# Navigating the JIBAR transition: Progress, impacts, readiness, and analytical insights

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**Significance:**

The move away from LIBOR to new risk-free rates is crucial in finance. In this Commentary, I examine South Africa's readiness for transitioning from JIBAR to these new rates, especially regarding interest rate derivatives. I delve into how this shift impacts pricing, unique to South Africa's market. Using a mathematical model based on a $2 \times 2$ Wishart process, I analyse caplet pricing considering backward- and forward-looking rates. Comparing these caplet types reveals the complexities of pricing in this changing financial landscape. The insights shed light on challenges and opportunities for South Africa and the finance sector as JIBAR nears its end, emphasising the need for robust mathematical strategies in navigating this transition.

## Introduction

The world of Quantitative Finance and Risk Management has changed significantly since the 2007–2008 Global Financial Crisis (GFC). Problems that used to have simple answers in finance have become more complicated. Quantitative analysts, often called quants, used to be very confident in their understanding of the basics of financial modelling. These basics included clear benchmarks like LIBOR and JIBAR, reliable interbank credit, and stable single currency values (as mentioned by others[1,2]).

The financial mathematics community found itself confronted with the task of pricing progressively intricate structured financial products. However, the landscape was irrevocably altered by the GFC, introducing uncertainties stemming from unreliable market interbank credit and the volatility in frequency basis. Consequently, the industry responded by introducing the multi-curve pricing framework – a paradigm that entails the construction of multiple yield curves, each tailored to a specific tenor.[3]

In the context of South Africa, the transition away from the Johannesburg Interbank Agreed Rate (JIBAR) has emerged as a significant financial endeavour. This Commentary undertakes an exploration of the progress achieved thus far, the ramifications for a relatively modest market, the readiness of South Africa to navigate the complexities of the JIBAR transition, and the indispensable analytical groundwork required to ensure a seamless and prosperous shift away from JIBAR.

## LIBOR and JIBAR background

### *LIBOR*

In the early 1980s, financial institutions initiated a quest for a standardised benchmark to facilitate the pricing of a diverse array of financial instruments. The London Interbank Offered Rate (LIBOR), which made its inaugural appearance in 1986, emerged as the predominant benchmark within this context. LIBOR is defined as the rate at which an individual Contributor Panel bank could borrow funds.

It is essential to underscore that the rate submitted by each bank must be derived from the institution's assessment of its funding costs within the interbank market. In this context, "funds" encompasses unsecured interbank cash and funds procured through the primary issuance of interbank Certificates of Deposit.

However, in September 2012, Barclays Bank incurred a substantial fine of GBP290 million due to its illicit efforts to manipulate LIBOR. Such instances of benchmark rate manipulation, driven by individual and institutional interests, engendered diminished reliance on the benchmark and cast doubts upon its future viability. Consequently, the volume of transactions referencing LIBOR witnessed a noteworthy decline. In response, diverse working groups were convened to orchestrate international endeavours aimed at reviewing and reforming interest rate benchmarks. The overarching objective is to supplant existing benchmarks with risk-free or nearly risk-free rates.

The International Organization of Securities Commissions (IOSCO) has promulgated a set of guiding principles that pertain to benchmark rates. These principles encompass considerations of appropriateness, design, integrity, and efficacy. A pivotal aspect of these principles involves an assessment of the sufficiency of transaction volumes to serve as the foundation for a benchmark reference rate.

Within markets confronting the impending obsolescence of Interbank Offered Rates (IBORs), most notably those heavily reliant on LIBOR, a complex and protracted transition process becomes imperative.

### *JIBAR*

JIBAR constitutes a prominent benchmark interest rate within the financial landscape of South Africa. Its functionality bears a resemblance to that of other IBORs, such as LIBOR, playing a pivotal role as a reference rate in diverse financial transactions, encompassing loans, derivatives, and various other financial instruments. JIBAR's calculation process involves the collaboration of five contributing banks, namely Standard Bank, Nedbank, FirstRand Bank, Absa, and Investec. On a daily basis, these banks disseminate a series of money market rates, signifying their willingness to engage in the purchase and sale of Negotiable Certificates of Deposit (NCD) to entities including the Johannesburg Stock Exchange (JSE) and the South African Reserve Bank (SARB). Subsequently, the benchmark administrator, SARB, calculates the average midpoints based on these NCD rates for varying tenors, specifically, one month, three months, six months, and twelve months. It is worth noting that the three-month JIBAR rate holds particular significance within the South African financial landscape, serving as a critical reference rate for numerous loans, derivatives, and financial products.

Much akin to LIBOR, JIBAR carries inherent risks related to bank liquidity and interbank dynamics, potentially rendering it susceptible to substantial instability, especially during periods characterised by heightened volatility. Furthermore, its foundation rests upon an expert judgement model, thereby rendering it susceptible to potential attempts at manipulation. In light of these considerations, a strong impetus exists within the South African financial sector to mitigate the risks associated with rate manipulation, augment market integrity, and ensure that benchmark rates derive from genuine market transactions rather than expert judgements.

Practitioners active in South Africa's interest rate markets have raised legitimate questions regarding the necessity of transitioning from JIBAR to an alternative risk-free rate. Notably, JIBAR fails to conform to the sufficiency guidelines delineated by the IOSCO, prompting the SARB to embark on a reformative trajectory akin to the transformations undertaken by other central banks in relation to IBORs. During this transitional phase, an interim enhancement framework has been introduced, designed to fortify JIBAR over a finite period, pending the adoption of an alternative reference rate. A central facet of this enhancement revolves around elevating the obligation size imposed upon each contributing bank – a notable shift from the previous obligation of ZA100 million per point on the NCD curve to the current threshold of ZAR500 million per point. This augmentation serves to enhance JIBAR's adherence to the sufficiency principle delineated by IOSCO, thereby bolstering its robustness.

Anticipations regarding the alternative reference rate posit its character as a risk-free or near-risk-free benchmark, potentially devoid of term structure. In this context, ZARONIA (South African Overnight Index Average), derived from the repo market, has been embraced as the alternative reference rate of choice, symbolising a steadfast commitment to heightened transparency and accuracy within the South African financial landscape.[4] ZARONIA, renowned for its origins and reliability, emerges as a compelling candidate to supplant JIBAR, serving as a more representative indicator of short-term borrowing costs. Its robust attributes further accentuate its suitability for the role of JIBAR's successor.

Table 1 provides a statistical snapshot of the JIBAR and ZARONIA rates over the specified period. The relatively low standard deviations, detrended values, and nonlinear detrended values suggest that the rates remained stable, with limited variations and trends. The positive spot spread indicates that JIBAR rates tended to be higher than ZARONIA rates during this period. The values for detrended standard deviation are relatively low for both JIBAR and ZARONIA, indicating that, even after removing trends, the rates remained relatively stable. Negative values for kurtosis and skewness for both JIBAR and ZARONIA suggest that the rate distributions are leptokurtic and negatively skewed. This means that the rate distributions have thinner tails and are skewed to the left (negatively). Figure 1 provides a time-series representation of the relationship between JIBAR and ZARONIA over the course of approximately 14 months (data were collected from the South African Reserve Bank website from 28 July 2022 to 19 September 2023). It suggests a positive correlation between JIBAR and ZARONIA.

**Table 1:** Descriptive statistics of South African benchmark rates (3-month JIBAR and ZARONIA*)*, 28 July 2022 to 19 September 2023

| | JIBAR (%) | ZARONIA (%) | Spot spread (%) |
|---|---|---|---|
| Mean | 7.3980 | 7.0158 | 0.3821 |
| Standard deviation (s.d.) | 0.9214 | 0.9338 | 0.0760 |
| Detrended s.d. | 0.2414 | 0.2204 | 0.0738 |
| Nonlinear detrended s.d. | 0.1596 | 0.1723 | 0.0594 |
| Kurtosis | -1.0076 | -1.0667 | 0.4772 |
| Skewness | -0.4552 | -0.3858 | 0.2495 |

*Data source: South African Reserve Bank[5]*

### *South Africa's readiness*

A crucial question arises about how prepared South Africa is for the upcoming change. In my view, rushing this transition might not be necessary. South Africa's financial world is quite small, mainly involving five important banks that play a big role in determining the JIBAR. Unlike bigger and more developed financial markets, the risk of manipulating JIBAR in South Africa is much lower.

Therefore, there is no need to hurry with this transition to risk-free rates. We should remember that JIBAR will eventually not be used, but we do not know when exactly that will be. JIBAR is based on banks lending to each other without any guarantees, while the new benchmark rates are based on safer transactions without credit factors. Switching to these safer transactions raises important questions about how it will affect financial markets.

The SARB has taken proactive steps by creating a special group to find a new, suitable risk-free rate, similar to what was done in the USA and UK when they moved away from IBOR. Globally, there is a preference for using a very safe rate. However, it is crucial to recognise that many financial markets do not meet the requirements to develop such rates. Therefore, many markets, like the European Union and Japan, have chosen to quickly adopt nearly risk-free overnight and secured rates.

The SARB has made it clear that they want to approach this transition carefully to avoid causing instability and market swings. They are committed to following the best international practices.

Additionally, the uncertainty about JIBAR's future has raised questions about its current impact on swaps and agreements. The shift to new reference rates may affect derivative hedging. One major concern is not knowing if there will be a way to hedge existing loans and debt linked to the 3-month JIBAR after the transition. This situation could lead to a risk of differences between privately agreed loans and their related derivatives. Moreover, introducing new benchmark rates could significantly change the way existing hedging strategies work.

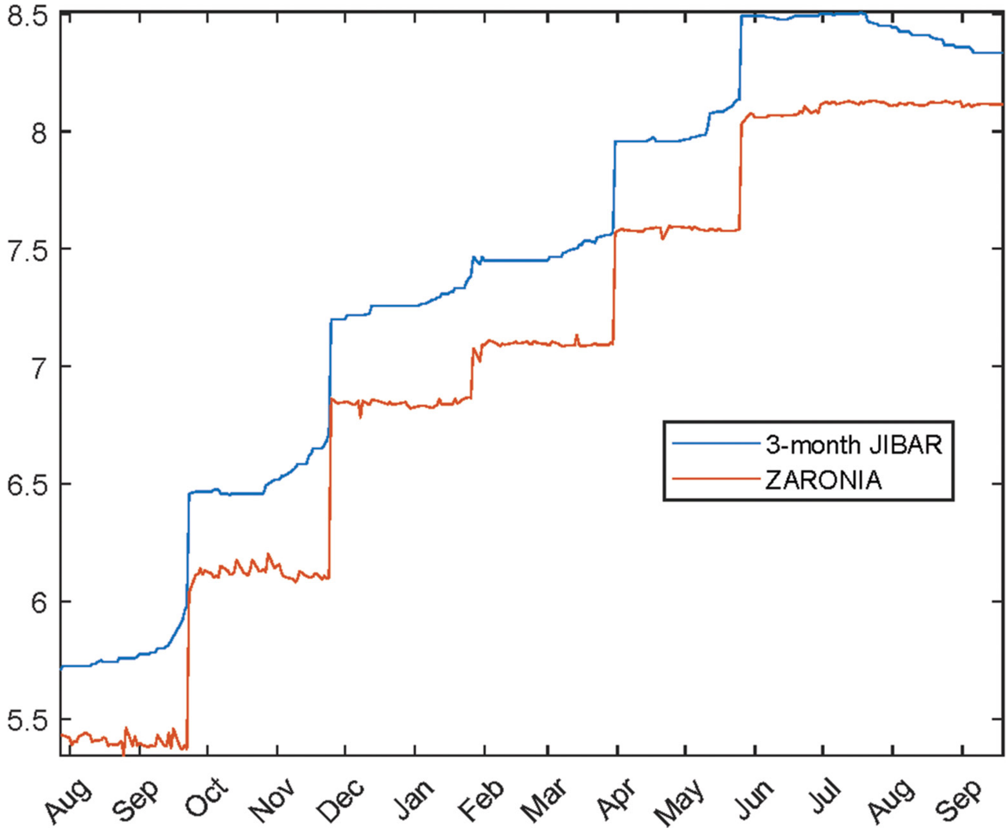
## Derivative pricing

I initiate the discussion by exploring derivative pricing, specifically in the context of employing an alternative risk-free rate. In this regard, I examine the effective daily compounding rate applied retrospectively over the time interval $T_{j-1}, T_j$:

$$ARR\left(T_{j-1}, T_j\right) := \frac{1}{\tau_j}\left(\prod_{i=1}^{N}\left(1+\delta_i RFR_i(t_i)\right)-1\right), \forall i, t_i \in \left[T_{j-1}, T_j\right], \quad \text{Equation 1}$$

where $RFR_i(t_i)$ for $i \in 1, \cdots, N$ denotes the alternative overnight rates in the given reference period. In Equation 1, the variable $\tau_j$ signifies the cash day count fraction relevant to the accrued period, while $\delta_i$ pertains to the cash day count fraction corresponding to the overnight accrued period. Importantly, this rate encapsulates the actual rate operative over the specified period, distinguishing itself by its reduced volatility when contrasted with an average rate. It derives its foundation from the well-established Overnight Index Swap market, leveraging the extant cross-hedging capabilities inherent within this market.

Overnight risk-free rates distinguish themselves by their inherent risk-free or nearly risk-free nature, in stark contrast to the IBORs which encompass an amalgamation of factors, including a bank credit risk premium, liquidity considerations, and supply–demand dynamics. In the event of the permanent discontinuation of the pertinent IBORs,




*Data source: South African Reserve Bank*[5]

**Figure 1:** Analysing the dynamic interplay: JIBAR and ZARONIA rates, 28 July 2022 to 19 September 2023.

it becomes impractical to entirely replicate these multifaceted determinants. However, a judicious approach entails the application of a spread adjustment to the corresponding adjusted risk-free rates. The methodologies underlying this approach are devised with three primary objectives in mind:

- To effectuate the elimination or minimisation of value transfer ramifications at the juncture when the fallback is instituted.
- To eradicate or mitigate any potential for manipulation, thereby safeguarding the integrity of the transition process.
- To eliminate or mitigate against the disruptive impact on financial markets that may ensue at the moment that the fallback mechanism is activated.

## Spread adjustment

As outlined in the current ISDA protocol[6], the primary alternative for derivatives linked to LIBOR rates involves using the combined overnight risk-free rate along with an extra credit adjustment spread.

The spread adjustment could be calculated based on observed market prices for the forward spread between the relevant IBOR and the adjusted risk-free rates in the relevant tenor at the time when the fallback is triggered. The spread is given by:

$$S(t) = FL(t) - FR(t), \qquad \text{Equation 2}$$

where *FL* is the *t* forward LIBOR rate and *FR* is the *t* forward risk-free rate. This spread gives a current representation of the prevailing market conditions and forward expectations. The fallback rate is then given by:

$$F(t) = FR(t) + S(t). \qquad \text{Equation 3}$$

### *Wishart processes*

The application of Wishart processes in finance is central as it incorporates risks characterised by volatility-covolatility matrices. To acquaint oneself with the foundational concepts related to Wishart processes, it is recommended to refer to seminal works[7-9] and the contributions of Gnoatto and collaborators[10,11]. Additionally, the PhD thesis by Gnoatto[12] provides comprehensive insights into this subject.

Let us begin with a formal definition:

**Definition 1.** Consider a $d \times d$-dimensional Brownian motion W ($W \sim \mathcal{BM}_d$), along with arbitrary matrices Q and M belonging to $\mathcal{M}_d(\mathbb{R})$, an initial value $x_0$ within the closure of positive semidefinite real $d \times d$ matrices ($x_0 \in \bar{\mathcal{S}}_d^+$), and a non-negative parameter $\alpha$. The Wishart stochastic differential equation is represented as:

$$dX_t = (X_t M + M' X_t + \alpha Q' Q)dt + \sqrt{X_t}\, dW_t Q + Q' dW_t' \sqrt{X_t}, ;\ X_0 = x_0.$$
Equation 4

Here, X is a strong solution within $\bar{\mathcal{S}}_d^+$, characterising a Wishart process with parameters Q, M, $\alpha$, and $x_0$. This process is conventionally denoted as $X \sim \mathcal{WP}_d(Q, M, \alpha, x_0)$.

In the modelling context, define the filtered probability space $\left(\Omega, \mathcal{F}, (\mathcal{F}_t)_{t \geq 0}, \mathbb{Q}\right)$ and assume that the short rate is driven by a Wishart process *X*, specifically:

$$RFR(t) = \lambda_0 + tr[\Lambda X_t] \quad \text{for all } t \geq 0. \qquad \text{Equation 5}$$

Here, $\Lambda$ belongs to $\bar{\mathcal{S}}_d^+$, and $\lambda_0$ is a scalar. It is essential to note that $tr[\cdot]$ signifies the trace operator applicable to any square matrix.

### *Monte Carlo pricing*

In the domain of quantitative finance, the pricing of intricate financial derivatives frequently demands the application of advanced mathematical models and computational methodologies. One such derivative is the caplet, a financial contract that grants the holder the privilege to receive payments if a reference interest rate surpasses a predetermined strike rate. In this illustrative instance, I embark on the evaluation of caplet pricing, employing a Monte Carlo simulation approach (for a comprehensive discussion of this method, please refer to Glasserman [13]). What adds a noteworthy dimension to this scenario is the contemplation of both backward-looking and forward-looking caplets (each follows a $2 \times 2$ Wishart process). These processes are characterised by specific parameters, including volatility and drift matrices, providing valuable insights into the complexities of modelling interest rate dynamics, and valuing these derivative instruments.

The payoff of the caplet over the period $[T_{j-1}, T_j]$ is given by:

$$\tau_j\left(\frac{1}{\tau_j}\left(\prod_{i=1}^{N}(1+\delta_i RFR_i(t_i))-1\right)+S(t)-K\right)^+ \quad \text{Equation 6}$$

where $K$ is the strike price of the caplet. This is equivalent to a geometric Asian option. The price at time $t \leq T_{j-1}$ of this option is computed as:

$$c_t = \mathbb{E}_t^Q\left[e^{-\int_t^{T_j} RFR(s)ds}\,\tau_j\left(\frac{1}{\tau_j}\left(\prod_{i=1}^{N}(1+\delta_i RFR_i(t_i))-1\right)+S(t)-K\right)^+\right] \quad \text{Equation 7}$$

Equation 7 can be straightforwardly evaluated through numerical methods, such as Monte Carlo simulation. In this approach, we assume that the underlying alternative risk-free rate adheres to the Wishart process outlined in Equation 4. In the subsequent experiment, we specifically examine the following instance of the Wishart process:

$$M=\begin{pmatrix}0.03 & 0.02\\0.02 & 0.035\end{pmatrix},\ Q=\begin{pmatrix}0.02 & 0.015\\0.015 & 0.025\end{pmatrix},\ X_0=\begin{pmatrix}0.04 & 0.045\\0.045 & 0.05\end{pmatrix},$$

$$A=\begin{pmatrix}1.00 & 0.00\\0.00 & 1.00\end{pmatrix},\ \alpha=0.1.$$

Table 2 and Figure 2 depict the pricing distinctions between forward- and backward-looking caplets in the context of a Wishart process. As observed, as documented in previous research, forward-looking caplets consistently exhibit lower valuations in comparison to their backward-looking counterparts. This disparity underscores the significance of comprehending the distinctive characteristics of these caplets in the

**Table 2:** Monte Carlo prices and standard errors (s.e.) for backward and forward caplets, with backward caplets showing slightly higher values than forward caplets. Additionally, the Monte Carlo standard errors for these prices are exceptionally small, indicating a high level of precision in the simulation results. The spread adjustment S = 0.003821.

| | Strike | 0.025 | 0.03 | 0.035 | 0.04 | 0.045 | 0.05 | 0.055 | 0.06 | 0.065 |
|---|---|---|---|---|---|---|---|---|---|---|
| Backward caplet | Price | 0.0430 | 0.0406 | 0.0382 | 0.0359 | 0.0335 | 0.0312 | 0.0288 | 0.0265 | 0.0241 |
| | s.e. | 2.840e-05 | 2.8314e-05 | 2.8234e-05 | 2.8404e-05 | 2.8953e-05 | 2.870e-05 | 2.8820e-05 | 2.9052e-05 | 2.9058e-05 |
| Forward caplet | Price | 0.0423 | 0.0400 | 0.0376 | 0.0353 | 0.0329 | 0.0305 | 0.0283 | 0.0257 | 0.0235 |
| | s.e. | 4.723e-05 | 4.7860e-05 | 4.8295e-05 | 4.8157e-05 | 4.8140e-05 | 4.8502e-05 | 4.8525e-05 | 4.8265e-05 | 4.8746e-05 |

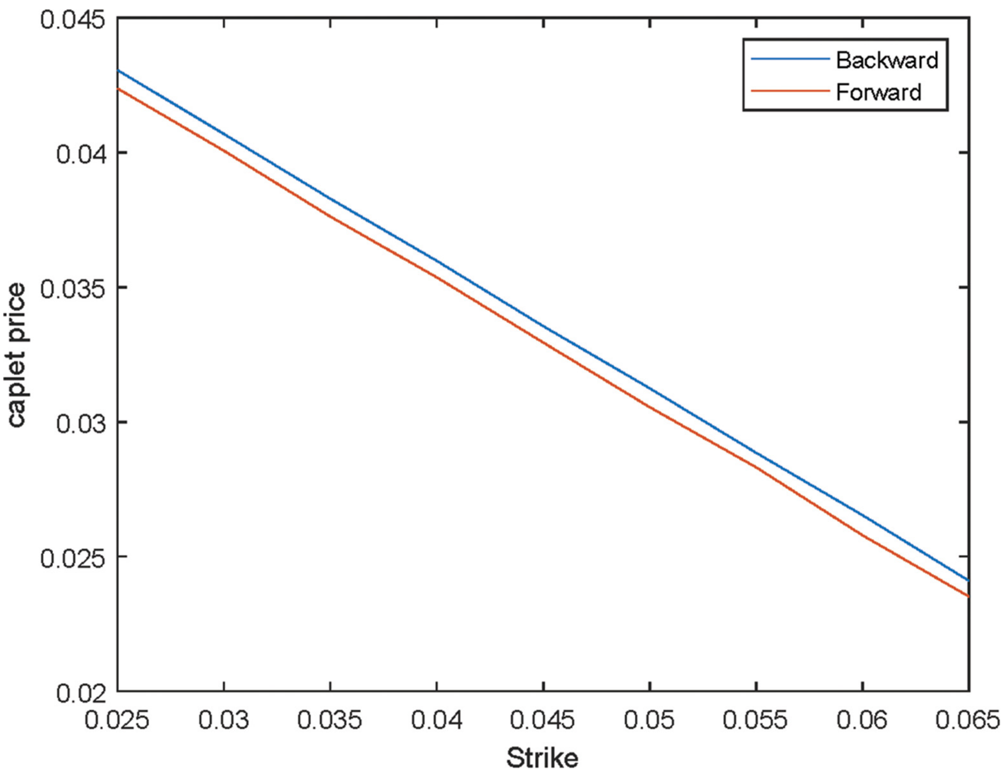



**Figure 2:** Comparison of caplet prices: forward vs backward looking rates in a Wishart process.

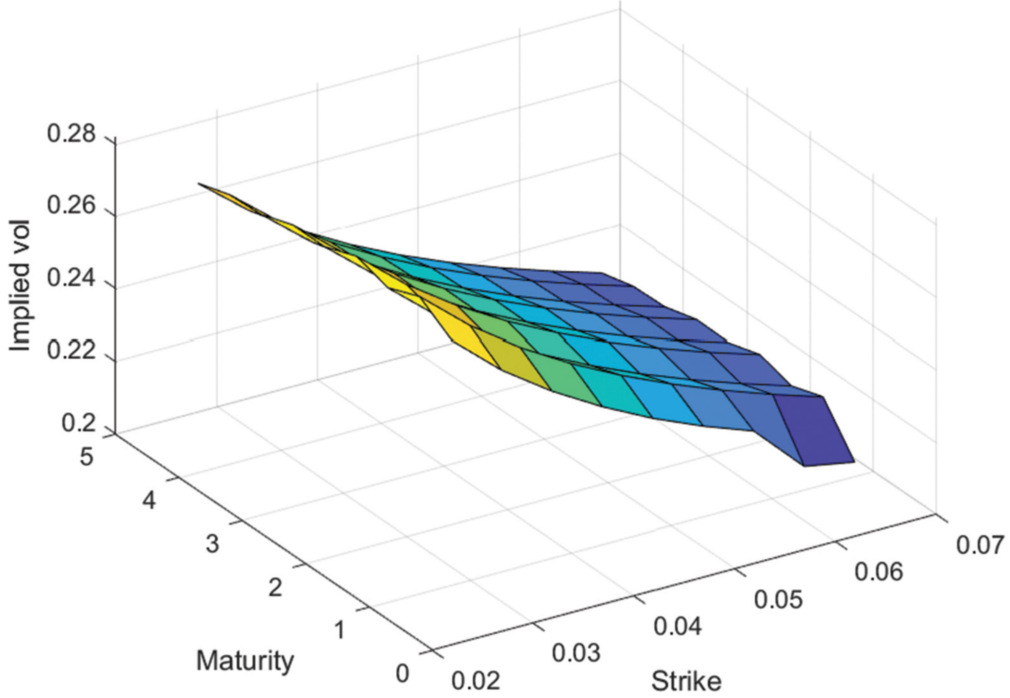



**Figure 3:** Volatility surface of backward-looking caplets computed using the Fourier-based method in a Wishart process.

realm of risk management and financial decision-making, especially in the context of emerging benchmark risk-free rates.

Figure 3 presents the volatility surface of backward-looking caplets, computed using a Fourier-based method as discussed by Fantana[14], within the framework of a Wishart process. This visualisation offers valuable insights into the complex dynamics of interest rate derivatives.

## Conclusion

As highlighted by SARB[4], the process of transitioning from JIBAR to alternative reference rates in South Africa represents a substantial and pivotal endeavour, bearing significant implications for the nation's financial markets. Notable advancements have been achieved in this endeavour, encompassing the establishment of an alternative reference rate, ZARONIA, and the extensive dissemination of knowledge within the market. Nonetheless, the transition is accompanied by persistent challenges, particularly in the context of adapting to the distinctive characteristics inherent to South Africa's financial landscape.

The consequences of this transition, particularly within a relatively compact market, underscore the importance of meticulous analysis and effective risk management. The indication of South Africa's readiness, propelled by regulatory backing and proactive involvement of market participants, is a positive signal. However, it is imperative to maintain a vigilant stance, ensure clear communication, and undertake comprehensive analyses as the transition unfolds. By actively addressing the identified challenges and conducting the requisite analyses, South Africa can navigate the JIBAR transition with success, ultimately contributing to the cultivation of a more resilient and transparent financial system for the foreseeable future (see for example Backwell et al.[15]).

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## Competing interests

I have no competing interests to declare.

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