Term premium estimation for South Africa

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Abstract

This white paper decomposes sovereign yields into expectations of future average short term rates and a term premium. We estimate that the term premium in South African sovereign bonds is lower than after the onset of the COVID pandemic, but still meaningfully higher than its historical average. Codera uses these estimates to extract market expectations of monetary policy and signals relating to the inflation and economic growth outlook, as well as produce estimates of market perceptions of liquidity premia and sovereign credit risk.

I Introduction

We estimate sovereign yield curves for South Africa and apply a term structure model to decompose sovereign yields into expectations of future average short term rates and a term premium. Term premia estimates are very useful as they allow expectations of future monetary policy rates (as well as the economy's neutral rate) to be calculated, allow for assessments of liquidity and sovereign risk embedded in bond market prices, and the transmission of risk shocks to the economy.

We estimate sovereign yield curves using the approach of Nelson-Siegel-Svensson

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(Nelson and Siegel 1987 and Svensson 1994) over a range of maturities (3 month to 10 year maturities):

$$r(m) = \beta_1 + \beta_2 \left(\frac{1 - exp(\frac{-m}{\tau_1})}{\frac{m}{\tau_1}} \right) + \beta_3 \left(\frac{1 - exp(\frac{-m}{\tau_1})}{\frac{m}{\tau_1}} exp(\frac{-m}{\tau_1}) \right) + \beta_4 \left(\frac{1 - exp(\frac{-m}{\tau_2})}{\frac{m}{\tau_2}} exp(\frac{-m}{\tau_2}) \right)$$

where $r(m)$ is a range of daily zero-coupon rates at different maturities m from Bloomberg, based on four estimated factors describing the level (β_1), slope (β_2) and curvature (β_3 and β_4) of the sovereign yield curve and the τ parameters capturing the shape of the function used to fit the curve.

We impose restrictions on the parameters to ensure good fit of daily and monthly yield curves, and ensure stability and interpretability of the parameter estimates.[1] Our approach balances scalability, economic interpretability, curve fit, and computational efficiency. Our model assumes that the yield curve level estimate for each day/month is positive, with specific upper bounds, and further restrictions following the recommendations of Wahlstrom et al. (2022) to minimise the error between the fitted yield curves and the observed market yields using an adaptive nonlinear least-squares algorithm. To estimate the optimal parameters to best fit the yield curve, we set the initial values for optimisation for each day/month as follows: β_1 based on the observed long-term rate, β_2 as the relevant observed yield curve slope, β_3 and β_4 at zero, and τ_1 and τ_2 at one.

Thereafter, we use the information for the fitted yield curves to estimate the affine term structure model of Adrian et al. (2013) to decompose yields into term premium

[1] Particularly at a daily frequency, the South African yield curve exhibits unusual variations at specific short- and medium-term maturities. Possible explanations include limited issuance of short maturity government bonds, limited trading of high quality liquid assets owing to Basel III regulatory requirements and a National Treasury switch auction programme that switches out bonds maturing within one to two years into longer-term bonds to manage sovereign refinancing risk. Limited available reference bonds likely limits price discovery and therefore affects the representativeness of short maturity generic reference rates, while the switches likely distort the short-end of the South African yield curve by encouraging hoarding of switch-eligible bonds.

and rate expectations components. The model estimates principal components of the term structure, calculates holding-period excess returns and uses this information to estimate implied risk neutral curves (i.e. rates at which investors would not require compensation for risk, which are obtained by setting the risk premium parameters to zero) to compare to empirical yield curves. We estimate term premia at daily and monthly frequency for a range of sovereign yield curves but focus this white paper on a South African application.

II Estimates

The onset of the COVID-19 pandemic saw a meaningful steepening of the South African yield curve (Figure 1). The short end of the curve fell as the market expected monetary policy easing over the short term, while the long end shifted up on higher sovereign and market risk on account of the higher market volatility and expected negative impact of the pandemic and economic lockdowns on the economy and fiscal position. The surprise monetary policy cut on 14 April 2020 saw the short end of the curve shift lower, but the long-end also shifted down, as the cut boosted confidence and the risk premium embedded in long rates fell.

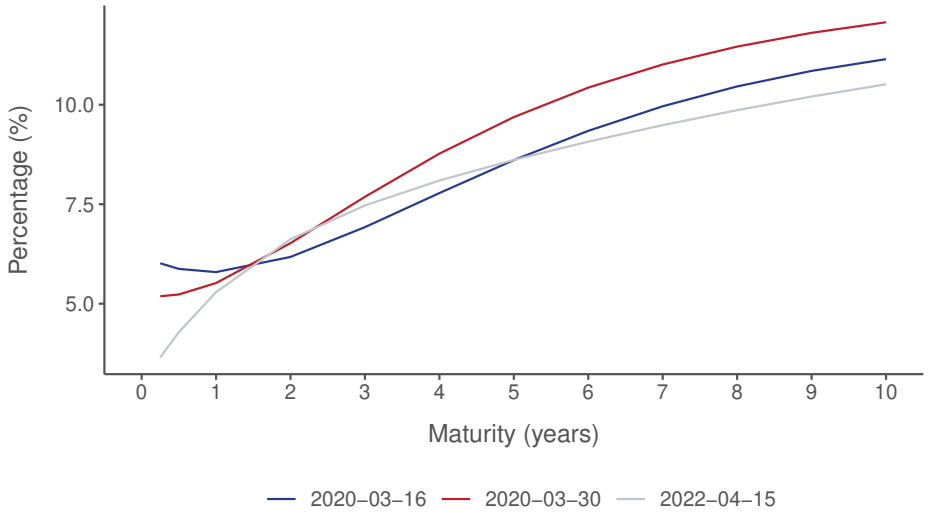

Figure 1: Fitted yield curves on selected dates

The term premium presented here is the difference between the nominal 10-year sovereign bond yield and average expected short rates over that horizon and captures sovereign bond market liquidity risk, sovereign credit risk and inflation uncertainty. Figure 2 shows that average short rate expectations embedded in 10 year yield have fallen over the last two decades. However, in line with the international literature, we find that term premium changes are the dominant driver of long yield dynamics. The South African term premium spiked dramatically during the Global Financial Crisis of 2008-9, as well as with the onset of the COVID-19 pandemic (Figure 3). Our estimate of the term premium embedded in 10 year South African sovereign bonds has been positive for most of the last 20 years.[2] This, in part, reflects the steepness of the South African yield curve, with long-term rates usually a lot higher than short-term interest rates (Figure 4.[3] A positive, and large, term premium implies that the existence of large inflation and credit risk premia in South Africa. The slope of the sovereign curve has become much steeper with the onset of the COVID pandemic, with the initial easing of monetary policy and as liquidity premia and credit risk embedded in government long bonds increased.

[2]Our term premium estimates are similar to those of Soobyah and Steenkamp (2020), but we restrict the parameters from the Nelson-Siegel-Svenson model to prevent erratic and economically inappropriate parameter estimates and to enhance the yield curve fit relative to the approach taken in Soobyah and Steenkamp (2020).

[3]The term spread is the 10 year generic government yield less the 3 month Treasury bill rate, where Bloomberg's South African Treasury bill rate has been backdated using the SARB's 91 day tender rate.

Figure 2: Implied short rate expectations embedded in 10 year South African government bond yields

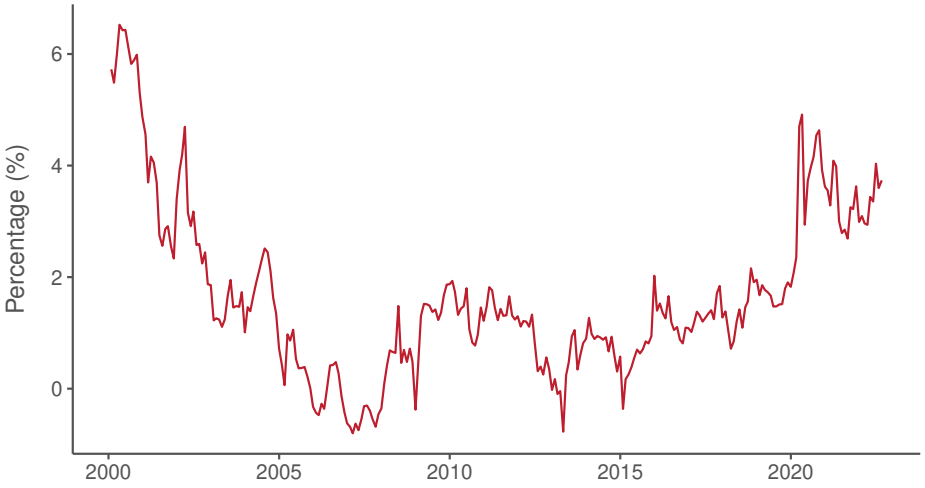

Figure 3: 10 Year Term Premium Estimate

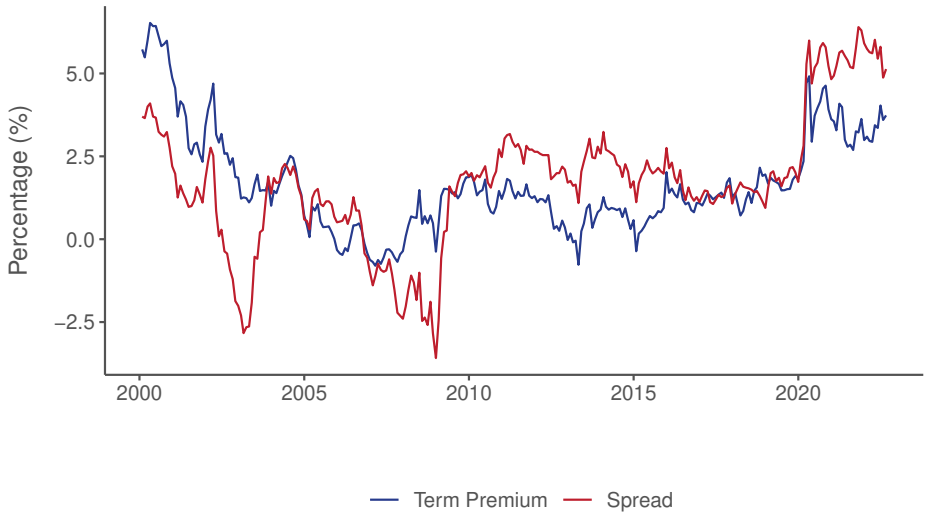

Figure 4: The South African term spread and 10-year term premium

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