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# Frontier Markets under External Factors Consideration: Over-Diversification, Risk, and Portfolio Choices (2015–2024)

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**Abstract:** Aiming to optimize the portfolio benefits, frontier markets are widely used for portfolio diversification strategies, but their high risk profiles and sensitivity to external shocks also brought uncertainty to the investment choices. This article examined the impact of integration in diversity on performance in frontier markets, the influence of exogenous shocks on portfolio outcomes, and the risk-adjusted priorities investors should adopt. In terms of methodologies, it is possible to use Minitab-based theoretical optimization portfolios with ex-post back-tests across two sub-periods (2015–2019; 2020–2024), using MRPUR, volatility, correlation, skewness, and drawdown diagnostics on portfolios spanning Morocco (MOR), Namibia (NAM), Kenya (KEN), and Central Africa (CEN) under the COVID-19 shock. The results illustrated that adding KEN did not reduce risk and diluted realized returns materially, while a selective MOR+NAM allocation delivered premium performance; investors should avoid over-diversification, and it is better to adopt dynamic allocation across observation countries.

**Keywords:** Frontier markets; Diversification; External shocks; Portfolio optimization; Investment risk.

## 1. Introduction

In spite of the fact that the premise of diversification was an issue of extensive dispute, the high-risk profile and shock-sensitive correlations of frontier markets were major conditions in the establishment of diversified strategies. In the context of "over-diversification," which is a condition that marginal benefits would diminish due to high correlation and non-trivial trading frictions rapidly, and where theoretical diversification benefits do not translate into realized risk relief automatically, the purpose of this paper is to evaluate the debates in terms of Over-Diversification, Risk, and Portfolio Choices.

The study analyzes the degree to which portfolio performance could be enhanced by diversification in frontier markets consistently, investigates the manner in which external disruptions alter outcomes across regimes, and formulates risk management strategies for environments that are distinguished by significant transaction costs and elevated volatility. The empirical setting integrates COVID-19 as a salient external shock and treats 2020–2024 as a distinct regime relative to 2015–2019, reflecting the pandemic's macro-financial impact on frontier markets.

The paper has contributions in three dimensions. First, it tested the concept by comparing Minitab-based optimal portfolios with ex-post back-tests from the two sub-periods. It accomplished this using a single set of diagnostics that included volatility, correlation, skewness, and drawdown. It also includes the pandemic as an outside factor and shows that performance depended on the regime, with bigger drawdowns and less stable returns during the shock period. Eventually, it reflected the limitations of indiscriminate diversification—exemplified by the limited risk reduction and diluted realized returns when adding Kenya (KEN)—and provided the evidence for investor advice that prioritizes selective diversification and dynamic allocation over breadth.

## 2. Literature Review

Classical portfolio theory provides the logic of diversification under mean-variance trade-offs, but in the real world, constraints such as time-varying correlations, market frictions, and co-movement by shocks restrict the theoretical profits (Markowitz, 1952; Fama and French, 1992) [1-2]. Recent studies have shown that, as financial integration has intensified, the diversification advantages of frontier markets have diminished, especially during periods of international stress (Abidi et al., 2019; Evans and van Vuuren, 2019; Thomas et al., 2017) [3-5].

### 2.1. Frontier Market Risks

The risk profile of frontier markets is based on structural and institutional factors. The risk profile of most frontier markets is largely based on poor political governance. Policy instability and ineffective implementation of policies reduce long-term attractiveness to investors and reduce risk premia. The inefficiencies of the regulatory and market environment—weaker enforcement, less developed market mechanisms, and weaker protection of investors—lead to lower stability in frontier markets compared to developed markets, increasing the risk of large jumps and fat-tailed behaviour (Ferreira et al., 2021; Fifield et al., 1996; Mandelbrot, 1963; Kaboneka et al., 2014; African Development Bank, 2023) [6-10].

Also, the hidden prices of foreign markets are hard for outside investors to see, and the danger of adverse selection is increased (Guney et al., 2017) [11]. Increased trading costs, such as large bid-ask spreads, higher custody and settlement costs, and significant price changes, are an important factor to consider. These costs may offset the theoretical advantages of unrestricted optimisers, especially for rebalancing strategies (Fifield et al., 1996; Marshall et al., 2013; Naumoski et al., 2017; Pandey, 2012) [7, 12-14]. Secondly, the integration of the markets also increases risk. The ability to exchange

currencies, capital controls, and temporary suspensions of trading increase the risk of illiquidity and can turn a small change in the correlation into a big loss (Narayan and Rehman, 2018) [15]. Cross-border integration creates a second layer of risk. Since the integration with developed markets has reduced the diversification advantage, the share price is increasingly affected by global risk factors such as the US dollar cycle, the world rate and the risk appetite (Pätäri et al., 2018; Evans and Van Vuuren, 2018; World Bank, 2020) [16-18].

## 2.2. External Shocks

Exogenous shocks are transmitted to the frontier economies through trade, capital flows, remittances, and the mobility of people, and also through domestic fiscal space and capacity. Various sources suggest that in the frontier economies, a significant contraction took place in 2020 (IMF, 2020; World Bank, 2021) [19-20], and that Sub-Saharan Africa, in particular, experienced the first decline in its GDP in 25 years (in 2020, a decrease between 2.1 and 5.1 percent was often reported) (African Development Bank, 2023; World Bank, 2021) [10, 20]. During the pandemic, the financial markets were largely affected, especially in the years 2020–2021. For the majority of African countries, the increase in external debt and the deterioration in the external situation exacerbated the burden of debt service and increased the risk of default in the short term (see IMF, March 20, 2020; NB, March 20, 2020).

"Macro shocks have a direct impact on asset prices. In turbulent periods correlations between risk assets rise, common factors dominate returns, liquidity evaporates, and withdrawal costs rise at precisely the time when investors are most eager to rebalance their portfolios (Ferreira et al., 2021; Thomas et al., 2022) [6, 21]. And indeed, when dividing samples between periods of calm and periods of turbulence, studies have found higher realised volatility, deeper left tails, and worse risk-adjusted profiles in the years of the pandemic (Dania and Maysami, 2017; Evans and van Vuuren, 2019) [22, 4]. As a matter of methodology, dynamic covariance cyclicality and regime-switching models are more likely to reflect the nonlinear deconstruction of diversification in periods of turbulence than the matrices in the pre-pandemic period (Hoang, 2021; Phanrattinon et al., 2020) [23-24].

## 2.3. Investment: Diversification, Implementation, And Over-Diversification

During times of peace, exposure to countries with relatively stronger institutions and more robust microstructures does offer some improvement in risk-adjusted returns as measured not only by conventional ratios but also by simple indicators such as the mean return per unit of risk (MRPUR).1 However, in recent times the closer co-movement with the international factors and the persisting impact of frictions have eroded these benefits (Abidi et al., 2016; Thomas et al., 2018) [25-26].

Then comes the argument about over-diversification. Recent research on country combinations has indicated that a shift from a selective two- or three-country basket to a broader regional basket does not necessarily reduce the variance after costs and can even lower the average return by increasing turnover and exit costs during crises (Sukumaran et al., 2015; Naumoski et al., 2017) [27, 13]. By introducing a marginal asset, the fund manager can reach an equilibrium point where the diversification benefit is zero. When the marginal asset has a high degree of correlation with the existing portfolio, high transaction costs and liquidity costs, and higher tail risk, the marginal benefits of diversification rapidly diminish and can even become negative after costs (Evans and van Vuuren, forthcoming; Patari et al., forthcoming; Marshall et al., forthcoming). Further diversification does not seem to increase risk as correlations rise and trading costs rise (Pandey, 2012; Guney et al., 2017) [14, 11].

One approach is to prefer constrained optimization, which include turnover, spread, and transaction costs, over unconstrained ones, which do not. This is because it takes into account the operational constraints of real portfolios. This is why the literature has shifted from 'diversification at all costs' to 'selective diversification' and 'dynamic allocation'. With this in mind and consistent with the findings of this dissertation, it is better to adopt dynamic allocations across countries, keep the portfolio narrow and of high quality in high-cost settings, and only to diversify into new markets when they provide truly orthogonal outcomes after costs (Abidi et al., 2019; World Bank, 2021) [3, 20]. Second, tools based on time-varying correlations help to avoid a dependence on static correlations, which can break down in shocks (Hoang, 2022; Phanrattinon, 2021) [23-24]. Third, using clustering by common exposures, such as currency, commodity, or governance and quality, to build a portfolio and then diversifying across clusters can help to reduce the redundancy of breadth.

# 3. Quantitative Analytic and Back-Testing

## 3.1. Generally Description

For each of the African frontier markets, daily closing price indices for the period 2015–2024 were used. The trading calendars for each market were matched to each other, non-overlapping non-trading days were removed, and daily returns were calculated as the percentage change in the natural logarithm of the difference between the closing prices of the previous day and the closing price of the current day. Then the daily returns were summed to obtain cumulative returns normalized by the January 1, 2015, return. Figure 1 is the summary figure; Figures 2–4 are the micro-components, it illustrated the performance of four portfolios over the two periods. Portfolio 1 invested in MOR, NAM, and KEN during Period 1; Portfolio 2 invested in MOR, NAM, and KEN during Period 1; and Portfolio 3 invested in MOR and NAM during Period 1 and switched to CEN in Period 2. Portfolio 4 is the overall return compared with US market.

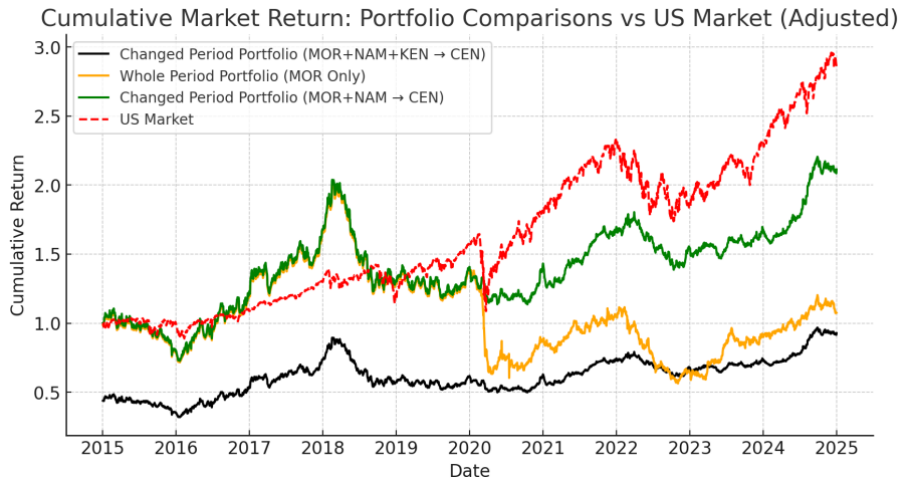



**Figure 1.** Portfolios performance in whole period summary

Source: Author's work.

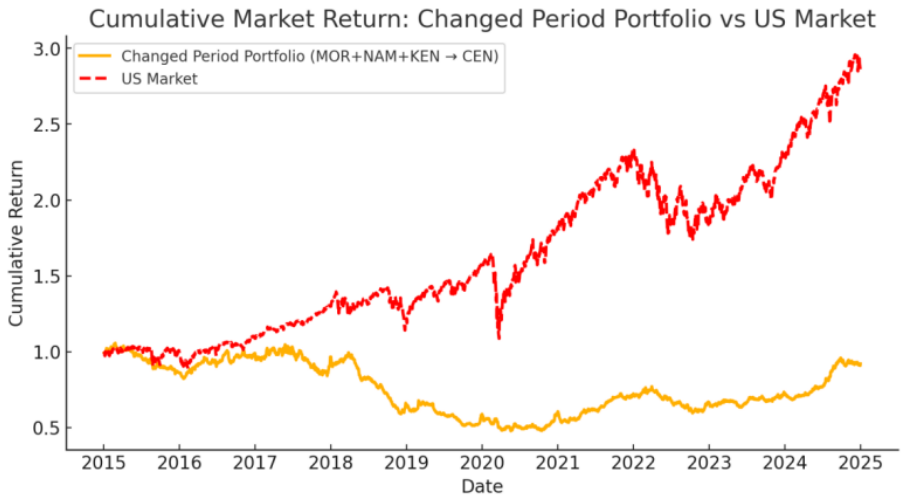



**Figure 2.** Changed portfolio 1 performance vs US market

Source: Author's work.

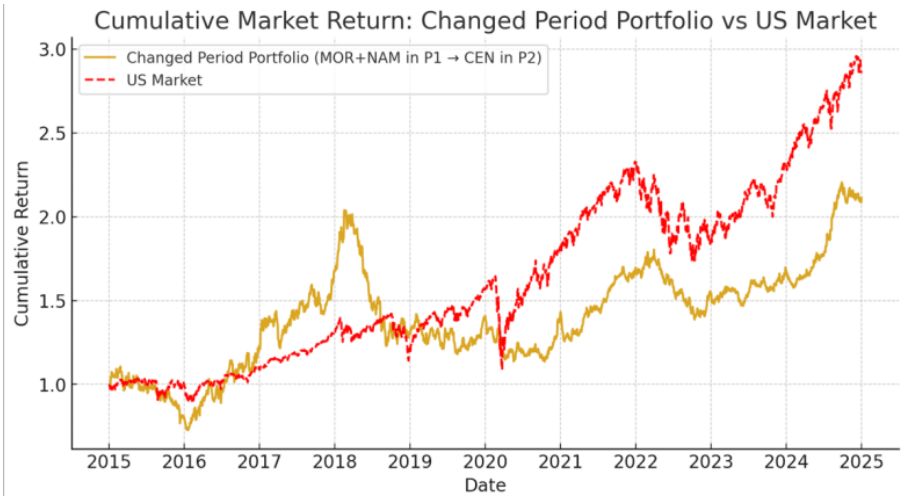



**Figure 3.** Changed portfolio 2 performance vs US market

Source: Author's work.

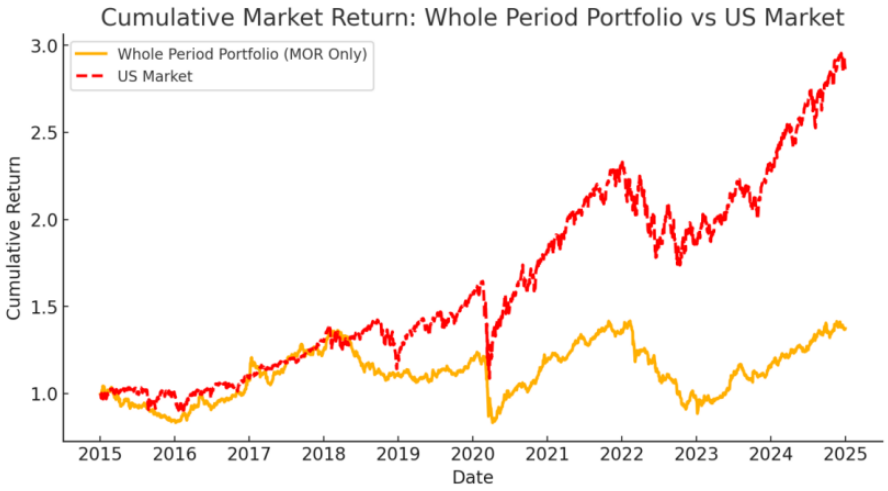



**Figure 4.** Non-changed portfolio 3 performance vs US market

Source: Author's work.

All portfolios are constructed under the long-only constraint, which means that the weights must add up to one, and no leverage or shorting is allowed. For the changed-period strategies, we take the allocations for Period 1 from the optimiser in Figure 2, and at the beginning of the year 2020, the portfolios are fully converted into CEN.

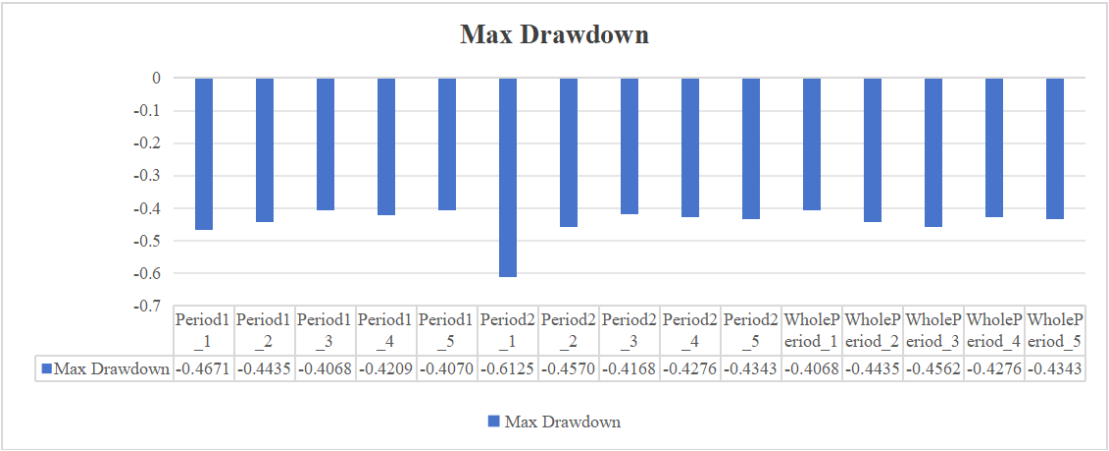
Role of Figures 2–4: The rankings for the Period 1 optimizer and the MRPUR criterion for the market baskets are shown in Figure 2. Figure 3 compares the realized performance of the baskets chosen in Figure 2 with the averages of the four other baskets. Period II, a portfolio change, and the period switch are tested in Figure 4. Figure 1 aggregates the results of figures 2–4 to show the results for the entire sample in one figure.

Interpretive frame: This explains why any additional market which increases volatility more than it increases the mean will reduce this ratio and weaken the compounding of the results. The average return per unit of risk (MRPUR) is the ratio of the average return to the volatility. The main source of the gap between theoretically optimum performance and the realized performance is the market friction and the varying correlation of prices.

In general, the Minitab theoretical optimization in Figure 1 identified MOR + NAM + KEN (Portfolio 1) as the optimal portfolio for Period 1 (2015–2019), which achieved the highest MRPUR of 0.02652. However, the statistical back-test results in Figure 5 reveals that MOR + NAM (Portfolio 2) yielded the best realized return, so the question should be provided by the bias between the back-test and theoretical findings in terms of Kenya (KEN).

### 3.1.1. Risk-Adjusted Return Efficiency (Figure 5 and Figure 6 in Period 1)

Figure 5 tracks the cumulative return performance in Period 1; it shows that MOR + NAM outperformed MOR + NAM + KEN by 2019, achieving a cumulative return of 24.5 per cent compared to 21.3 per cent for MOR + NAM + KEN. This finding indicates that, although KEN contributed marginally to the theoretical optimal portfolio, it failed to enhance realized return efficiency and instead introduced higher performance volatility.



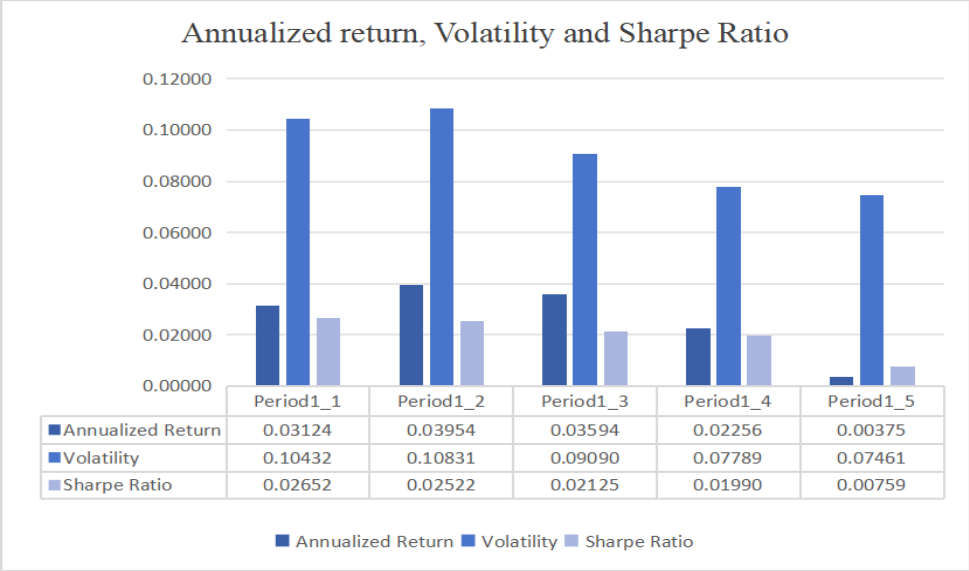

| | Period1_1 | Period1_2 | Period1_3 | Period1_4 | Period1_5 | Period2_1 | Period2_2 | Period2_3 | Period2_4 | Period2_5 | WholePeriod_1 | WholePeriod_2 | WholePeriod_3 | WholePeriod_4 | WholePeriod_5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max Drawdown | -0.4671 | -0.4435 | -0.4068 | -0.4209 | -0.4070 | -0.6125 | -0.4570 | -0.4168 | -0.4276 | -0.4343 | -0.4068 | -0.4435 | -0.4562 | -0.4276 | -0.4343 |

**Figure 5.** Max drawdown

Source: Author's work.

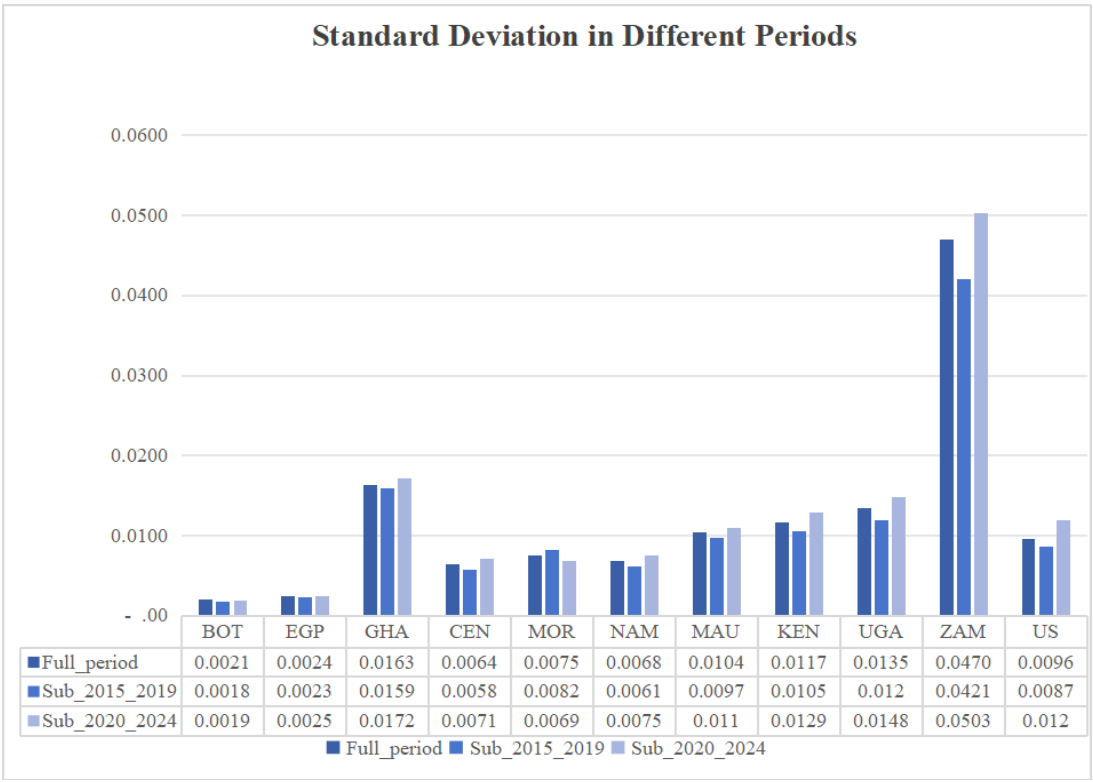
### 3.1.2. Volatility impact (Figure 6 and Figure 7 in Period 1)

The assumption that diversified risk (adding Kenya (KEN)) to reduce volatility was not supported by empirical evidence. Figure 6 presents the Period 1 performance data, reflecting that the volatility of MOR + NAM + KEN (0.10432) was slightly lower than MOR + NAM (0.10831). This result contradicts the expectations that diversification should have led to a substantial volatility reduction. Additionally, standard deviation data in Figure 7 confirms that Kenya (0.01041) had higher volatility than Morocco (0.00754) and Namibia (0.00682). This evidence suggests that Kenya's inclusion did not significantly reduce overall portfolio risk in Period 1 and brought unnecessary exposure to volatility.




| | Period1_1 | Period1_2 | Period1_3 | Period1_4 | Period1_5 |
|---|---|---|---|---|---|
| Annualized Return | 0.03124 | 0.03954 | 0.03594 | 0.02256 | 0.00375 |
| Volatility | 0.10432 | 0.10831 | 0.09090 | 0.07789 | 0.07461 |
| Sharpe Ratio | 0.02652 | 0.02522 | 0.02125 | 0.01990 | 0.00759 |

**Figure 6.** Annualized return, volatility and sharp ratio
Source: Author's work.




| | BOT | EGP | GHA | CEN | MOR | NAM | MAU | KEN | UGA | ZAM | US |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Full_period | 0.0021 | 0.0024 | 0.0163 | 0.0064 | 0.0075 | 0.0068 | 0.0104 | 0.0117 | 0.0135 | 0.0470 | 0.0096 |
| Sub_2015_2019 | 0.0018 | 0.0023 | 0.0159 | 0.0058 | 0.0082 | 0.0061 | 0.0097 | 0.0105 | 0.012 | 0.0421 | 0.0087 |
| Sub_2020_2024 | 0.0019 | 0.0025 | 0.0172 | 0.0071 | 0.0069 | 0.0075 | 0.011 | 0.0129 | 0.0148 | 0.0503 | 0.012 |

**Figure 7.** Standard deviation in different period
Source: Author's work.

## 3.2. Reason for Choosing MOR+NAM in Period 1 As the Optimal Portfolio

### 3.2.1. MOR + NAM can achieve higher annualized returns in period 1 (Figure 6)

According to Figure 6, the annualized return for MOR + NAM was 3.954 per cent, while MOR + NAM + KEN achieved only 3.124 per cent. This finding indicates that the theoretical assumption that KEN would enhance returns was not validated in actual market conditions. In contrast, MOR + NAM outperformed in terms of realized annualized returns, suggesting that this portfolio was more effective in obtaining long-term benefits over the investment period.

### 3.2.2. MOR + NAM Provided More Stable Volatility and Correlation Characteristics (Figures 7 & 8)

According to Figure 7, Kenya (0.01041) exhibited a higher volatility compared to Morocco (0.00754) and Namibia (0.00682). It means the inclusion of KEN increased risk. Furthermore, Figure 8 shows that the correlation between Morocco and Namibia (0.148) was stronger than Kenya's correlation with either Morocco (0.075) or Namibia (-0.0001). By the reason of KEN's weak or negative correlation, it failed to enhance diversification benefits in the portfolio efficiently, so its inclusion in the portfolio did not improve overall risk reduction, which made the MOR + NAM the more stable and effective choice in a portfolio.

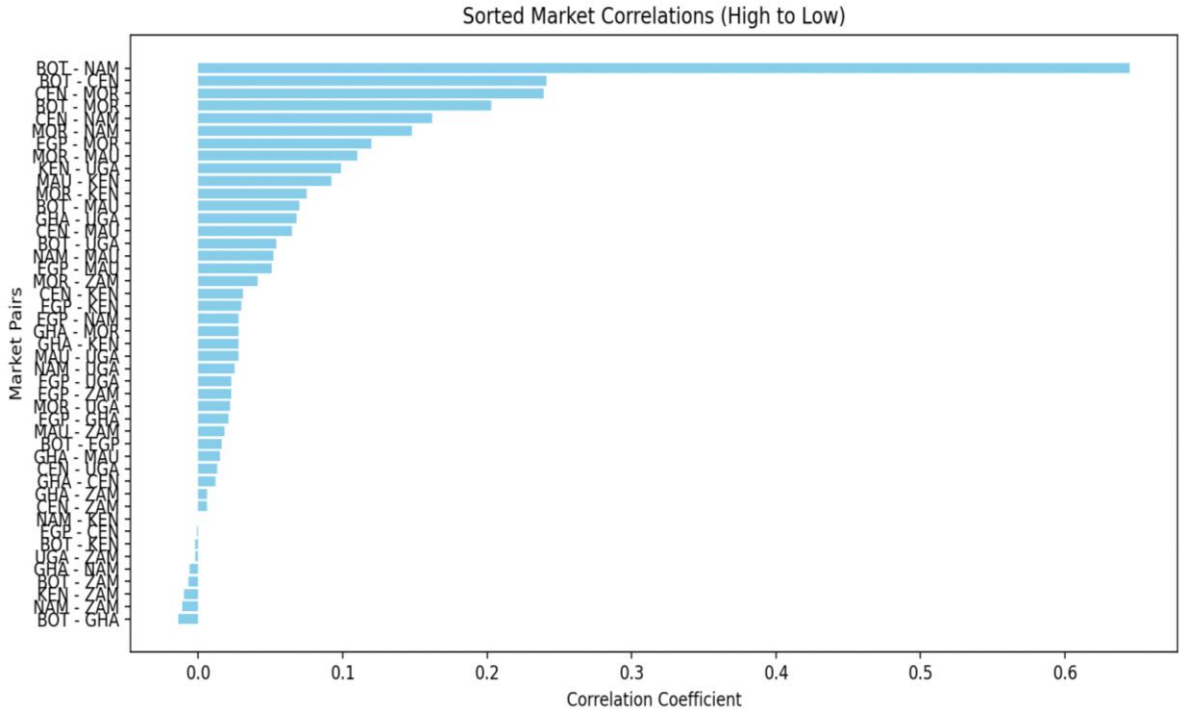



**Figure 8.** Sorted market correlations

Source: Author's work.

# 4. Comparative Analysis of Three Portfolio Performance

## 4.1. Clarifying the Baseline

In Figures 1-4, the baseline value of "1" indicates the break-even point. It represents neither profit nor loss. For instance, while Figure 2 illustrates the performance trajectory of a portfolio transitioning from MOR + NAM + KEN in period 1 to CEN only in period 2, the actual total portfolio cumulative return was specified shown in Figure 9 as -0.0726, it reflected a loss in total.

## 4.2. Impact of Kenya (KEN) on Portfolio'S Volatility and Performance

The inclusion of Kenya (KEN) into the portfolio influenced the portfolio's volatility and overall performance. According to Figures 1 and 2, portfolios that included KEN exhibited more fluctuations in volatility and draw-downs. Specifically, Figure 5 indicates that portfolios such as the Period1_1 which included KEN, experienced maximum draw-downs of -0.4671. In contrast, the MOR-only portfolio (WholePeriod_1) had a lower draw-down of -0.4068. This suggests that the inclusion of KEN increased the exposure to market fluctuations, potentially because of Kenya's economic vulnerabilities during the period under review. Notably, the frontier economies faced increased risk of debt defaults in the medium term, which could have contributed to the observed volatility in portfolios which included KEN (African Development Bank, 2023).

## 4.3. External Variable for Economic Shocks: The COVID-19 Pandemic'S Influence

The COVID-19 pandemic impacted the global financial markets during the period 2020-2022 (period 2). Because of the nature of vulnerability in the traditional economic system, most frontier markets experienced significant economic contractions. For instance, in Sub-Saharan Africa, the pandemic led to the region's first recession in 25 years; in 2020, economies shrank by 2.1 – 5.1 per cent (World Bank, 2021). This economic downturn adversely affected portfolios with substantial exposure to these markets. Figure 5 reveals that the portfolio Period2_1, which transitioned to CEN only during the pandemic, suffered the most severe draw-down of -0.6125. This significant loss indicated the heightened vulnerability of certain sample frontier markets to global economic shocks; it illustrates the importance of the inclusion of external factors when assessing portfolio risk and performance.

## 4.4. Achieve a Balance Between Stability and Growth: Evaluating Whole-Period and Changing-Period Portfolios According to Figure 5 And Figure 6

Through Figures 5 and 6, it is obvious that the analysis between whole-period and changing-period portfolios reveals a trade-off between stability and growth potential. Primarily, all portfolios' cumulative returns were less than the S&P 500 index (1.857); it reveals the challenges of achieving returns comparable to developed market indices of diversified portfolios in frontier sample markets. Then, the MOR-only portfolio (WholePeriod_1) demonstrated a greater stability, which had a maximum draw-down of -0.4069 (Figure 5). However, its cumulative return was located at the medium at 0.3762 (Figure 9). Conversely, the portfolio that transitioned from MOR + NAM to CEN (Period 1_2 to Period 2_1) achieved a higher cumulative return of 1.113 (Figure 9) but experienced a larger draw-down of -0.6125 (Figure 5). This could be strong evidence that a diversification strategy and strategic transitions in portfolios could enhance returns, but they also increase the exposure to market volatility; it is necessary to achieve a balance between risk and reward. Furthermore, the portfolio like MOR+NAM+KEN to CEN (Period1_3 to Period2_1) obtained a negative cumulative return of -0.07259906. It illustrates the potential pitfalls of

over-diversification. And it is safe to obtain a conclusion based on this comparative analysis that over-diversification could diminish returns while the risk reduction is not significant, as the benefits of diversification plateau beyond the equilibrium point.

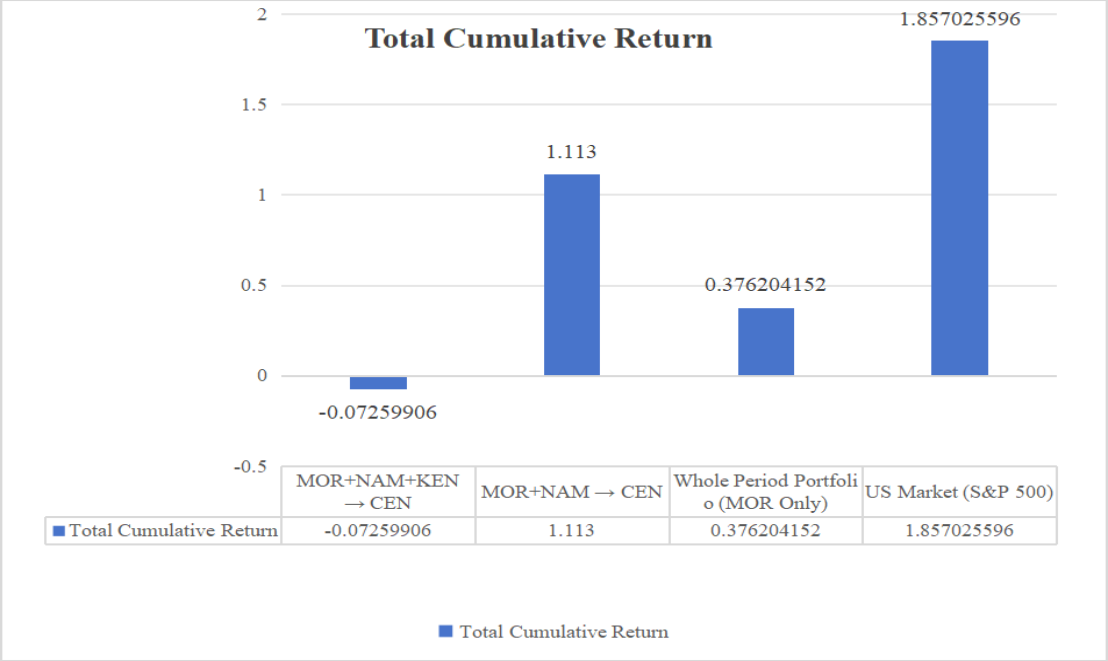



**Figure 9.** The total cumulative return

Source: Author's work.

## 5. Conclusion and Limitations

This study evaluated the diversification benefits of investing in targeted African frontier stock markets. While the comparatively limited integration of these markets with industrialised economies could enhance portfolio diversification, the analysis also highlighted associated challenges such as political instability, regulatory inefficiency and a lack of liquidity. The study utilises mean return per unit of risk (MRPUR), pairwise correlations and portfolio-optimisation backtests to provide an empirical assessment of frontier markets' involvement in global portfolios.

The resulting segmentation in African markets—manifested in persistently low return correlations with global indices—can dampen portfolio volatility and improve risk-adjusted performance during periods of macroeconomic stress. Empirically, Morocco and Namibia (2015–2019) and Senegal (CEN, 2020–2024) combined moderate risk profiles with consistent returns, rendering them attractive for long-horizon investors.

The study also measures the evolving character of frontier markets over the past 10 years as a period. The tendency of raising globalisation and capital flows has altered correlation structures and provided time-varying opportunities for diversification. Especially, Senegal emerged as a strong performer in 2020–2024, whereas Namibia's performance weakened amid elevated uncertainty linked to global disruptions such as the COVID-19 pandemic. These dynamics suggest that static allocation rules are unlikely to remain optimal during changing market conditions.

Even though the diversified allocational portfolios have theoretical benefits, frontier-market investing is not free of material constraints. Elevated transaction costs, limited transparency, regulatory inconsistencies, and episodes of political instability—particularly acute in parts of Africa—can impair execution and raise required returns. Recognising both diversification potential and operational risks is therefore essential when integrating frontier exposures into globally diversified portfolios.

Primarily, the Minitab program fixed portfolio weights assume an equal or predefined allocation, which does not align with real-world investment portfolios. Real investors adjust portfolio weights typically based on market conditions and risk tolerance and expected returns. The portfolios that relied on default weights might lead to a sub-optimal portfolio performance and have bias in real diversified portfolios. Additionally, the study is ex-post in nature, it analyzed past market data without considering ex-ante forecasting. Without predictive models, the findings would have limitations on guiding future investment decisions. Market conditions evolve, and historical performance also has limitations on reflecting future trends. These limitations reduced the study's practical relevance for forward-looking portfolio optimization. Moreover, market liquidity and data gaps in samples bring challenges in frontier market samples. Low trading volumes and inconsistent data availability in samples could have bias on return calculations and statistical reliability. Additionally, the exclusion of certain markets due to missing data could result in bias, it has limitation on the broader applicability of the findings.

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