Risk-Adjusted Performance of South African Active Investment Strategy of Liability-Driven Investor

Martin Kocúrek[*]

¹Department of Finance, Faculty of Economics and Finance, University of Economics in Bratislava, Slovak Republic

[*](martin.kocurek@euba.sk)

ATIF/REFERENCE: Kocúrek, M. (2024). Risk-Adjusted Performance of South African Active Investment Strategy of Liability-Driven Investor. *International Journal of Advanced Natural Sciences and Engineering Researches*, 8(5), 251-257.

Abstract – This paper investigates the risk-adjusted performance of an active investment strategy tailored for a liability-driven investor (LDI) within the South African financial market. The primary focus is on a portfolio consisting predominantly of short-term government securities and cash, reflecting the LDI's objectives of capital preservation and liquidity. Utilizing risk-adjusted performance indicators such as the Sharpe Ratio, Jensen's Alpha, and Sortino Ratio, along with Value at Risk (VaR) methodologies, this study provides a comprehensive analysis of the portfolio's risk-return profile over a period from August 29, 2000, to September 21, 2021. The findings indicate that the active management strategy has been effective in balancing risk and return, achieving competitive returns relative to the risks undertaken. The positive Jensen's Alpha highlights the portfolio manager's skill in generating excess returns, while the VaR estimates offer insights into potential downside risks under various market conditions. This research contributes to the broader understanding of risk-adjusted investment strategies for liability-driven investors, particularly within emerging markets, and underscores the importance of ongoing portfolio monitoring and risk management.

Keywords – Risk-adjusted performance, portfolio management, South Africa, Value at Risk, liability-driven investor.

I. INTRODUCTION

Liability-driven investors (LDIs), such as insurance companies and pension funds, face unique challenges in managing their investment portfolios. These investors have specific liability streams from its key business operations, i.e. sale of insurance products or private pension saving products that they must match with their assets in order to ensure their ability to meet future obligations. As a result, LDIs often adopt specialized investment strategies that prioritize capital preservation, liquidity, and risk management. These are performed within asset-liability matching processes (ALM).

Active management is one approach that LDIs can employ to navigate the complex investment landscape and achieve their objectives. By actively selecting securities, adjusting portfolio allocations, and responding to changing market conditions, LDIs aim to generate competitive risk-adjusted returns while adhering to their unique constraints.

This paper focuses on the risk-adjusted performance of an actively managed South African investment portfolio designed for a liability-driven investor. The portfolio primarily consists of short-term

government securities and cash, reflecting the LDI's emphasis on capital preservation and liquidity. By analyzing the portfolio's composition, risk-adjusted performance metrics, and Value at Risk (VaR) estimates, this study seeks to evaluate the effectiveness of the active investment strategy in meeting the LDI's specific requirements.

The remainder of this paper is structured as follows: Section II presents a review of relevant literature, Section III describes the data and methodology employed in the analysis, Section IV presents the results, Section V discusses the implications of the findings, and Section VI concludes the paper.

This introduction sets the context for the research by highlighting the unique challenges faced by LDIs, introducing the focus on an actively managed South African investment portfolio, and outlining the structure of the paper. It positions the study within the broader literature on LDI investment strategies and emphasizes the practical relevance of the findings.

II. LITERATURE REVIEW

We follow [1] and apply risk-adjustment investment performance indicators Sharpe Ratio, Jensen's Alpha, Sortino Ratio and Value at Risk variance-covariance method, VaR Historical Simulation and Monte Carlo Simulation.

Sharpe ratio [2], is defined following way:

$$SR = \frac{R_i - R_f}{\sigma_i}$$
(1)

where expected return (Ri) beyond the risk-free rate (Rf) is divided by the risk.

Jensen's Alpha, introduced by Michael Jensen [3], measures the excess return of an investment relative to its expected return based on the Capital Asset Pricing Model (CAPM) and is mathematically expressed the following way: $\alpha_i = R_i - R_f - \beta_i(R_m - R_f)$

Excess return in relation to the risk-free asset Rr and to the gain according to the risk incurred β_i in relation to the market portfolio R_m.

The Sortino Ratio, developed by Frank Sortino, is a modification of the Sharpe Ratio [4] that only considers downside risk.

$$\theta = \frac{R_i - R_f}{\sqrt{\frac{1}{N}\Sigma_{i=1}^{N}\left[Min(0;R_i - R_f)\right]^2}}$$

Value at Risk (VaR) three distinct approaches were utilized [5]: the variance-covariance approach, historical simulation, and Monte Carlo simulation. The variance-covariance approach assumes a normal distribution of returns and uses the historical mean and standard deviation to calculate VaR. Historical simulation, on the other hand, relies on the actual historical returns of the portfolio to estimate VaR. Lastly, Monte Carlo simulation generates numerous random scenarios based on the historical mean and standard deviation of returns to determine the VaR [6].

III. DATA AND METHOD

To model the investment portfolio and collect secondary data of particular portfolio assets for this article, it was required to use financial IT platform Bloomberg Terminal. The research commenced with consultations involving representatives from three LDI institutions. These consultations aimed to gather insights into the institutions' investment strategies, considering their distinctive risk profiles and internal business processes limited by core business activities of liability-driven investor. The discussions identified constraints imposed by each institution's asset-liability management (ALM) frameworks and the regulatory requirements (e.g. SOLVENCY I, II or BASEL I, II and III) they must adhere to. This approach ensured that the investment portfolio modelling took into account the unique characteristics and

limitations of each LDI institution, providing a comprehensive understanding of their investment decision-making processes within their specific contexts and modelled investment portfolio accordingly.

For the South African Portfolio 1, daily data was collected covering the period from 29 August 2000, to September 21, 2021. This dataset includes the daily closing prices of each investment security of portfolio, bond coupon rates, and ask yields. In total, 1,176,840 observations were gathered for South African Portfolio, providing a comprehensive time series of security prices, coupon rates, and yield information spanning approximately 21 years.

A. *Risk-Adjusted Investment Performance Indicators*

To evaluate the risk-adjusted investment performance of the portfolios, we employed the Sharpe Ratio which measures the excess return earned per unit of volatility or total risk; Jensen's Alpha, which determines the abnormal return of a portfolio over the theoretical expected return; and the Sortino Ratio, which differentiates harmful volatility from total overall volatility by using the asset's standard deviation of negative portfolio returns. Furthermore, Value at Risk (VaR) methods were applied to assess the potential losses within the portfolios.

By employing these risk-adjustment performance indicators and VaR methods, a comprehensive analysis of the portfolios' risk-return characteristics was conducted, providing valuable insights into their behaviour under various market conditions.

B. *Composition Methodology South African Active Investment Strategy*

The aim of this strategy is to achieve a positive return relative to a specified benchmark while maintaining a moderate turnover level and managing an allocation size of South African Rand (ZAR) 170 million (EUR 8.6 million). The portfolio managers are expected to outperform this benchmark, although no specific outperformance target is provided. The investment universe is restricted to plain vanilla government bonds, Treasury bills (T-bills) issued by the South African government, and cash. The strategy stipulates a maximum cash limit of ZAR 50 million. The portfolio is not permitted to invest in semi-government bonds or non-government bonds. The strategy imposes a liquidity requirement, stating that the portfolio's liquidity should be suitable to service required operational payments. Additionally, the portfolio is not allowed to use derivatives, leverage, borrowing, securities lending, or short selling. Investment concentration limits are defined to mitigate risk and ensure diversification within the portfolio. Government bonds, including T-bills and cash, must comprise between 0% and 100% of the total mandate, allowing flexibility while ensuring a focus on secure, government-backed securities. Single issuer limits are established to prevent excessive exposure to any one issuer, particularly within the government bond sector, thereby ensuring a diversified and balanced portfolio. These constraints are essential for managing risk and ensuring that the portfolio does not become overly concentrated in any single type of security or issuer.

IV. RESULTS

A. *Real Composition of South African Active Investment Portfolio*

The allocated portfolio size is ZAR 170 million (EUR 8.6 million). The portfolio is primarily composed of rates products, specifically cash securities denominated in ZAR. These cash securities account for 100% of the portfolio's market value, indicating a strong focus on short-term, liquid investments. Within the cash securities, the portfolio is further divided into two main categories: Treasury Bills (T-Bills) and Additional securities. T-Bills make up a significant portion of the portfolio, accounting for 89.97% of the total market value. The portfolio holds a diverse range of T-Bills issued by the Republic of South Africa, with maturities ranging from September 11, 2019, to April 1, 2020.

The T-Bills within the portfolio have a weighted average life (WAL) of 0.28 years, indicating that the average time until maturity of these securities is relatively short. This short WAL is consistent with the

portfolio's focus on liquidity and its ability to meet potential redemption requests or other short-term obligations. Moreover, the T-Bills offer a nominal yield of 6.62%, which represents the expected return on these investments without considering any potential capital gains or losses.

One of the key risk measures for fixed income portfolios is duration, which quantifies the sensitivity of the portfolio's value to changes in interest rates. This portfolio has a duration of 0.24, with a duration contribution of 0.243. This low duration indicates that the portfolio's value is relatively less sensitive to interest rate fluctuations compared to portfolios with higher durations. The short-term nature of the T-Bill investments contributes to this low duration profile, as shorter-term securities are generally less impacted by interest rate movements compared to longer-term bonds.

The "Additional securities" category accounts for the remaining 10.03% of the portfolio's market value. This portion is invested in a ZAR cash position, with a nominal yield of 6.65%. The inclusion of this cash position provides additional liquidity to the portfolio. The portfolio's overall yield, as measured by the nominal yield, stands at 6.62%, indicating the expected return on the investments. The portfolio also exhibits a slightly negative option-adjusted spread (OAS) of -10 basis points, suggesting that the portfolio's yield is marginally lower than the benchmark yield curve after accounting for embedded options.

In terms of credit quality, the portfolio is invested entirely in securities issued by the Republic of South Africa, which implies a relatively low credit risk profile. The portfolio's focus on government-issued securities aligns with its conservative and liquidity-oriented investment approach.

Assigned portfolio benchmarks are South African Short-Term Fixed Interest (STeFI) Composite Index with weightings of 70% and The S&P South Africa Sovereign Bond 1-3 Year Index with weighting of 30%.

The South African Portfolio is a ZAR-denominated, short-term, and liquidity-focused investment portfolio primarily composed of South African government-issued Treasury Bills. The portfolio's structure and characteristics, including its low duration, high allocation to cash securities, and conservative credit profile, align with its objectives of preserving capital and maintaining liquidity. The portfolio's yield and unrealized gains suggest that it has performed relatively well in the prevailing market conditions as of the reporting date.

B. *Risk-Adjusted Performance Indicators results*

The risk-adjusted performance analysis of the investment portfolio provides a comprehensive assessment of the portfolio's risk-return profile, enabling a deeper understanding of its performance relative to the risks undertaken. The Sharpe Ratio, Jensen's Alpha, Sortino Ratio, and Value at Risk (VaR) estimates offer distinct perspectives on the portfolio's risk-adjusted returns and potential downside risk. The risk-adjusted performance analysis of the South African Investment Portfolio yielded significant insights into the portfolio's behaviour and characteristics. Table 1 presents a comprehensive summary of the risk-adjusted performance indicators from the analysis.

Table 1. Risk-Adjusted Performance indicator Results

Risk-Adjusted Performance Indicator	Result
Sharpe Ratio	0.96389
Jensen's Alpha	0.7631
Sortino Ratio	0.6553
VaR: Variance-Covariance Method	2.23% / ZAR 3,791,000
VaR: Historical Simulation Method	1.85% / ZAR 3,145,000
VaR: Monte Carlo Simulation	ZAR 3,571,930

The calculated Sharpe Ratio of 0.96389 measures the portfolio's excess return per unit of risk. This ratio indicates that for every unit of risk taken, the portfolio has generated nearly one unit of excess return above the risk-free rate. A Sharpe Ratio close to 1 suggests that the portfolio is effectively balancing risk and return, indicating efficient performance and good risk management practices. The

portfolio's Sharpe Ratio of 0.96389 implies that for every unit of total risk, the portfolio has generated 0.96389 units of excess return. While this is a positive result, it also suggests that there may be potential for further optimization of the portfolio's risk-return trade-off.

Jensen's Alpha of 0.7631 provides an additional layer of insight into the portfolio's risk-adjusted performance that measures the excess return earned by the portfolio over its expected return based on the Capital Asset Pricing Model (CAPM). The CAPM takes into account the portfolio's systematic risk (beta) and the market risk premium. A positive alpha indicates that the portfolio manager has added value through active management, generating returns above what would be expected given the portfolio's beta. In this case, the alpha of 0.7631 suggests that the portfolio has outperformed its expected return, i.e. assigned benchmarks which were South African Short-Term Fixed Interest (STeFI) Composite Index with weightings of 70% and The S&P South Africa Sovereign Bond 1-3 Year Index with weighting of 30%. Portfolio has outperformed those benchmarks by 0.7631% on an annualized basis. This outperformance can be attributed to the portfolio manager's skill in security selection, asset allocation, or timing decisions.

The Sortino Ratio of 0.6553 offers a more focused evaluation of the portfolio's risk-adjusted performance by considering only the downside deviation. This ratio distinguishes between harmful volatility and total overall volatility, providing a clearer picture of the portfolio's performance in a downside risk framework. The Sortino Ratio is calculated by dividing the portfolio's excess return over the risk-free rate by its downside deviation. A higher Sortino Ratio indicates a better risk-adjusted return when considering only the downside risk. The portfolio's Sortino Ratio of 0.6553 suggests that for every unit of downside risk, the portfolio has generated 0.6553 units of excess return. While this is a positive result, it is lower than the Sharpe Ratio, indicating that the portfolio's risk-adjusted performance is more favourable when considering total risk rather than solely downside risk.

The Value at Risk (VaR) estimates provide a forward-looking assessment of the portfolio's potential downside risk. VaR quantifies the maximum potential loss that the portfolio could incur over a specific time horizon, at a given confidence level. The variance-covariance method estimates a VaR of 2.23% or ZAR 3,791,000, indicating that there is a 95% probability that the portfolio's losses will not exceed this amount over the specified time horizon (e.g., one day or one month). This VaR estimate assumes a normal distribution of returns and relies on the portfolio's historical volatility and correlations.

The historical simulation method, which does not assume a specific distribution of returns, estimates a VaR of 1.85% or ZAR 3,145,000. This approach uses the portfolio's actual historical returns to estimate the potential loss, providing a more realistic assessment of downside risk. The Monte Carlo simulation, which generates numerous random scenarios based on the portfolio's historical characteristics, estimates a VaR of ZAR 3,571,930. This simulation approach provides a more comprehensive view of potential losses by considering a wide range of possible market conditions.

In summary, the risk-adjusted performance metrics indicate that the South African Investment Portfolio is well-managed, with strong returns relative to its risk. The high Sharpe Ratio and positive Jensen's Alpha highlight effective risk-return management and superior performance against market expectations. The Sortino Ratio confirms good downside risk management. The various VaR measures provide a detailed understanding of potential losses under different scenarios, reinforcing the portfolio's resilience and robust risk management framework.

V. DISCUSSION

The risk-adjusted performance analysis of the South African Investment Portfolio provides valuable insights into the effectiveness of the active investment strategy employed by the liability-driven investor (LDI). The portfolio's composition, which primarily consists of short-term government securities and cash, aligns with the LDI's objectives of capital preservation, liquidity, and risk management.

The Sharpe Ratio of 0.96389 suggests that the active management strategy has been successful in balancing risk and return, as the portfolio has earned a return commensurate with the risk taken. Jensen's Alpha of 0.7631 provides strong evidence of the portfolio manager's skill in generating excess returns through active management, outperforming the assigned benchmarks by 0.7631% on an annualized basis.

The Sortino Ratio of 0.6553 highlights the effectiveness of the active management strategy in mitigating harmful volatility and preserving capital during adverse market conditions, despite being lower than the Sharpe Ratio. The Value at Risk (VaR) estimates offer a forward-looking perspective on the portfolio's potential downside risk, serving as valuable tools for risk management and decision-making.

It is important to interpret the risk-adjusted performance metrics and VaR estimates within the context of the LDI's specific requirements and constraints, as the LDI's focus on capital preservation, liquidity, and risk management may necessitate a more conservative investment approach compared to other types of investors.

The results of this analysis should be considered alongside other qualitative factors, such as the LDI's investment philosophy, the portfolio manager's experience and expertise, and the overall market conditions. Regular monitoring and assessment of the portfolio's risk-adjusted performance and risk exposures are essential to ensure that the active management strategy remains aligned with the LDI's objectives and adapts to changing market dynamics.

VI. CONCLUSION

The risk-adjusted performance analysis of the South African Investment Portfolio demonstrates the effectiveness of the active investment strategy in meeting the specific requirements of the liability-driven investor. The portfolio's composition, risk-adjusted performance metrics, and VaR estimates suggest that the portfolio is well-managed, with a strong focus on capital preservation, liquidity, and risk management.

The Sharpe Ratio, Jensen's Alpha, and Sortino Ratio collectively indicate that the portfolio has generated competitive risk-adjusted returns, outperforming its assigned benchmarks while effectively managing both total and downside risk. The positive Jensen's Alpha highlights the portfolio manager's skill in generating excess returns through active management decisions.

The VaR estimates provide a comprehensive assessment of the portfolio's potential downside risk, equipping the LDI with valuable insights for risk management and decision-making. The range of VaR estimates obtained through different methodologies offers a robust understanding of the portfolio's risk exposure under various market conditions.

However, it is crucial to consider the portfolio's performance within the specific context of the LDI's objectives and constraints. The conservative nature of the investment strategy, dictated by the LDI's focus on capital preservation and liquidity, may result in lower absolute returns compared to more aggressive approaches. Nonetheless, the portfolio's risk-adjusted performance demonstrates its alignment with the LDI's investment mandate and risk profile.

Moving forward, regular monitoring and assessment of the portfolio's risk-adjusted performance and risk exposures are essential to ensure its continued effectiveness. The LDI should engage in ongoing dialogue with the portfolio manager to discuss potential enhancements to the investment strategy, considering evolving market conditions and the LDI's specific needs.

In conclusion, the South African Investment Portfolio's active investment strategy has proven successful in meeting the LDI's objectives of capital preservation, liquidity, and risk management. The risk-adjusted performance analysis provides evidence of the portfolio's ability to generate competitive returns while effectively managing risk. By maintaining a close alignment between the investment strategy and the LDI's specific requirements, the portfolio is well-positioned to continue supporting the LDI in achieving its long-term financial goals.

REFERENCES

[1] R. Sivák et. Al., *Riziko vo financiách a bankovníctve.* 5th ed., Bratislava, Slovakia: Sprint 2 s.r.o., 2018.
[2] W. F. Sharpe, W. F. (1966). Mutual fund performance. The Journal of Business, 39(1), 119-138.

[3]   M. C. Jensen (1968). The performance of mutual funds in the period 1945-1964. The Journal of Finance, 23(2), 389-416.

[4]   F. A. Sortino, F. A., & L. N. Price, (1994). Performance measurement in a downside risk framework. The Journal of Investing, 3(3), 59-64R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital-to-RF converter," U.S. Patent 5 668 842, Sept. 16, 1997.

[5]   P. Jorion, (2007). Value at Risk: The New Benchmark for Managing Financial Risk (3rd ed.). McGraw-Hill

[6]   T. J. Linsmeier & N. D. Pearson, (2000). Value at risk. Financial Analysts Journal, 56(2), 47-67.