Seigel and Svensson (BNSS), Swap Bond Spread (SBS), Breakeven Inflation (BEI) and Bond Reversion (BRev). The long fly strategies are kept DN+CN for operational efficiency, which eliminates the need to deal with cash surpluses or shortfalls and ensures a balanced risk management framework (e.g. the 2v5v10 long fly strategy would buy the 5-year sovereign bond and sell the 2-year and 10-year sovereign bonds in a duration and cash neutral manner).

The top and bottom three fly strategies from each risk factor were selected from a universe of approximately 200 fly strategies for each of the 10 bond risk factors. The top and bottom three fly strategies were chosen because of the high correlation among bond yields across the curve, especially for close maturities. Fly strategies with points close together have higher correlations and lower volatility compared to those with points far apart. Thus, managing fewer fly strategies reduces operational and dilution risk, and may lead to better pricing with larger trade sizes.

The Bond All-Factor Rank (B-AFR) was also introduced to rank the 10 bond risk factors, allowing for the selection of three fly strategies with the highest and lowest average ranks, respectively. Monthly rebalancing was chosen as it accounts for both duration neutrality and trade costs. Transaction costs were ignored for our analysis to understand the profitability of the long fly strategy. We believe a roundtrip trade cost of one basis point or less to be reasonable for the fly strategies to be profitable. For example, a one basis point (bp) roundtrip trade cost (0.5 bps on entry and 0.5 bps on exit) equates to annualised trade costs of 84 bps assuming monthly rebalancing and a spread duration of 7 (0.01% × 7 × 12). Trade costs can be actively managed with less frequent rebalancing but need to be monitored because of changing duration risks. Intra-month rebalancing is recommended following large non-parallel curve shifts; however, a consistent 1-month rebalance frequency is maintained for the purposes of this analysis. Our analysis provides a comprehensive approach to quantify bond risk factors with a focus on DN+CN fixed income fly strategies.

Curve scenarios

This section discusses various curve scenarios, as described by Hariparsad and Maré (2023) that relate to slope and curvature risk. These are presented in Table 2, which outlines changes in short-, medium- and long-dated sovereign bond yields, including curvature changes. First-order changes,

TABLE 1: Defines and explains the 10 bond risk factors that will be used for the analysis and back-test.

Bond risk factors	Short name	Description
Bond spread duration	BSD	• Spread duration of the long bond fly is determined and is the same as the modified duration of the middle-dated bond • Assuming a long bond fly spread duration of 5, if the spread increases (decreases) by 1%, then a 5% capital loss (profit) will result
Bond absolute spread	BAS	• The long bond fly absolute spread is calculated using the duration and cash neutral weights • If the absolute bond spread is positive (negative), the long bond fly will earn (detract) interest over time
Bond term spread	BTS	• The net term to maturity of the long bond fly using the duration and cash neutral weights. A positive (negative) term spread implies that the middle bond of the fly is closer to the long-point (short-point)
Bond risk premium	BRP	• BRP is defined as SA sovereign bond yield in USD – US treasury yield both with the same term to maturity. The BRP is akin to a CDS spread but also incorporates a liquidity and currency risk premium. The BRP is calculated for each of the three points of the long bond fly and the net BRP is found by using the duration and cash neutral weights
Bond carry and roll	B/C+R	• Carry is defined as the yield earned from holding a sovereign bond for 1-month. Roll is defined as the capital gain as the sovereign bond rolls down the curve over 1-month as it approaches maturity (assuming an unchanged, upward sloping bond curve). The carry and roll is calculated for each of the three bonds of the long bond fly and the net C+R is found by using the duration and cash neutral weights
Bond convexity	BCVX	• The convexity of the three sovereign bonds on the long bond fly is identified. The SCVX is calculated as the net convexity of the long bond fly using the duration and cash neutral weights
Bond Nelson-Siegel-Svensson	BNSS	• The NSS uses a Nelson-Siegel-Svensson three-factor model to fit a smooth curve to the actual nominal sovereign bond curve • Deviations between the fitted NSS curve and the actual nominal sovereign bond curve are computed for each of the three bonds on the long bond fly. The BNSS is defined as the net deviation of the three bonds on the long bond fly using the duration and cash neutral weights
SA swap less SA bond spread	SBS	• The difference between the SA swap rate and SA nominal sovereign bond yield of the same term to maturity is computed for each of the three bonds on the long bond fly • The net SA swap less SA sovereign bond spread difference is calculated using the duration and cash neutral weights of the long fly strategy and encapsulates the net SA bank credit and liquidity risk
Break-even inflation	BEI	• For each of the three bonds in the long bond fly, the difference between SA nominal and inflation-linked sovereign bonds of the same term to maturity are computed. This spread is commonly known as break-even inflation and can be viewed as investors inflation expectations • The net difference of the SA nominal and inflation-linked sovereign bonds is then calculated using the duration and cash neutral weights of the long fly strategy • The BEI accounts for the net inflation risk premium of the long fly strategy
Bond reversion	BRev	• Compares all the long fly strategy returns over the previous month and selects the underperformers • This is a reversion strategy and based on the assumption that the underperforming long fly strategies will revert to their long-term average and outperform in the upcoming month

such as parallel up-and-down scenarios, affect the average yield level and are explained by a single point on the curve. Second-order changes, such as steep/flat twists and bull/bear steepening/flattening focus on two points on the curve while third-order changes, such as positive and negative twists compare three points on the curve. In general, flattening scenarios reduce curvature, while steepening scenarios increase curvature.

Changes in short-, medium- and long-dated sovereign bond yields and overall curvature are provided. First order changes such as parallel up-and-down scenarios do not have material changes in slope or curvature as most bond yields across the curve move by similar amounts.

The DN+CN long fly strategy benefits from decreased curvature or curve steepness, while a short fly strategy benefits from increased curvature or curve flattening. Curvature represents the relationship between short-, medium- and long-dated points on a yield curve. High curvature occurs when the medium-dated point is significantly higher than the average of the short and long-dated points, and the medium-dated point is expected to revert lower to historical norms, favouring a long fly strategy. Conversely, a short-curvature strategy benefits from increasing curvature. Over the long term, we can say that a long DN+CN fly strategy outperforms during curve steepening and positive twists but underperforms during flattening and negative twists.

Since 1998, we found that interest rate-cutting cycles occurred 60% of the time with stable inflation which was driven by a hawkish SA Reserve bank and below-trend growth after the 2008 global financial crisis. We observe that interest rate cuts lead to steeper curves, especially early in the cutting cycle, while recessions can cause bear steepening as longer-dated yields rise because of increased government borrowing requirements.

First-order curve changes occurred evenly over the period, with parallel down being slightly more prevalent during interest rate-cutting cycles. Second-order changes such as bull/bear flattening are common during cutting cycles with bear steepening most prevalent during hiking cycles. Third-order changes (negative and positive twists) are relatively evenly distributed with negative twists favoured during cutting cycles, while positive twists prevail during hiking cycles.

Back-tested performance and risk statistics of the bond factors

In this section, we explore the back-tested performance, characteristics and benefits of the top and bottom three DN+CN fly factors.

The top three BAS, BNSS, B/C+R, BEI and BRev factors have the highest annualised gross returns (between 1% and 1.5%), while the corresponding bottom three factors have the lowest

TABLE 2: First-, second- and third-order bond curve scenarios that will be used to analyse the performance of the long fly strategies.

Curve scenario	Degree of change	Short bond yields	Medium bond yields	Long bond yields	Curvature
Parallel up	1st order	Higher↑	Higher↑	Higher↑	Little change
Parallel down	1st order	Lower↓	Lower↓	Lower↓	Little change
Steep twist	2nd order	Lower↓	Little Change	Higher↑	Increased↑
Flat twist	2nd order	Higher↑	Little Change	Lower↓	Decreased↓
Bear steep	2nd order	Slightly Higher↑	Higher↑	Much Higher↑	Increased↑
Bull steep	2nd order	Much Lower↓	Lower↓	Slightly Lower ↓	Increased↑
Bear flattening	2nd order	Much Higher↑	Higher↑	Slightly Higher↑	Decreased↓
Bull flattening	2nd order	Slightly Lower↓	Lower↓	Much Lower↓	Decreased↓
Negative twist	3rd order	Lower↓	Higher↑	Lower↓	Increased↑
Positive twist	3rd order	Higher↑	Lower↓	Higher↑	Decreased↓

Source: Adapted and redefined from: Hariparsad, S. & Maré, E., 2023, 'Examining swap butterfly risk premia in South Africa', *Investment Analysts Journal* 52(3), 220–245. https://doi.org/10.1080/10293523.2023.2240563

annualised gross returns (between -0.9% and -0.2%). The top three B-AFR have the highest gross annualised returns of 1.49% with a high Ret/SD score of 1.2. The bottom three BTS, BCVX and BSD factors have positive gross annualised returns (between 0.2% and 0.4%) relative to the negative performance of the other bottom three factors. The Omega ratio for the top three dominant factors is notable with values ranging between 1.3 and 2.0 while the bottom three have values at 1 or lower. The Omega ratio for the defensive factors (top and bottom three) is relatively consistent between 0.8 and 1.2. The Max DD and CVaR of the bottom three dominant and defensive factors are higher than that of their corresponding top three factors. This means that extreme negative returns are slightly larger for the bottom three factors relative to the top three factors. The B-AFR has improved risk statistics and risk-adjusted returns relative to the individual bond risk factors. *Denotes greater than zero mean at 1% significance level. **Denotes less than zero mean at 1% significance level.

Table 3 illustrates the performance statistics of the top and bottom three (DN+CN) bond factors. The top three bond factors from the BAS, BNSS, B/C+R, BEI and BRev factors deliver annualised returns between 1% and 1.4%, standard deviations between 1.7% and 1.8% and return-to-standard deviation (Ret/SD) ratios between 0.4 and 0.7. Conversely, the corresponding bottom three bond factors portray a different picture. They display annualised returns between -0.3% and -0.9%, standard deviations ranging from 0.8% to 1.9% and Ret/SD ratios between -0.7 and -0.1. The most noteworthy disparities in annualised returns are observed in BAS, B/C+R and BNSS factors, with differences between the top and bottom three factors exceeding 1.6%, followed by BEI and BRev with differences of 1.5% and 1.4%, respectively. The wide divergences in returns between each of the top and bottom three bond factors distinguish whether investing in a particular factor offers genuine benefits or is merely a coincidence.

Reviewing the B-AFR which aggregates all 10 bond factors by averaging the rank of each fly strategy based on their respective month-end values, we see that the top and bottom three bond factors return 1.5% and -0.7% per annum, with Ret/SD ratios of 1.2 and -0.4, respectively. Thus, the B-AFR provides a diversified approach and enhances both absolute and risk-adjusted performance.

We find that successful long fly strategies share distinct characteristics such as high absolute spreads and BRPs, large positive Nelson-Siegel-Svensson (NSS) differences, strong carry and roll metrics, wide break-even inflation spreads and low swap spreads (SA bonds less swaps). Mean-reversion is also an effective factor as fly strategies that have underperformed over the past month are likely to outperform the following month. Identifying these attributes allows for a long or short strategy, where investors take a long position in the top three and a short position in the bottom three bond factors.

For the BTS, BCVX and BSD factors, the annualised returns for the bottom three bond factors exceed those of the top three bond factors, ranging between 0.1% and 0.4% for the bottom three versus -0.1% to 0.2% for the top three. Analysing the BTS, BCVX and BSD factors reveals that lower net term spreads, convexity or spread durations result in fly strategies with points that are relatively close together. This proximity leads to higher correlations, and lower risk and expected returns.

Given the above bond factor characteristics we categorise the bond factors as the dominant factors (BAS, BRP, BNSS, SBS, B/C+R, BEI and BRev) and defensive factors (BTS, BCVX and BSD). A noteworthy observation is that the maximum drawdown (Max DD) for the dominant factors is generally larger than that of the defensive factors, owing to their higher return volatility. Furthermore, the Omega ratio for the top three dominant factors exceeds 1.3, while the bottom three factors fall below 1, which suggests relatively better upside to downside risk metrics for the dominant factors. The skew and kurtosis values for both dominant and defensive factors indicate episodes of very high positive returns, particularly during cutting cycles. The B-AFR incorporates both dominant and defensive factors and, thereby diversifies risk, which results in significantly improved absolute and risk-adjusted performance. This underscores a fundamental investing concept: achieving long-term outperformance necessitates a certain level of risk. Identifying efficient risk factors and determining when and how much to invest is pivotal to successful investing. Our analysis offers valuable insights into the performance and risk characteristics of fly strategies and fixed income in general. It highlights the importance of

TABLE 3a: Gross annualised risk and return statistics (standard deviation, returns and return to standard deviation ratio) for the top and bottom three bond factors from January 1998 until May 2023.

Category	Bond factors	Short name	Index		Ret (pa)		SD (pa)		Ret/SD	
			Bottom 3	Top 3	Bottom 3 (%)	Top 3 (%)	Bottom 3 (%)	Top 3 (%)	Bottom 3	Top 3
Defensive bond factors	Bond term spread	BTS	111.7	105.0	0.44	0.19	2.2	1.1	0.2	0.2
	Bond convexity	BCVX	103.8	99.6	0.15	-0.02	2.4	1.0	0.1	-0.0
	Bond spread duration	BSD	109.8	95.8	0.37	-0.17	1.5	1.5	0.2	-0.1
Dominant bond factors	Bond absolute spread	BAS	78.6	142.5	-0.94**	1.40*	1.3	1.9	-0.7	0.7
	Bond risk premium	BRP	100.1	113.7	0.00	0.51	1.7	1.7	0.0	0.3
	Bond Nelson-Siegel-Svensson	BNSS	88.0	132.3	-0.50	1.11*	1.6	1.7	-0.3	0.7
	Bond carry and roll	B/C+R	81.4	130.2	-0.81**	1.04*	1.2	1.8	-0.7	0.6
	SA swap less SA bond spread	SBS	98.2	115.9	-0.08	0.66	2.0	1.6	-0.0	0.4
	Break-even inflation	BEI	95.9	134.4	-0.18	1.28*	1.8	1.7	-0.1	0.7
	Bond reversion	BRev	92.5	127.7	-0.34	1.06*	1.8	1.8	-0.2	0.6
	Average	Avg	94.6	118.9	-0.22	0.68*	1.2	1.0	-0.2	0.7
	Dominant	-	88.7	129.3	-0.47	1.02*	1.1	1.2	-0.4	0.9
	Defensive	-	108.6	100.2	0.32	0.01	1.7	0.7	0.2	0.0
	Bond all factor rank	B-AFR	83.8	145.5	-0.69**	1.49*	1.2	1.7	-0.4	1.2

SA, South African.

TABLE 3b: Gross annualised risk and return statistics (maximum drawdown, omega ratio, skewness, kurtosis and CVaR at 1% level) for the top and bottom three bond factors from January 1998 until May 2023.

Category	Bond factors	Short Name	Max DD		Omega		Skew		Kurtosis		CVaR 1%	
			Bottom 3 (%)	Top 3 (%)	Bottom 3	Top 3	Bottom 3	Top 3	Bottom 3	Top 3	Bottom 3 (%)	Top 3 (%)
Defensive bond factors	Bond term spread	BTS	5.8	3.4	1.1	1.0	0.7	-1.0	4.5	5.2	-1.7	-1.3
	Bond convexity	BCVX	10.0	5.8	1.0	0.8	0.0	-0.2	4.0	12.8	-2.6	-1.3
	Bond spread duration	BSD	4.6	7.5	1.2	0.9	2.6	0.8	26.1	5.2	-1.5	-1.4
Dominant bond factors	Bond absolute spread	BAS	20.7	5.2	0.5	2.0	-0.2	1.5	5.6	12.9	-1.6	-1.6
	Bond risk premium	BRP	6.9	6.2	0.9	1.3	0.6	1.3	13.2	14.1	-2.3	-1.8
	Bond Nelson-Siegel-Svensson	BNSS	14.2	4.3	0.7	1.5	1.1	0.5	15.6	3.8	-1.9	-1.4
	Bond carry and roll	B/C+R	18.3	3.5	0.6	1.6	-1.0	1.4	5.7	18.3	-1.8	-2.0
	SA swap less SA bond spread	SBS	7.4	3.6	1.0	1.3	-0.4	1.3	3.5	16.7	-2.2	-1.8
	Break-even inflation	BEI	7.0	3.5	1.0	1.8	-1.0	2.5	4.5	23.7	-2.2	-1.2
	Bond reversion	BRev	17.0	4.5	0.8	1.5	0.1	1.2	2.6	9.0	-1.8	-1.5
	Average	Avg	6.4	3.1	0.7	3.3	-0.2	1.7	3.2	15.2	-1.3	-0.9
	Dominant	-	11.9	3.1	0.7	2.0	-1.0	1.4	3.6	11.8	-1.3	-1.0
	Defensive	-	5.9	3.5	1.1	1.0	1.1	-0.2	12.6	2.5	-1.4	-0.8
	Bond all factor rank	B-AFR	16.8	1.9	0.7	2.8	-0.7	0.2	3.9	4.1	-2.1	-1.2

SA, South African.

balancing risk and return in investment strategies and emphasises diversification and strategic allocation in enhancing overall portfolio performance.

Performance of bond factors during curve scenarios and risk-off periods

In this section we review the performance of the bond factors during second and third-order curve scenarios. Table 4 displays the average gross monthly returns of the top and bottom three bond factors under second- and third-order curve scenarios, cutting and hiking interest rate cycles and during global risk-off events. Analysing the performance in this manner provides valuable insights into which bond factors perform best and worst under specific curve scenarios.

The top three dominant factors have their highest gross monthly returns occurring during bull flattening, bull steepening and steep twists and their worst performance during bear flattening. The B-AFR has consistent, positive gross monthly returns. The dominant factors and B-AFR are mostly negative with their largest underperformance occurring during bear flattening and flat twists. The bottom three defensive factors have positive performance during bull flattening, bull steepening and steep twists. The top three dominant, defensive and B-AFR factors perform much better under positive twists relative to negative twists and during interest rate cuts relative to hikes. On average, the top three B-AFR returns 14 bps during global risk-off events followed by the defensive and dominant factors with averages of 0 bps and -2 bps respectively. However, for the bottom three the B-AFR returns -27 bps during global risk-off events followed by the defensive and dominant factors with averages of -19 bps and -20 bps, respectively.

For the top three dominant factors, the highest gross monthly returns are observed during bull flattening, bull steepening, and steep twists, with average gross monthly returns ranging from 18 bps to 21 bps. The top three defensive factors exhibit relatively flat average gross monthly returns across scenarios, except during steep twists and bull steepening which average +4 bps and -5 bps,

TABLE 4a: Average gross monthly returns of top and bottom three bond factors from January 1998 until May 2023 under second and third order bond curve scenarios, and interest rate cycles.

Scenarios	Frequency (%)	Top three bond factors			Bottom three bond factors		
		Dominant (%)	Defensive (%)	B-AFR (%)	Dominant (%)	Defensive (%)	B-AFR (%)
Average gross monthly returns during second order curve changes							
Second order scenarios:							
Bull flat	20	0.18	0.02	0.16	-0.04	0.11	-0.03
Bear flat	18	-0.08	-0.01	0.10	-0.17	-0.24	-0.26
Bull steep	19	0.21	-0.05	0.20	0.08	0.21	0.09
Bear steep	18	0.00	0.01	0.09	-0.03	0.00	-0.03
Steep twist	13	0.20	0.04	0.05	0.13	0.27	0.20
Flat twist	11	-0.02	-0.01	0.09	-0.26	-0.24	-0.39
Weighted avg.	100	0.09	0.00	0.12	-0.04	0.03	-0.07
Average gross monthly returns during third order curve changes							
Third order scenarios:							
Negative twist	49	-0.01	-0.03	0.08	-0.09	-0.09	-0.13
Positive twist	51	0.18	0.03	0.22	0.01	0.15	0.01
Weighted avg.	100	0.09	0.00	0.15	-0.04	0.03	-0.06
Average gross monthly returns during interest rate cycles							
Interest rate cycle:							
Hiking	39	0.06	0.00	0.07	-0.01	0.01	-0.03
Cutting	61	0.10	0.00	0.16	-0.05	0.04	-0.08
Weighted Avg	100	0.09	0.00	0.12	-0.04	0.03	-0.06

B-AFR, bond all-factor rank.

TABLE 4b: Average gross monthly returns during global risk-offs of top and bottom three bond factors from January 1998 until May 2023.

Global risk-off events	Yld Chg (%)	Start	End	Top three bond factors			Bottom three bond factors		
				Dominant (%)	Defensive	B-AFR (%)	Dominant (%)	Defensive (%)	B-AFR (%)
Russian default	2.1	30 April 1998	31 May 1999	0.03	-0.02	0.15	-0.27	-0.19	-0.29
9/11, Dotcom bubble	1.5	30 November 01	30 September 2002	-0.27	-0.19	-0.17	-0.17	-0.32	-0.10
Global financial crisis	2.7	31 October 2007	30 June 2008	0.01	0.04	0.13	-0.01	-0.02	-0.06
US taper tantrum	2.2	30 April 2013	31 Jan 2014	-0.05	0.08	0.23	-0.30	-0.33	-0.47
COVID	0.5	31 December 2020	31 October 2021	0.08	0.11	0.36	-0.37	-0.33	-0.66
RUS-UKR war	1.1	28 February 2022	30 September 2022	0.02	0.00	0.09	-0.13	-0.07	-0.20
-	1.6	Average		-0.02	0.00	0.14	-0.20	-0.19	-0.27
-	0.5	Minimum		-0.27	-0.19	-0.17	-0.37	-0.33	-0.66
-	2.7	Maximum		0.08	0.11	0.36	-0.01	-0.02	-0.06

B-AFR, bond all-factor rank.

respectively. The top three B-AFR deliver consistent positive performance across all second order scenarios, with favourable average gross monthly returns during bull flattening and steepening (16 bps and 20 bps, respectively) and 5 bps to 10 bps for other scenarios. Overall, the top three dominant factors outperform during steepening relative to flattening, with the top three B-AFR delivering consistent returns during both scenarios. In contrast, the top three defensive factors exhibit similar returns that are close to zero during both flattening and steepening.

The bottom three dominant factors display negative performance, with the largest underperformance occurring during bear flattening and flat twists (-17 bps and -26 bps, respectively). Performance for the bottom three defensive factors is also negative during bear flattening and flat twists, with gross average monthly returns of -24 bps. During bull flattening, bull steepening, and steep twists, the bottom three defensive factors outperform the bottom three dominant factors by 13 bps to 15 bps. The bottom three B-AFR, dominant and defensive factors generally underperform during flattening relative to steepening scenarios, with the bottom three defensive factors performing relatively better than the bottom three B-AFR and dominant factors.

During third order curve scenarios (i.e. positive and negative twists), we observe that bond factors perform significantly better under positive twists compared to negative twists. During positive (negative) twists the medium-dated bond outperforms (underperforms) the short- and long-dated bonds in a long fly strategy. The top three B-AFR and dominant factors perform well under positive twists, with average gross monthly returns of 18 bps and 22 bps respectively, while the top three defensive factors contribute 3 bps. For the bottom three defensive factors, the performance is -9 bps during negative twists and 15 bps during positive twists. The bottom three B-AFR underperforms with -13 bps during negative twists and 1 bp during positive twists.

As mentioned previously, interest rate cuts have occurred more frequently, 61% of the time, while hikes occurred the remaining 39% of the time as inflation fell from 9% to 5% over the period. The top three B-AFR and dominant factors performed relatively better during interest rate cuts, with

average gross monthly returns of 16 bps and 10 bps, respectively. During hikes, the top three B-AFR and dominant factors exhibit similar average gross monthly returns. In contrast, the bottom three B-AFR and dominant factors, have negative returns under both interest rate hikes and cuts, while the bottom three defensive factors have positive performance during both hiking and cutting cycles, at 1 bp and 4 bps, respectively.

Finally, we compare the performance of the top and bottom three bond factors during major global risk-off events (9/11 and dotcom bubble, global financial crisis or GFC, US taper tantrum, COVID and the inflation spike caused by Russia–Ukraine war). These global risk-off events are defined when SA sovereign bond yields rise by more than 50 bps, we witness foreign outflows, underperformance from emerging market assets, and a flight to safety with US treasuries and the US dollar outperforming. The top three B-AFR, dominant, and defensive factors show varying performance during these events, with average gross monthly returns ranging from -27 bps to 36 bps. During 9/11 and the dotcom bubble all the bond factors underperformed as the US cutting cycle was ending and the South African Reserve Bank (SARB) began hiking interest rates which resulted in curve flattening decreased curvature and underperforming long fly strategies. Conversely, during the COVID pandemic, the SARB had to react to declining growth and rising unemployment by cutting interest rates aggressively, which resulted in bond curve steepening and increased curvature which favoured the long fly strategies. The bottom three B-AFR, dominant, and defensive factors underperformed during major global risk-off events, with gross average monthly returns of -27 bps, -20 bps and -19 bps respectively.

Bond factor correlations to common financial and economic indicators

Understanding the relationship between the bond factors and financial and economic indicators is essential for optimising bond strategy returns. This section compares the correlations between the bond factors and various economic and financial indicators, shedding light on when to implement long and short fly strategies.

The economic indicators have a one-quarter lag because of the delay in their release. We see strong, positive correlation for the top three B-AFR and dominant factors and bottom three defensive factors compared to the equity, bond and commodity indicators, and strong, negative correlations to the credit spread and volatility indicators. For the bottom three B-AFR and dominant factors the correlations are positive relative to the bond and commodity indicators and negative relative to the economic, volatility, equity and credit spread indicators.

In Figure 2, a bar chart illustrates the correlations between the top and bottom three B-AFR, dominant, and defensive bond factors with economic, credit spread, volatility, equity,

commodity, currency, and bond indicators using lagged 1-month quarterly data because of reporting delays. Table 5 provides definitions of these indicators, along with lag lengths and quarterly changes used for correlation calculations.

The economic data uses a one-quarter lag because of the delay when the data are released. Absolute and percentage changes are shown for each of the indicators.

For the top three B-AFR and dominant factors and bottom three defensive factors, we observe positive correlations relative to the equity, bond and commodity indicators, and negative correlations to the credit spread and volatility indicators. This suggests that the top three B-AFR and dominant factors and bottom three defensive factors have robust performance during risk-on environments with a strong ZAR exchange rate, falling SA sovereign bond yields, low global volatility and credit spreads, positive global growth which favours rising commodity prices and SA's fiscal stability. These bond factors perform well during bull scenarios (bull steepening, bull flattening and steep twists), typical of risk-on environments.

The top three defensive factors are uncorrelated to most of the economic factors, and this highlights their defensive properties but exhibits slight positive correlations towards economic and equity performance, which suggests some risk-on characteristics. Because of their uncorrelated nature, the top three defensive factors protect capital relatively better than the corresponding bottom three defensive factors during major global risk-off events. If an investor's risk tolerance is low, opting for the top three defensive factors will protect capital more effectively during risk-off periods at the expense of low returns over the long term. However, if a higher risk appetite is suitable, selecting the bottom three defensive factors will allow for greater upside potential with relatively less capital protection. Fortunately, we do not have to choose as the top three B-AFR perform relatively well under both risk-off and risk-on periods.

We also found that all the top and bottom three bond factors have negative correlations to the SA budget. A plausible reason is that as the SA budget deficit improves (less negative), the curve flattens (lower government borrowing requirements) resulting in the long-dated bond outperforming relative to the medium-dated bond.

Conclusion

In this study, we used a duration and cash neutral long fly strategy to identify 10 bond factors by analysing and back-testing monthly SA sovereign bond yield data from January 1998 to May 2023. We found that the top and bottom three dominant factors generated an annualised return of 1% and -0.5%, respectively. The bottom three defensive factors outperformed the top three defensive factors with
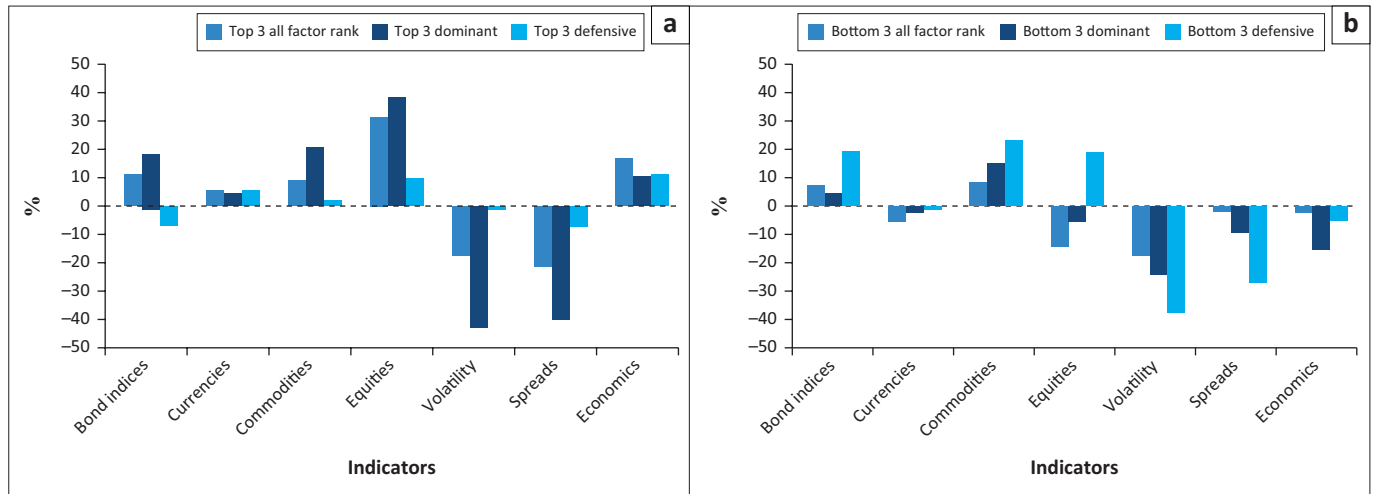
Source: Bloomberg and IRESS data

FIGURE 2: Bar charts depicting the correlation between the top (left chart) and bottom (right chart) three B-AFR, dominant and defensive factors relative to several economic, credit spread, volatility, equity, commodity, currency, and bond indicators using quarterly data.

TABLE 5: Definitions of bond, currency, commodity, equity, volatility, credit spread and economic indicators used to find correlations of top and bottom three Bond All-Factor Rank, dominant and defensive bond factors using quarterly data.

Classification	Indicator code	Description	Change	Quarterly Lag
Bond indices	ALBI	SA All-Bond Index Total Return (in ZAR)	Quarterly percentage change	0
	CILI	SA Inflation Linked Composite Index Total Return (in ZAR)	Quarterly percentage change	0
	US10YTR	US 10-year Treasury Total Return Index (in USD)	Quarterly percentage change	0
Currencies	USDZAR	1 USD in South African Rands	Quarterly percentage change	0
	DXY	US Dollar Index Total Return ((in USD)	Quarterly percentage change	0
Commodities	BRENT	Generic Brent Crude Spot Price (in USD)	Quarterly percentage change	0
	GOLD	Gold Spot Price (in USD)	Quarterly percentage change	0
Equities	ALSI	JSE All Share Index Total Return (in ZAR)	Quarterly percentage change	0
	SABANKS	JSE Banks Index Total Return (in ZAR)	Quarterly percentage change	0
	SARESI	JSE Resources Index Total Return (in ZAR)	Quarterly percentage change	0
	SAREITS	JSE Real Estate Investment Trust Index Total Return (in ZAR)	Quarterly percentage change	0
	SAGENR	JSE General Retailers Index Total Return (in ZAR)	Quarterly percentage change	0
Volatility	VIX	S&P500 1-Month Implied Volatility Index	Absolute quarterly change	0
	SAVI	JSE All Share Index Implied Volatility Index	Absolute quarterly change	0
	MOVE	Implied volatility of U.S. Treasury Options (across various maturities)	Absolute quarterly change	0
Credit spreads	SA5YCDS	SA Sovereign 5-Year Credit Default Swap Spread	Absolute quarterly change	0
	USHYSPRD	US High Yield Bond Spread	Absolute quarterly change	0
	EMBISPRD	Emerging Market Bond Index Spread	Absolute quarterly change	0
Economics	SABAL	SA Budget Balance (as % GDP)	Absolute quarterly change	1
	SACURRACC	SA Current Account Deficit (as % GDP)	Absolute quarterly change	1
	SACORECPI	SA Core Inflation	Quarterly percentage change	1
	SAGDP	SA Real GDP	Quarterly percentage change	1
	USGDP	US Real GDP	Quarterly percentage change	1

SA, South African.

annualised returns of 0.3% and 0%, respectively, which highlighted their protective properties. The B-AFR combined all 10 bond factors, which resulted in greater diversification by balancing upside and downside risks relative to the dominant and defensive factors. Establishing long positions in the top three B-AFR factor and short positions in the bottom three B-AFR factor demonstrated notable returns. We find that successful fly strategies exhibit high absolute spreads and BRPs, wide deviations from NSS fair values and SA swap spreads, high carry and roll, recent underperformance over the past month and low net term spreads and convexities. By using bond fly strategies, we identified non-parallel risk premia that delivered consistent

risk-adjusted alpha over the period, which challenged the strong EMH principle.

This study also emphasises idiosyncrasies in the SA bond market that can be explained by MST, which suggests that investors prefer specific maturities but may deviate to other maturities if they have attractive valuations. In SA, long-dated bonds suit liability-driven investors, while banks with short-term liabilities use short-term bonds. Medium-dated bonds provide better alignment with economic fundamentals reflecting realistic pricing. Thus, fly strategies that exploit short-, medium- and long-dated bonds provide attractive risk premia potential.

High-risk macroeconomic events are extremely difficult to predict but are anticipated to increase according to recent surveys by the IMF and World Economic Forum with developing nations such as SA being the most adversely impacted. Having a fly strategy that can exploit increased geopolitical risks via non-parallel risk premia is an attractive proposition.

A substantial consideration in fly strategies is trade costs. To reduce trade costs, it is prudent to evaluate the frequency of portfolio rebalancing, maintain mutually beneficial relationships with service providers for efficient trading and ensure adequate market liquidity before executing trades. We find that a 3-month rebalancing frequency is a suitable compromise between managing trade costs and duration neutrality.

It is essential to understand macroeconomic, business and consumer cycles as these drive slope and curvature changes. Therefore, a robust investment process is crucial for identifying likely bond curve scenarios and selecting appropriate bond factors for improved performance. If effectively employed, changing fly strategy weight schemes could enhance returns subject to leverage considerations and risk tolerances.

Acknowledgements

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