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South Africa's yield curve conundrum

Discussion Document 07

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Matthew Simmonds

Director



South Africa's yield curve conundrum¹

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Abstract

South Africa's sovereign yield curve is one of the steepest in the world. We show that South Africa's curve has steepened over recent years and that this can be explained by an increase in the term premium embedded in long rates. We also show that market-implied long term neutral interest rates for South Africa are high compared to both advanced economies and some emerging markets. Simple reduced form models of the term premium however struggle to explain its dynamics. We argue that the answer to resolving South Africa's yield curve conundrum lies in improving our understanding of inflation and sovereign credit premia, as well as foreign exchange depreciation risk. Since a higher term premium tends to weigh on economic growth, we also argue that it is important for policymakers to use the policy levers that would help to reduce long term interest rates. These include strengthening the fiscal position, issuing government securities at a greater variety of maturities and lowering macroeconomic volatility - particularly related to high and variable inflation.

1. Introduction²

The sovereign yield curve describes the cost to the government of borrowing for various lengths of time. This note shows that not only has South Africa's yield curve been very steep by international standards, it has also steepened significantly over recent years. Yet there has been relatively little research into why South Africa's yield curve is so much steeper than in other countries.³

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² We thank Hylton Hollander, Mauro Longano and Matthew Simmonds for comments and suggestions.

³ There are papers that consider the determinants of South Africa's high interest rates, such as Fedderke (2020) who suggests yield spreads reflect public debt dynamics, and Soobyah and Steenkamp (2020b) who show that the yield curve embeds very high expected short rates, and Reid (2009) who extracts inflation expectations from the bond market.



To explain why South Africa's sovereign yield curve is so steep, this note presents estimates of the South African term premium and market-implied neutral interest rate. The term premium is the difference between the nominal yield on sovereign bonds and average expected short rates over a specific horizon. The term premium is a catch-all for sovereign bond market liquidity risk, sovereign credit risk and inflation uncertainty. Term premia estimates are useful for policy analysis 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 show that the steepening of South Africa's curve can be explained by an increase in the term premium. We also estimate the market-implied neutral rate embedded in South African sovereign long bond. Our proxy suggests that South Africa's market-implied neutral rate has defied the decline in global equilibrium interest rates. We argue that the increase in the South African term premium likely reflected an increase in inflation and credit premia associated with a worsening outlook for the government's fiscal position. However, we highlight using a simple modelling framework that it is difficult to explain the dynamics of the South African term premium using economic and financial variables. We suggest that part of the answer to why South Africa has such a steep curve lies in high perceived sovereign credit and inflation risk, which is expressed in crash risk that is priced into market expectations of the exchange rate.

2. The South African yield curve is steep and has become steeper recently

The yield curve can be used to assess market expectations of the outlook for the economy - such as the expected level of short-term interest rates, market-implied inflation expectations and risks around economic growth, inflation variability, sovereign credit risk or general macroeconomic risk. The slope of the South African yield curve has been positive since 2010 (Figure 1), reflecting uncertainty over future economic growth and inflation that means that investors need to be compensated to lock in their funds in



long-term investments.⁴ The slope of South Africa’s curve has also been steeper than for most advanced and emerging market economies (Figure 2)⁵.

Figure 1: Slope of the South African sovereign yield curve (10 year less 3-month rate)

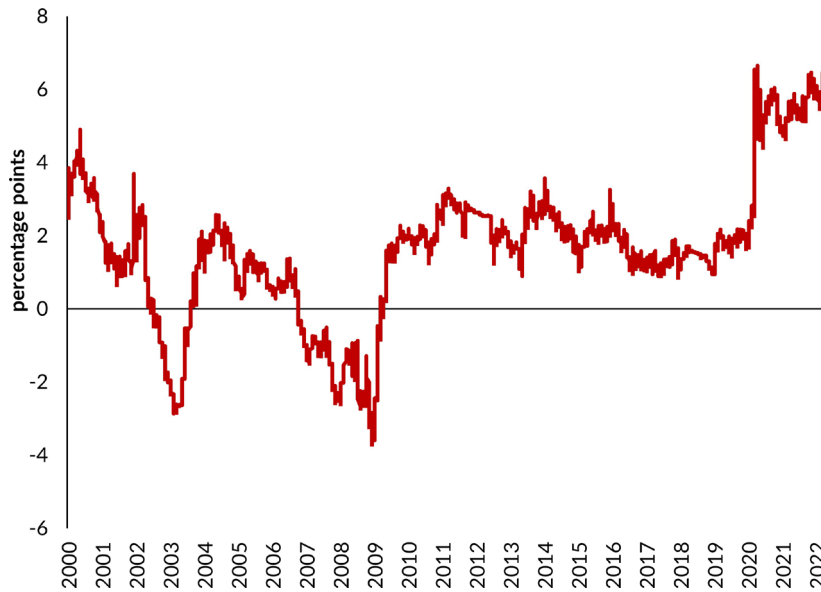
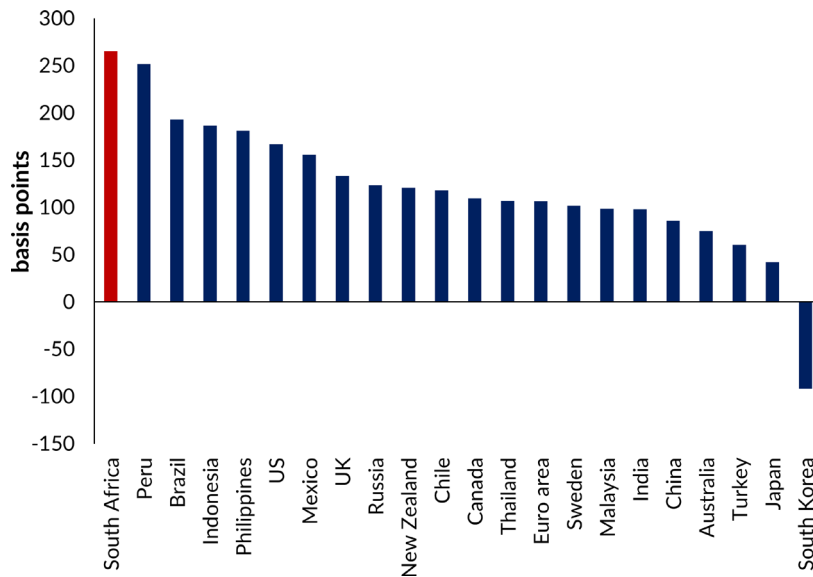


Figure 2: Average slope of the yield curve for selected economies since 2010



⁴ Notably, the South African curve briefly inverted after the onset of the Global Financial Crisis and during the COVID-19 pandemic in response to concerns over possible recession and expectations of monetary policy easing. Figure 1 is based on 10-year generic government yield less 3-month Treasury bill rate, where Bloomberg’s South African Treasury bill rate is backdated using the SARB’s 91-day tender rate.

⁵ We measure the yield curve slope using the difference between monthly 10-year government bond and 3-month Treasury bill yields. Russian yields for 2022 sourced from Russian Central Bank. Turkish 3-month Treasury bill yields were taken from Investing.com and missing values are excluded from the calculation. Vietnam and Colombia do not have 3-month Treasury bill rates available over the sample.

3 Estimates

Using the approach of Nelson-Siegel-Svensson (Nelson and Siegel 1987 and Svensson 1994) described in Erasmus and Steenkamp (2022), 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. The term premium 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 3 shows that average short rate expectations embedded in 10-year yield have fallen over the last two decades. Although expected short rates are the larger of the two components of long-term sovereign yields, 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 (GFC) of 2008-9, as well as with the onset of the COVID-19 pandemic (Figure 4). Our estimate of the 10-year term premium has been positive for most of the last 20 years.⁶ 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. A positive and large term premium likely implies 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-19 pandemic, with the initial easing of monetary policy and as liquidity premia and credit risk embedded in government long bonds increased.

The neutral interest rate is a useful concept for assessing the stance of monetary policy as it provides a guide to the level of interest rates that would be neither expansionary nor contractionary. Nominal neutral rates are sometimes estimated by adding a domestic risk premium (which could reflect expected real exchange rate depreciation and a country risk premium) to an estimated global rate and the domestic inflation target or by linking long term interest rates to structural factors that affect the domestic supply and demand for loanable funds (such as demographic factors or

⁶ Our term premium estimate is similar to that of Soobyah and Steenkamp (2020b), but we restrict the parameters from the Nelson-Siegel-Svensson 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 (2020b).



potential growth).⁷ While the South African Reserve Bank (SARB)'s estimates of the interest rate consistent with inflation at the inflation target declined meaningfully between 2000 and the GFC (South African Reserve Bank 2022), market-implied expectations of long term interest rates have remained stubbornly high. Figure 5 presents estimates of the market-implied neutral interest rate. We use risk neutral rates from our term premium modelling exercise to calculate an implied 5-year, 5-year forward interest rate (indicative of where 5 year interest rates are expected to be 5 years hence), as well as term premium-adjusted 1y5y and 5y1y forward expectations to capture short- and medium-term neutral concepts (indicative of whether the bond market expects where a 1 year (5 year) rate would be in 5 years (1 year)). We argue that the long-term nominal neutral interest rate embedded in the sovereign yield curve in South Africa is currently around 7.5 percent, which is only about 1 percentage point lower than in 2000 based on our market-implied 1y5y rate, or only about 0.3 percentage points lower based on our longer-term measure. Our estimates suggest that the market-implied neutral rate began rising well ahead of the recent policy tightening cycle that started in December 2021 and is about 0.5 percentage points higher than the SARB's terminal neutral estimate⁸.

Compared to other economies, our estimate of South Africa's market-implied neutral rate has been remarkably stable relative to those for some emerging markets such as Mexico or advanced economies such as the United Kingdom (Figure 6). That said, emerging markets such as Brazil and Turkey have even higher average expected long term rates embedded in their yield term structure and these estimated expected rates have also been stable over recent decades.⁹ There are many possible explanations for South Africa's high long term sovereign interest rates. As we argue below, part of the

⁷ For a structural decompositions of South Africa's neutral see Kuhn et al. (2019) who identify the contributions of the current account balance and country risk premium to the estimated level of the South African neutral rate.

⁸ See <https://codera.co.za/historical-terminal-rate-projections-by-sarb>. Our model suggests that monetary policy became extremely accommodative following the COVID-19 related repo cuts, with the repo rate falling well below the neutral rate and current inflation. The SARB's own neutral estimate (at around 7% nominal currently) suggests around 75 basis points of further tightening is required to shift to a neutral policy stance over the projection period (i.e. to return interest rates to a level consistent with inflation at the inflation target over the medium term, see <https://codera.co.za/neutral-rate-estimates-from-sarb/> for a summary of SARB's historical neutral estimates). Our model suggests that the market expects a greater degree of tightening would be required than assumed by the SARB, in line with current market expectations inferred from forward rate agreements (<https://codera.co.za/market-expectations-vs-central-bank-projections/>). Also, see Soobyah and Steenkamp (2021) for a discussion of the extraction of market expectations of monetary policy using market rates in South Africa.

⁹ These estimates appear broadly comparable to comparable estimates from Callaghan (2019) for New Zealand or Aguilar et al. (2022) for Mexico, as well as short rate expectations estimated for Turkey from Aydin and Ozel (2019).



answer likely lies in a high average rate of inflation, sovereign and foreign exchange risk that reinforce expectations of high average inflation, and limited sovereign issuance at short and medium term maturities. While some of these factors likely also contribute to high sovereign yields in Brazil and Turkey, state involvement in those bond markets may distort estimates of risk neutral rates for these economies and affect the accuracy of market-implied neutral estimates for those economies.

Figure 3: Implied short rate expectations embedded in 10 year South African government bond yields

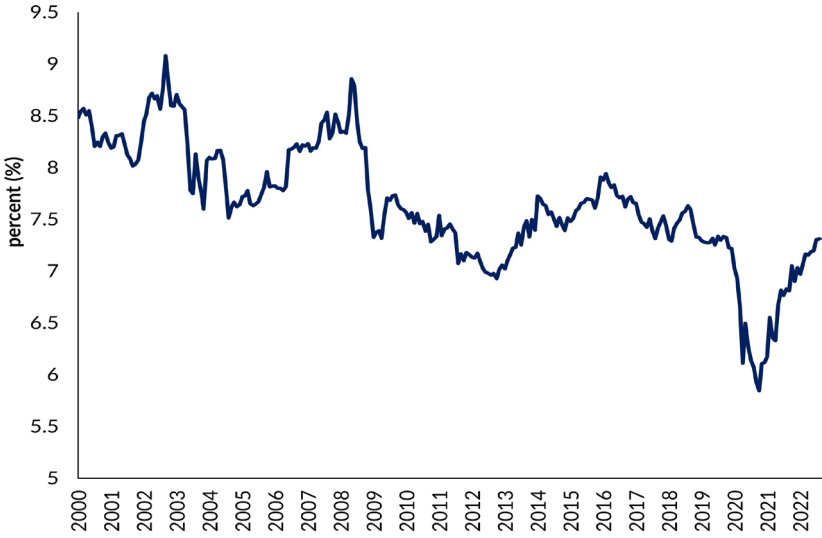


Figure 4: The South African term spread and 10-year term premium

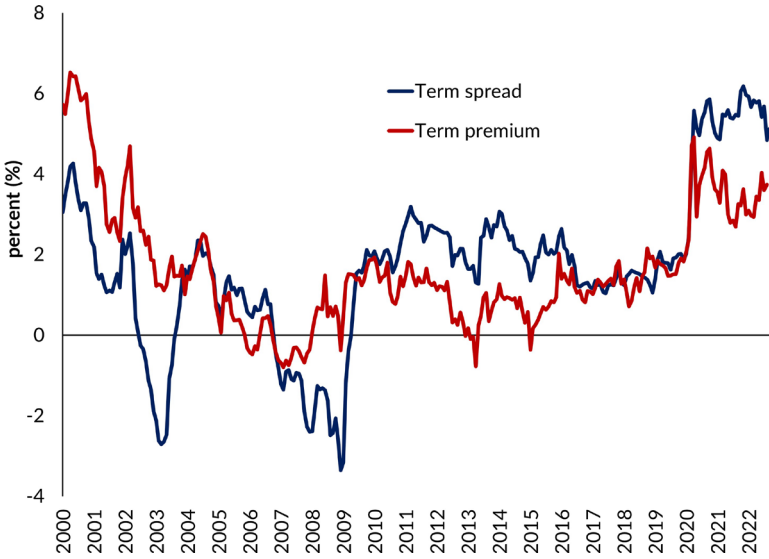




Figure 5: Estimated bond market-implied nominal neutral rate

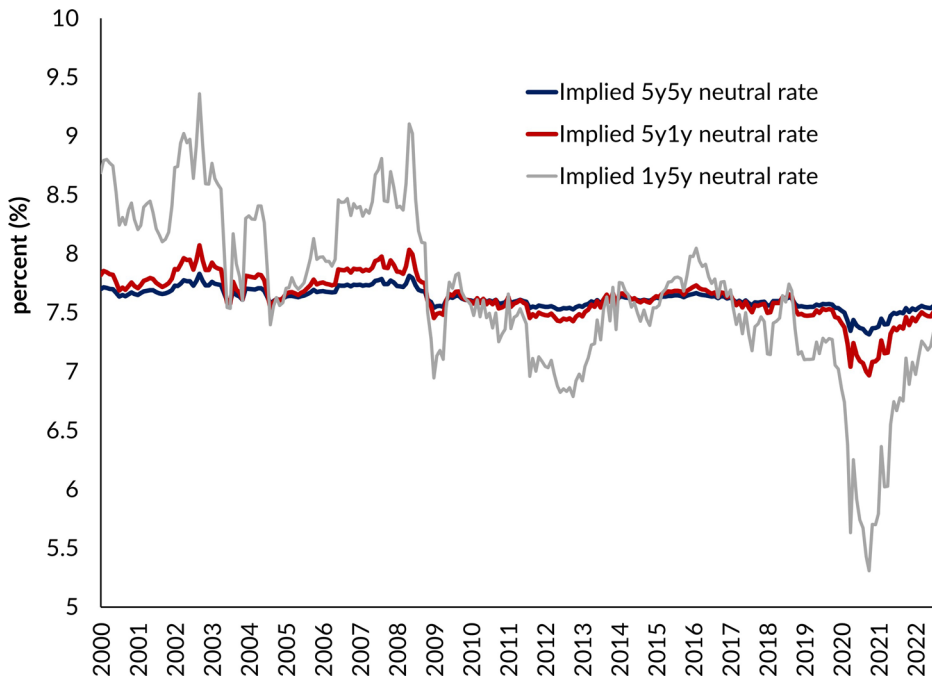
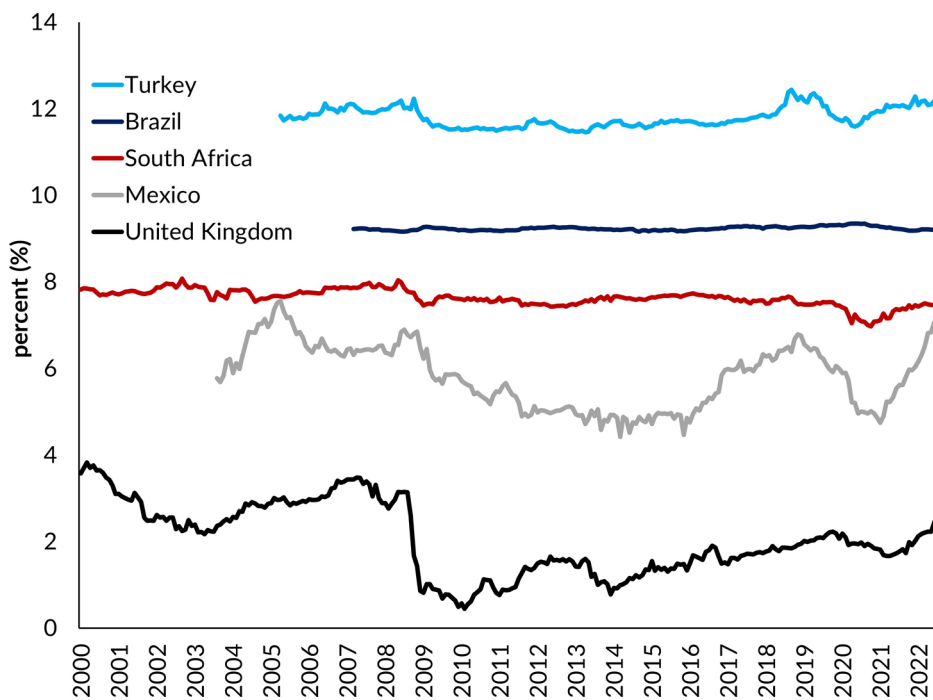


Figure 6: Estimated bond market-implied nominal neutrals for selected economies



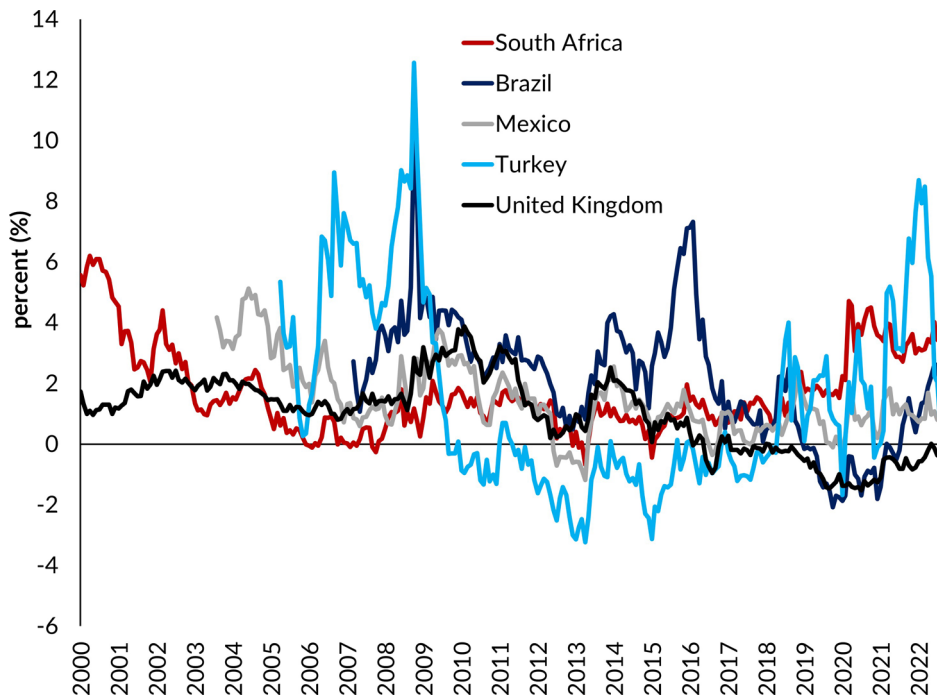
Note: Based on term premium-adjusted 5y1y rates

While South Africa's average expected interest rates are high in absolute terms and relative to Mexico and the United Kingdom, the South African term premium embedded in long rates is currently significantly higher than in the United Kingdom and Brazil, Mexico and Turkey (Figure 7). The section that follows attempts to explain the



level and dynamics of the South African term premium, and suggests that part of the explanation for South Africa's high term premium is high compensation for inflation and foreign exchange risk. Explaining the differences in term premia and yield curve slopes to other emerging markets would be an important contribution of future research.

Figure 7: Term premium embedded in 10-year government bond yields in selected economies



An important implication of a high neutral rate has been upward pressure on sovereign debt. Since South Africa's neutral rate exceeds its economic growth rate (r^* nominal neutral compared with nominal growth g), government debt tends to rise when borrowing costs are higher than economic growth.¹⁰ Higher perceived sovereign risk from higher debt is likely being expressed in long rates through a higher term. Soobyah and Steenkamp (2020b) estimate that term premium shocks tend to be associated with weaker economic activity in South Africa and tend to require an offsetting monetary policy response to stabilise the macroeconomy. In this way, the government's weak fiscal position and South Africa's uncertain political and economic outlook likely weigh

¹⁰ It is important to note that this also reflects a low and declining potential growth rate. Since democracy, Havemann and Hollander (2022) calculate that r (defined there as average nominal sovereign rates) have exceeded g briefly in the 1990s and again between 2012-20, when borrowing added to debt and caused the government debt-to-GDP ratio to rise meaningfully. See <https://codera.co.za/a-long-history-of-r-vs-g-in-sa/> for a summary.

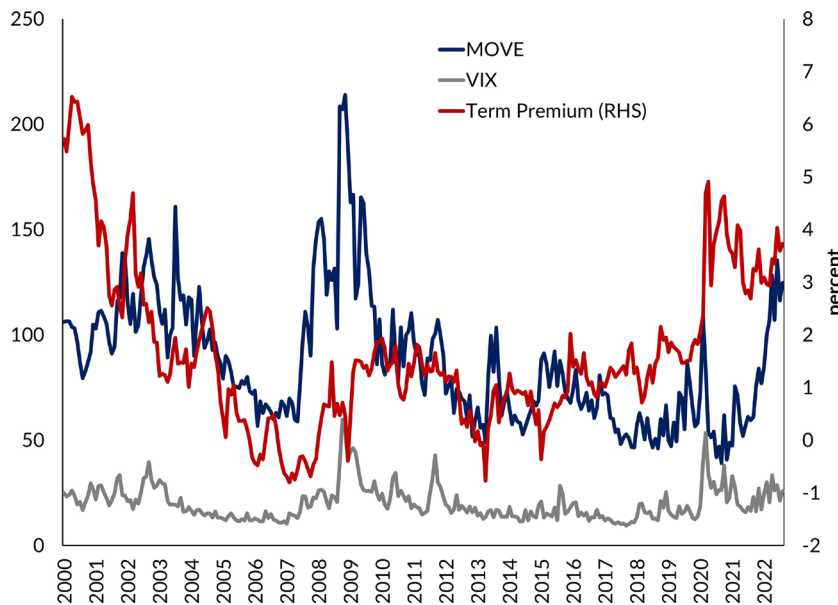


on growth. In the section that follows, we attempt to resolve South Africa's yield curve puzzle using common proxies of the high frequency drivers of interest rates.

4 What explains the South African term premium?

The South African term premium would be expected to be influenced by the domestic macroeconomic outlook and global financial market volatility. In terms of global factors, Figure 8 shows that the South African term premium has a low correlation with global risk aversion (proxied using the Chicago Board Options Exchange Volatility Index (VIX)) and global expected bond market volatility (proxied using the Merrill Lynch Option Volatility Expectations (MOVE) index).¹¹ On the other hand, Figure 1 shows that the term premium is highly correlated with real long-term interest compensation (proxied using the slope of the yield curve).

Figure 8: Global risk aversion, global bond market volatility and South Africa's sovereign 10-year term premium



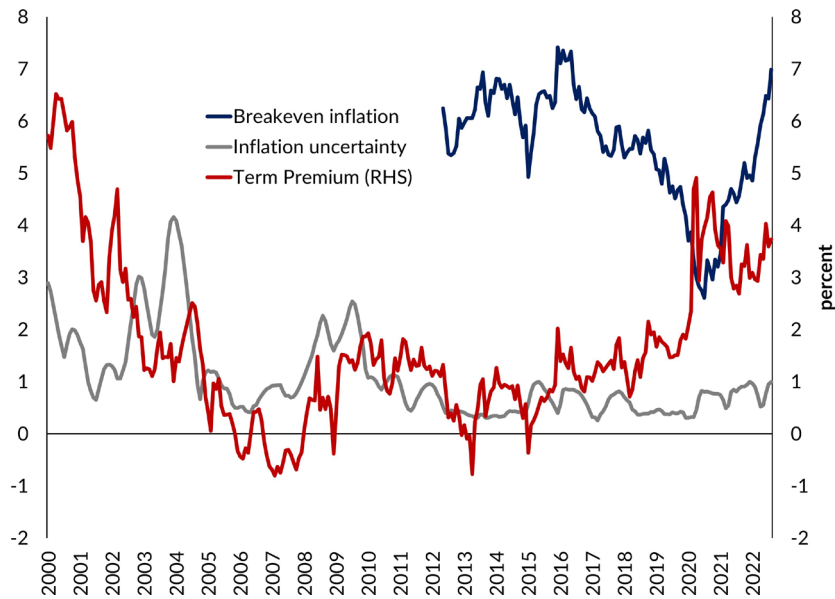
But what explains the real compensation premium built into the term premium? High and variable inflation is a likely explanation. Breakeven rates (bond market-implied expectations of inflation) indeed have a strong correlation with the term premium (Figure 9 plots 5-year expectations), although inflation uncertainty (proxied using the one year rolling standard deviation of inflation for South Africa) does not.¹²

¹¹ The South African term premium also has a low correlation with the estimated US term premium.

¹² Unfortunately, we do not have a sovereign inflation linker curve available with which to assess the extent to which the term premium reflects inflation uncertainty. This is something that could also be explored in future extensions of this work. Note that excluded market-implied expectations of inflation based on breakeven inflation as such data are only available from 2012 onwards.

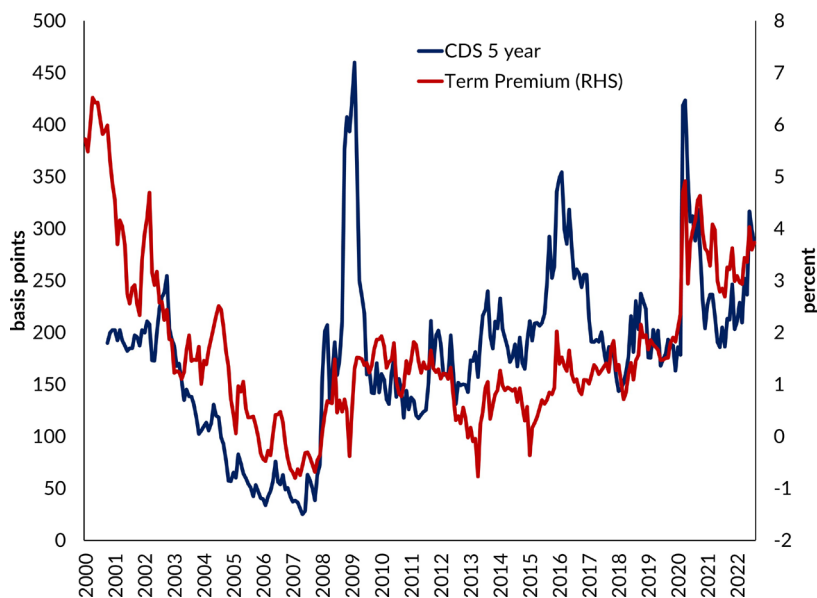


Figure 9: Inflation proxies and South Africa's sovereign 10-year term premium



Another possible explanation is the high market perception of South African sovereign risk. However, Figure 10 proxies sovereign risk using 5-year Credit Default Swap (CDS) spread on South African government debt and shows that the correlation with the term premium is low at less than 0.3 over our sample.¹³

Figure 10: Sovereign credit risk and South Africa's sovereign 10-year term premium



It is also possible that the South African term premium builds in a liquidity

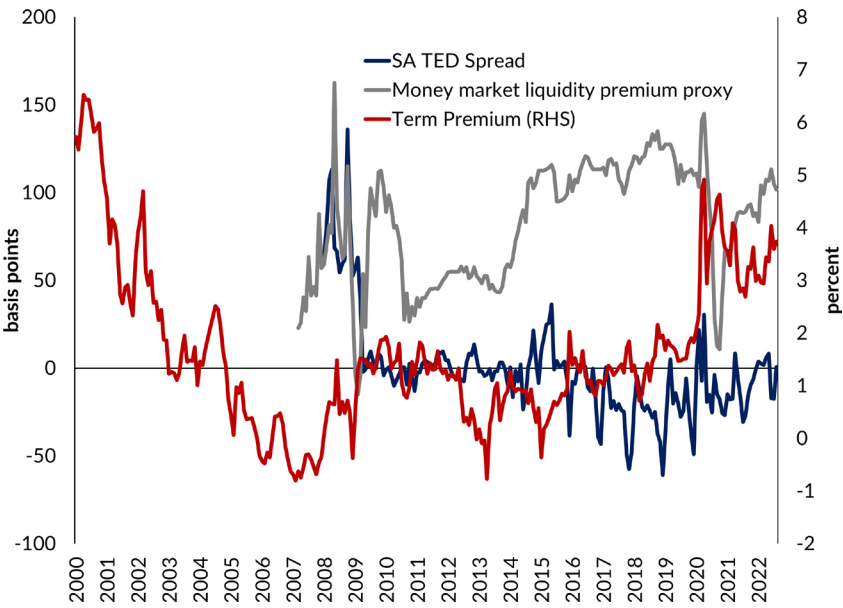
¹³ As argued in Soobyah and Steenkamp (2020a) CDS spreads do not accurately capture South African-specific sovereign risk and further work could develop better proxies of South African sovereign credit risk.



premium reflecting the availability of government bonds at short- and medium-term maturities. There are several policy settings that could contribute to a high bond market liquidity premium. These 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 that might encourage hoarding of switch-eligible bonds. In the absence of high frequency proxies capturing these influences on bond market liquidity, Figure 11 plots simple measures of liquidity in the South African money market.¹⁴ Whereas the TED spread has generally been positive in the US, it has been largely negative in South Africa over the last 7 years on account of elevated sovereign risk.

The SA TED spread has a negative (but low) correlation with the term premium, while the money market liquidity premium measure has a low positive correlation.¹⁵

Figure 11: Money market liquidity and South Africa’s sovereign 10-year term premium



Another possible explanation for South Africa’s steep sovereign yield curve is that meaningful exchange rate depreciation risk is embedded in our long-term interest rates. Our USDZAR options-implied variance estimate, which captures exchange rate

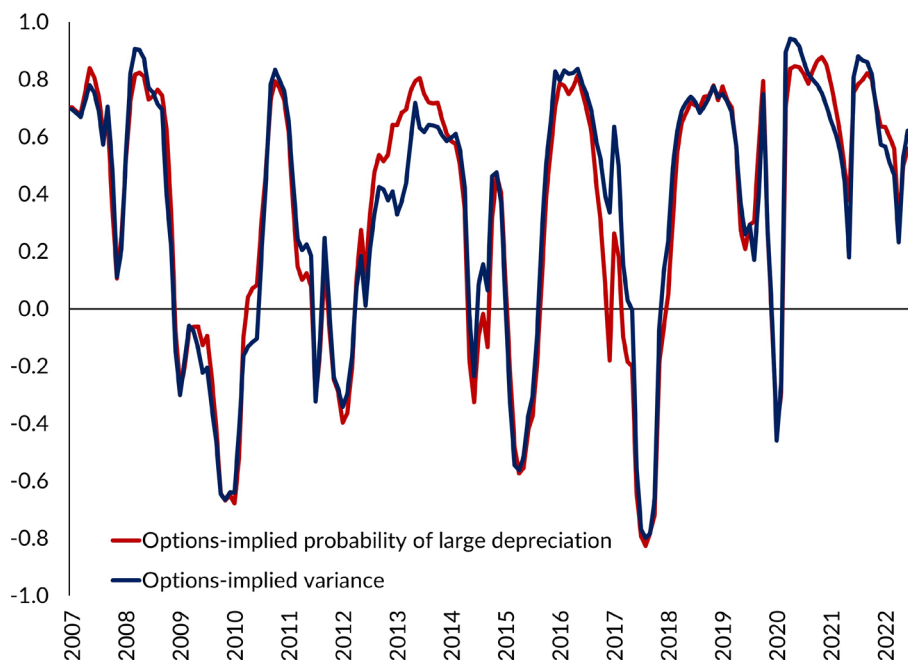
¹⁴ The SA TED spread is calculated as the difference between the rate banks lend to each other and the government’s short-term borrowing costs, while the money market liquidity premium proxy is based on an aggregation of the spread between 3-month JIBAR and the repo, the 12 month NCD spread over an equivalent swap rate and a volume adjustment to account for an immediacy premium applying to large trades based on the approach described in Olds and Steenkamp (2021).

¹⁵ It is also worth mentioning that measures of capacity pressures have a low correlation with the term premium for South Africa at a monthly frequency, though they have a mildly counter-cyclical relationship with the term premium at a quarterly frequency.



uncertainty priced into foreign exchange options prices, and our estimate of options market-implied probability of a 10% or greater depreciation in the USDZAR over the next month have both had a strong positive correlation with the South African sovereign term premium over the last several years (Figure 12).¹⁶ This suggests that high South African long term rates could partly reflect investor concerns about the possibility that the rand could depreciate strongly, which would be expected to push up inflation. Interestingly, the relationship becomes negative after large exchange rate depreciations. This could reflect the role of foreign investors in the South African bond market who are sensitive to foreign exchange risk or expectations that exchange rate overshooting would be partly reversed, especially when a specific bout of depreciation was driven by global risk shocks.

Figure 12: 1 year rolling correlation between South Africa's sovereign 10-year term premium and measures of USDZAR risk



To assess which macroeconomic factors can explain movements in the South African term premium, we present a decomposition based on a simple autoregressive distributed lag model and consider the potential economic drivers discussed earlier. Figure 13 plots the estimated contributions of the top economic and financial drivers to the explained level of the term premium.¹⁷ While the VIX can explain some of the

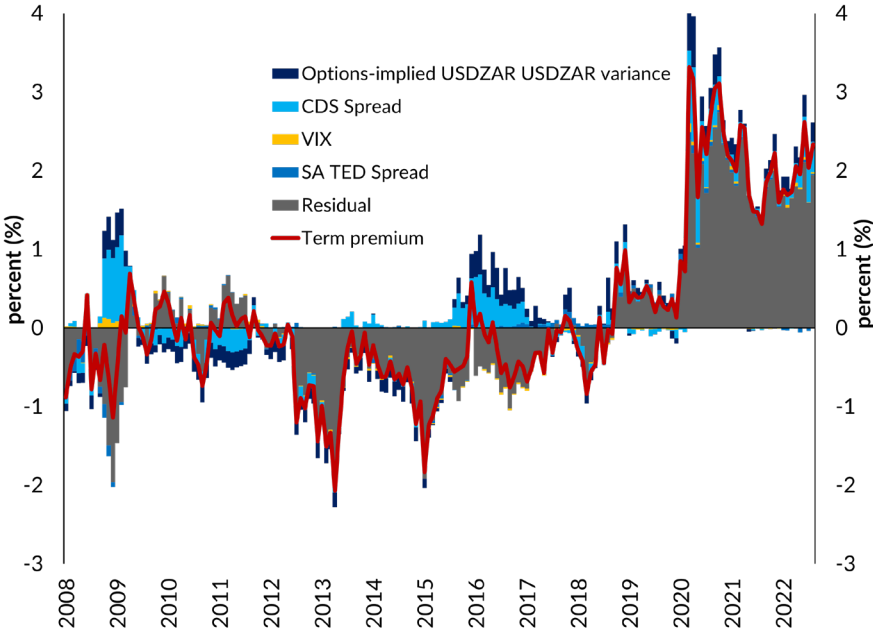
¹⁶ We measure exchange rate depreciation risk using options-implied variance updated based on the approach of Malz (1997) as described in Greenwood-Nimmo et al. (2022).

¹⁷ Note that the residual presented includes the contribution of the lagged term premium in the model.



dynamics of the South African term premium over the last decade, other global factors (such as the MOVE index and the US term premium) have even more limited explanatory power and are not included. Risk perceptions (as captured by CDS spreads) also help to explain only a very small additional proportion of the increase in the term premium. The SA TED spread (a proxy for credit and liquidity risk in the South African money market) explains little of the variation in the term premium. The largest contribution to explaining the term premium comes from our proxy for exchange rate risk.¹⁸ This suggests that some of increase in the term spread in South Africa has reflected increased investor concerns around about the possibility that the rand could depreciate.

Figure 13: Contributions to explaining the term premium embedded in 10-year government bond yields (demeaned)



Part of the reason our simple model does not fully explain what is driving the South African term premium is the inadequacy of the credit, liquidity and inflation risk premia proxies available for South Africa for the full sample considered. As argued in Soobyah and Steenkamp (2020a), for example, CDS spreads do not accurately capture South African-specific sovereign risk as global factors often drive their dynamics. It is

¹⁸We also considered the relationship between the variance risk premium for the USDZAR and the term premium, but the measure in Figure 13 has a stronger correlation with the 10-year term premium. The variance risk premium is the difference between implied variance and expected realised variance evaluated over the same horizon and measures the costs of hedging against currency volatility. South Africa's currency variance risk is much higher than for major advanced and emerging economies (other than Brazil and Turkey, see Greenwood-Nimmo et al. 2022). More generally, the rand also acts as a 'bellwether' emerging market currency, meaning that it tends to react very strongly to global risk shocks (Greenwood-Nimmo et al. 2021).



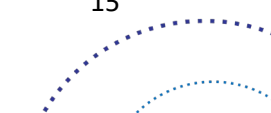
also likely that the worsening outlook for the government's fiscal position has been expressed as a higher perceived possibility of exchange rate depreciation and therefore higher inflation risk, but this forward-looking tail risk is not well captured by our proxies or the model specification used. We argue this requires the development of better proxies of sovereign credit risk, exchange rate crash risk and inflation premia. Likewise, explicitly controlling for the liquidity in the South African bond market using issuance or transaction data might help to reduce the size of the residual in Figure 13. There are also other factors that we have not considered that could help explain the South African term premium. For example, South Africa has historically run persistent current account deficits, creating a reliance on foreign funding and growing claims on the income of South African assets, which have implied exposure to foreign shocks and financing risk (Morule and Steenkamp 2018). Fedderke (2020) suggests that the public debt-to-GDP ratio can explain the South African-United States yield spread and the inclusion of fiscal debt sustainability metrics could also present a useful extension to consider.

Resolution of the term premium conundrum could also come through the specification of models that can capture the complex dynamics between risk and liquidity measures and asset prices, as well as the confounding influence of global markets. We have highlighted the role that expectations of rand depreciation might play in pushing up long bond yields, and believe that a promising avenue to explore would be understanding the relationship between macroeconomic fundamentals, risk premia and the exchange rate.¹⁹

5 Conclusion

South Africa's sovereign yield curve is one of the steepest among large emerging markets. Our estimates suggest this reflects a large term premium. We describe the factors that shape the term premium and suggest that a higher term premium usually coincides with a deterioration in market perceptions of South African credit risk and macroeconomic volatility. A high term premium likely is a meaningful drag on South Africa's growth prospects (Soobyah and Steenkamp 2020b) and therefore should be of concern to policymakers. A higher term premium also implies that long term interest rates in South Africa have been less reactive to domestic monetary policy than they might have been if South Africa had a stronger fiscal position, a lower inflation target or lower macroeconomic volatility overall. We argue that there are policy levers available

¹⁹ Resolving the term premium conundrum would also shed light on other puzzling South African phenomena, such as the persistent attractiveness of the South African rand as a carry currency, see <https://codera.co.za/carry-attractiveness/> for a cross country comparison.





to the government and the central bank that could help to reduce long term interest rates and boost growth. These include strengthening the fiscal position, issuing debt at a greater variety of maturities, and lowering macroeconomic volatility related to high and variable inflation.

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