

Does Risk Management Improve Portfolio Outcomes in Nigeria? A Historical Comparison of Equity, Deposit and Volatility-Managed Allocations.

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Abstract: This paper compares four simple ways for a Nigerian investor to divide savings between equities and bank deposits: all equities, all deposits, a fixed 50/50 mix rebalanced monthly, and a volatility-managed rule that holds less equity after volatile periods. Using monthly data on the Nigerian Exchange All-Share Index and the twelve-month deposit rate from the Central Bank of Nigeria Statistical Bulletin, the strategies are evaluated over February 2007 to December 2025 (227 months), with portfolio weights based only on past information. The volatility-managed rule, which targets 15 per cent annual volatility using the previous twelve months of returns, produced the highest compound growth (10.8 per cent a year, against 7.9 per cent for equities alone and 9.3 per cent for the 50/50 mix) and the best risk-adjusted return. Diversification of any kind cut the maximum drawdown from 70 per cent to around 40 per cent; the all-equity investor took until August 2023 to recover the peak of February 2008. A block bootstrap shows, however, that the growth advantage of the volatility rule over the 50/50 mix is not statistically reliable (95% interval -3.7 to $+5.9$ percentage points a year), and its performance is sensitive to the look-back window. Most strikingly, every strategy lost purchasing power. After adjusting for inflation, annual returns ranged from -3.2 per cent for the volatility-managed rule to -5.7 per cent for equities, and in US dollar terms all four lost money. Risk management changed how much Nigerian investors lost; it did not protect them from losing.

Keywords: asset allocation; volatility targeting; diversification; drawdown; real returns; Nigeria

JEL classification: G11; G12; G17

1. INTRODUCTION

Nigerian savers face a stark choice. The stock market offers the possibility of high returns but has also delivered very deep losses: the All-Share Index fell by about 70 per cent between early 2008 and early 2009 and did not regain its 2008 peak in nominal terms until 2023. Bank deposits offer a steady nominal return, but inflation averaged more than 14 per cent a year over 2007–2025 and has often exceeded deposit rates by a wide margin. Between the two lie countless mixed strategies, from a fixed balance between shares and deposits to rules that adjust exposure as market conditions change.

Portfolio theory provides the starting point. Markowitz (1952) showed that combining assets whose returns are not perfectly correlated reduces risk for a given expected return. Later work asked whether investors can do better than a fixed mix by adjusting their exposure over time. Moreira and Muir (2017) found that scaling equity exposure inversely to recent volatility raised risk-adjusted returns for a wide range of US factor portfolios, because high volatility is not reliably followed by high returns. That result has been challenged. Cederburg et al. (2020) show that the gains are much weaker in genuinely out-of-sample implementations, and DeMiguel et al. (2009) find that more sophisticated allocation rules rarely beat a naive equal-weight portfolio once estimation error is taken into account.

Evidence from Nigeria is limited. Studies of the Nigerian market have documented volatility clustering and leverage effects (Emenike, 2010; Atoi, 2014) and have asked whether stocks hedge inflation (Omotor, 2010), but there is little work on how simple allocation rules would actually have performed for a Nigerian investor, and none that considers what happened to the real or dollar value of those portfolios. This paper fills that gap. It makes three contributions. First, it compares four transparent allocation rules over almost nineteen years, using weights that depend only on information available at the time. Second, it measures performance in several ways: compound growth, volatility, drawdown, downside risk, risk-adjusted return and, most importantly, inflation-adjusted and US dollar returns. Third, it tests whether

the differences between strategies are statistically reliable using a block bootstrap and checks how sensitive the volatility rule is to its design.

The main findings are that the volatility-managed rule produced the best nominal and risk-adjusted performance, that its advantage over a fixed 50/50 mix is not statistically reliable, and that every strategy lost real value over the period. Section 2 reviews the literature, Section 3 describes the data and Section 4 the strategies and methods. Section 5 presents the results, Section 6 discusses them and Section 7 concludes.

2. LITERATURE REVIEW

2.1 Diversification and naive allocation

Markowitz (1952) formalised the trade-off between expected return and variance and showed that the risk of a portfolio depends on the covariance between its components. In practice, the inputs to mean–variance optimisation are estimated with considerable error. DeMiguel et al. (2009) compared fourteen optimised strategies with a simple $1/N$ rule across seven datasets and found that none consistently outperformed the naive rule out of sample. Their work makes a fixed 50/50 mix a natural and demanding benchmark.

2.2 Volatility management

Volatility management adjusts exposure to a risky asset inversely to its recent volatility. Moreira and Muir (2017) show that this strategy produces large alphas for the US market and for many factor portfolios, because changes in volatility are not matched by proportional changes in expected returns. Barroso and Santa-Clara (2015) find a similar effect for momentum strategies, where scaling by recent volatility nearly doubles the Sharpe ratio and reduces crash risk. Cederburg et al. (2020) argue that the published results rely on in-sample scaling constants; when the strategies are implemented in real time, most of the gains disappear. Barroso and Detzel (2021) show that the benefits of volatility management for the US market survive realistic trading costs, but that those for most factor portfolios do not. The evidence is therefore mixed, and it comes almost entirely from developed markets.

2.3 Measuring performance

The Sharpe (1966) ratio measures excess return per unit of total volatility. Sortino and van der Meer (1991) argue that investors care mainly about downside outcomes and propose measuring risk by the deviation of returns below a target. Maximum drawdown, the largest fall from a previous peak, captures the experience of an investor who held the portfolio through a crisis. For investors in high-inflation economies, nominal measures can be misleading. Fama and Schwert (1977) showed that US common stocks were negatively related to expected inflation, while Treasury bills offered a hedge against it. Whether Nigerian stocks protect investors against inflation is contested; Omotor (2010) finds that Nigerian stock returns may act as an effective hedge, at least over 1985–2008.

2.4 Emerging and Nigerian markets

Emerging equity markets tend to have higher volatility, fatter tails and stronger dependence on global and local shocks than developed markets (Harvey, 1995; Bekaert & Harvey, 2002). In Nigeria, Emenike (2010) and Atoi (2014) find volatility clustering, fat tails and leverage effects in the All-Share Index: negative shocks raise future volatility more than positive shocks of the same size. These are exactly the features that could make volatility management attractive, since a rule that reduces exposure after turbulent periods would have reduced exposure after the large negative shocks that drive volatility up.

2.5 Hypotheses

H1: A 50/50 mix of equities and deposits produces lower volatility and a smaller maximum drawdown than equities alone.

H2: A volatility-managed allocation produces higher risk-adjusted returns than a fixed 50/50 mix.

H3: Nigerian equity and deposit portfolios preserved purchasing power over 2007–2025.

3. DATA

3.1 Sources

Equity prices are monthly values of the All-Share Index of the Nigerian Exchange (formerly the Nigerian Stock Exchange), from Table A.19.1 of the Central Bank of Nigeria (CBN) Statistical Bulletin 2024, Financial Sector (Central Bank of Nigeria, 2025), extended to December 2025 with Table A.12 of the CBN's fourth-quarter 2025 bulletin (Central Bank of Nigeria, 2026c). The two sources agree exactly for every overlapping month. The twelve-month deposit rate comes from the CBN money-market indicators (Central Bank of Nigeria, 2026b). Inflation is year-on-year headline

inflation from the CBN inflation series (Central Bank of Nigeria, 2026a), and the naira–US dollar rate is the official monthly average from the same bulletins.

3.2 Return construction

The equity return is the monthly percentage change in the All-Share Index. The index is a price index, so dividends are excluded, and the equity returns reported here understate the total return available to investors by roughly the dividend yield. The deposit return is last month's quoted annual twelve-month deposit rate divided by twelve. This is a stylised cash return: an actual twelve-month deposit locks funds for a year and its rate is fixed at the start, so the monthly accrual approximates a ladder of rolling deposits. Inflation-adjusted returns deflate each month's portfolio return by the monthly equivalent of year-on-year inflation, $(1 + \pi_t)^{1/12} - 1$, which approximates the monthly change in the consumer price index. US dollar returns are computed by adjusting each month's naira return for the change in the official exchange rate.

One data point deserves mention. The bulletin reports the same index value (26,842.07) for December 2019 and January 2020, implying a zero return in January 2020. This may be a recording issue, but it affects a single month and is retained as published.

3.3 Sample

The first twelve months of returns (February 2006 to January 2007) are used only to estimate the initial volatility for the volatility-managed rule. The evaluation sample therefore runs from February 2007 to December 2025, 227 months, and all four strategies are evaluated over exactly the same months. Over this period the All-Share Index rose from 36,785 in January 2007 to 155,613 in December 2025, the twelve-month deposit rate averaged 8.58 per cent, inflation averaged 14.5 per cent a year and the naira depreciated against the dollar at an average rate of 13.7 per cent a year.

4. METHODOLOGY

4.1 Strategies

Four strategies are defined in advance.

Equity only: 100 per cent in the All-Share Index.

Deposit proxy: 100 per cent in the deposit accrual.

Balanced 50/50: half in each, rebalanced to equal weights at the start of every month.

Volatility-managed: the equity weight in month t is

$$w_t = \min(1, (0.15)/(\sigma_{t-1})),$$

where σ_{t-1} is the annualised standard deviation of the previous twelve monthly equity returns. The remainder is held in deposits. Leverage and short positions are not allowed. Because σ_{t-1} uses only returns up to month $t-1$, the weight is known at the start of month t .

The 15 per cent target and twelve-month window were set before looking at the results and are not optimised. Section 5.4 shows how the results change with other choices.

4.2 Performance measures

For each strategy I report the compound annual growth rate (CAGR), the annualised standard deviation of monthly returns, the maximum drawdown, the share of months with negative returns, the terminal value of ₦100 invested in February 2007, the annualised downside deviation below zero, the 5 per cent value at risk (VaR) and conditional value at risk (CVaR), the Sharpe and Sortino ratios with the deposit rate as the risk-free benchmark, and the inflation-adjusted and US dollar CAGRs.

4.3 Statistical inference

Differences in CAGR between strategies are assessed with a paired moving-block bootstrap, which resamples blocks of twelve consecutive months jointly for the two strategies being compared, preserving both serial dependence and the correlation between them. Two thousand replications are used, and the 2.5th and 97.5th percentiles of the bootstrapped difference form a 95 per cent interval.

5. RESULTS

5.1 Overall performance

Table 1 reports the main results. Equities alone grew at 7.92 per cent a year, turning ₦100 into ₦423, but with an annual volatility of 25.8 per cent and a maximum drawdown of 69.8 per cent. Equity returns were negative in 48 per cent of

months. The deposit proxy grew at 8.91 per cent a year with almost no volatility, ending at ₦503. In other words, an investor in deposits ended with more money than an investor in equities, without bearing any market risk.

Table 1 Performance of four allocation strategies, February 2007 – December 2025 (227 months)

Measure	Equity only	Deposit proxy	Balanced 50/50	Volatility-managed
CAGR (%)	7.92	8.91	9.30	10.84
Annual volatility (%)	25.76	0.82	12.87	18.64
Maximum drawdown (%)	-69.76	0.00	-39.13	-43.51
Negative months (%)	48.0	0.0	41.9	43.6
Terminal value of ₦100	423	503	538	700
Downside deviation (%)	15.51	0.00	7.13	10.24
Monthly VaR, 5% (%)	-9.06	0.38	-4.04	-6.02
Monthly CVaR, 5% (%)	-14.66	0.34	-6.91	-10.21
Sharpe ratio	0.09	–	0.09	0.18
Sortino ratio	0.14	–	0.14	0.30
Real CAGR (%)	-5.71	-4.84	-4.51	-3.17
US dollar CAGR (%)	-5.07	-4.19	-3.86	-2.50

Note. Equity = All-Share Index price return (no dividends). Deposit proxy = previous month's twelve-month deposit rate ÷ 12. The balanced portfolio is rebalanced monthly. The volatility-managed rule targets 15 per cent annual volatility using the previous twelve months. Sharpe and Sortino ratios use the deposit proxy as the risk-free rate. Real returns deflate by the monthly equivalent of year-on-year inflation; US dollar returns adjust for the change in the official exchange rate.

Combining the two assets did better than either alone. The 50/50 mix grew at 9.30 per cent a year with half the volatility of equities and a maximum drawdown of 39.1 per cent, so H1 is clearly supported. The gain in compound growth from mixing two assets with lower individual growth rates reflects the benefit of regularly rebalancing a volatile asset against a stable one, which sells after rises and buys after falls (Perold & Sharpe, 1988). The volatility-managed rule grew fastest of all, at 10.84 per cent a year, turning ₦100 into ₦700. Its volatility (18.6 per cent) and drawdown (43.5 per cent) were higher than those of the 50/50 mix, because it held more equity on average, but its Sharpe ratio of 0.18 and Sortino ratio of 0.30 were twice those of the other risky strategies.

5.2 How the strategies behaved over time

Figure 1 plots the value of ₦100 invested in each strategy. The crash of 2008–2009 dominates the equity path. From its peak in February 2008 to its trough in March 2009 the index lost about 70 per cent of its value, and the equity-only investor did not regain the February 2008 level until August 2023, fifteen and a half years later. The 50/50 and volatility-managed investors recovered much earlier because their losses were smaller and their deposit holdings kept earning interest.

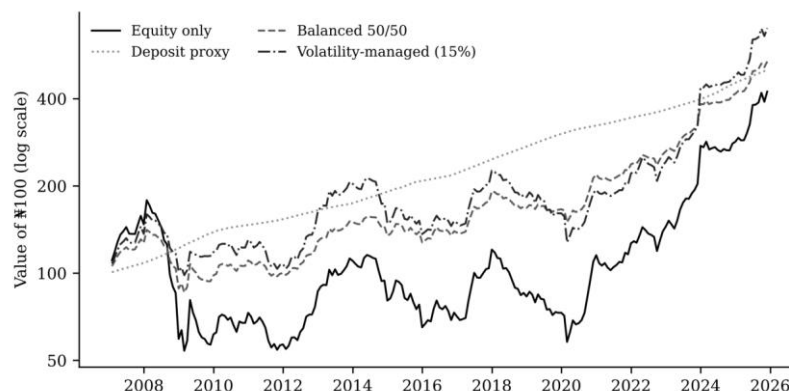


Figure 1. Value of ₦100 invested in February 2007 in each strategy (log scale), to December 2025. Source: author's calculations from Central Bank of Nigeria data.

Figure 2 shows the equity weight chosen by the volatility rule. It averaged 0.73 and ranged from 0.25 to 1.00. The weight fell from about 0.9 in January 2008 to below 0.6 by April 2008 and to 0.35 by February 2009, so the rule had already cut

its exposure before most of the crash losses were incurred. It rose to 100 per cent during calm periods, which it did in 19 per cent of months. In 2020 and again in 2024 the weight fell after volatile months and then recovered.

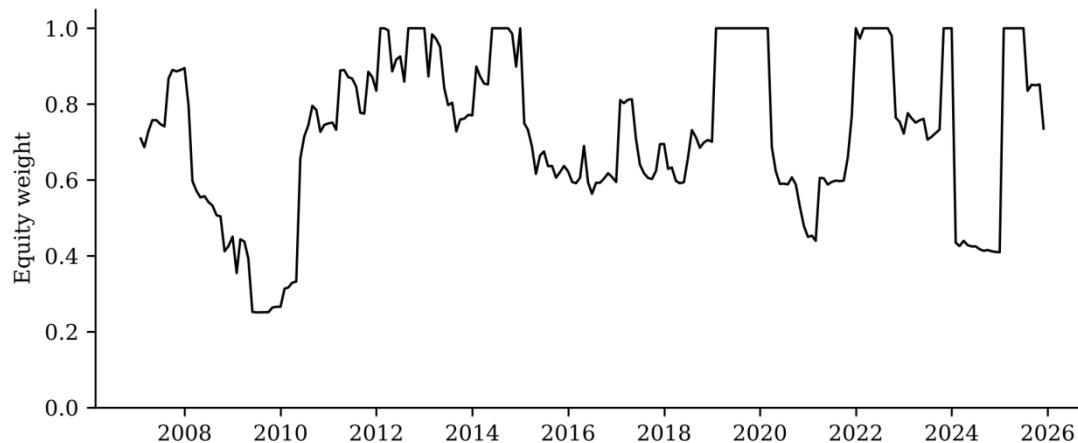


Figure 2. Equity weight in the volatility-managed strategy, February 2007 – December 2025. The weight is based only on the previous twelve months of returns. Source: author’s calculations.

Table 2 shows that the ranking of the strategies changed from one sub-period to another. In 2007–2011 equities lost 11 per cent a year, the deposit proxy was the best performer and the volatility rule only just stayed positive. In 2012–2016 and 2017–2021 the differences were small, and in 2017–2021 the volatility rule was the worst risky strategy, because it reduced exposure after volatile periods that were followed by recoveries. In 2022–2025 equities gained 38 per cent a year in nominal terms, driven by the rally of 2023–2025, and the volatility rule captured most of that gain.

Table 2 Nominal and real compound annual growth by sub-period (%)

Strategy	2007–2011	2012–2016	2017–2021	2022–2025
<i>Nominal</i>				
Equity only	–11.01	5.33	9.71	38.15
Deposit proxy	8.98	7.54	9.27	10.13
Balanced 50/50	–0.11	7.00	10.17	24.13
Volatility-managed	1.34	7.21	5.99	36.41
<i>Real (inflation-adjusted)</i>				
Equity only	–19.70	–4.81	–3.79	10.68
Deposit proxy	–1.67	–2.81	–4.17	–11.77
Balanced 50/50	–9.87	–3.30	–3.39	–0.55
Volatility-managed	–8.56	–3.11	–7.05	9.28

Note. 2007–2011 begins in February 2007. Real returns deflate by the monthly equivalent of year-on-year inflation.

5.3 Is the volatility rule really better?

The volatility rule’s advantage is large in point terms but not statistically reliable. In the block bootstrap, its CAGR exceeds that of the 50/50 mix by an average of 1.0 percentage point a year, but the 95 per cent interval runs from –3.7 to +5.9 points. Against equities alone, the interval runs from –2.9 to +10.8 points. In both cases zero lies well inside the interval. Nineteen years of monthly data, dominated by one great crash and one great rally, are not enough to establish that the rule would beat a fixed mix in another sample. H2 is supported in the point estimates but not with statistical confidence.

5.4 Sensitivity to design choices

Table 3 shows how the volatility rule performs with different targets and look-back windows. The twelve-month window used in the main analysis turns out to be the best choice. With a six-month window, the rule reacts more quickly but trades more noise; with a 24-month window, it reacts too slowly and holds too much equity going into crashes and too little coming out of them. Every 24-month version has a lower CAGR and Sharpe ratio than the corresponding twelve-month version, and some are worse than the simple 50/50 mix. Lower targets reduce volatility and drawdown, while higher targets push the strategy towards equities only. A 10 per cent target with a twelve-month window gives the best

combination of growth (10.98 per cent), drawdown (27.9 per cent) and Sharpe ratio (0.21), but this was not the pre-specified rule, and choosing it after looking at the results would be data mining.

Table 3 Sensitivity of the volatility-managed rule to the volatility target and look-back window

Target	Look-back	CAGR (%)	Volatility (%)	Max drawdown (%)	Sharpe	Average equity weight
10%	6 months	10.34	16.24	-38.68	0.16	0.57
10%	12 months	10.98	13.39	-27.87	0.21	0.50
10%	24 months	9.04	11.89	-27.30	0.07	0.45
15%	6 months	10.52	20.03	-48.94	0.17	0.78
15%	12 months	10.84	18.64	-43.51	0.18	0.73
15%	24 months	8.85	17.57	-42.65	0.08	0.67
20%	12 months	10.86	21.55	-50.51	0.19	0.87
25%	12 months	9.69	23.28	-60.52	0.14	0.94

Note. All versions use only past returns to set the weight. The main specification (15%, 12 months) is shown in the middle row.

5.5 Real and dollar returns

The most important result is in the last two rows of Table 1. After adjusting for inflation, every strategy lost purchasing power. Real CAGRs ranged from -3.2 per cent for the volatility rule to -5.7 per cent for equities alone. Over nineteen years, a real loss of 4.5 per cent a year, which is what the 50/50 investor experienced, reduces purchasing power by more than half. In US dollar terms the picture is similar: all four strategies lost between 2.5 and 5.1 per cent a year. H3 is rejected.

The sub-period results in Table 2 show that the real losses were concentrated in 2007–2011 for equities and in 2022–2025 for deposits. During 2022–2025, when inflation averaged well over 20 per cent, the deposit proxy lost almost 12 per cent a year in real terms while equities gained almost 11 per cent. Over that period equities were the better inflation hedge, but over the full sample, which includes the 2008–2009 crash and the long recovery that followed, they were not.

5.6 A less generous safe asset and trading costs

The twelve-month deposit rate is a favourable assumption for the defensive leg, since most retail savers hold savings accounts that pay much less. Replacing it with the CBN's average savings deposit rate, which implies a return of 3.5 per cent a year over the sample, changes the picture in an instructive way. The 50/50 mix now grows at only 6.5 per cent a year, less than equities alone (7.9 per cent), with a maximum drawdown of 42.3 per cent. The volatility-managed rule still grows fastest, at 9.1 per cent a year, with a drawdown of 44.7 per cent. The benefit of mixing depends heavily on what the safe asset pays, while the advantage of the volatility rule over a fixed mix becomes larger when the safe asset is poor.

The volatility rule also trades. Its equity weight changes by an average of about 50 per cent of the portfolio a year. A cost of 50 basis points per unit of weight traded lowers its CAGR from 10.8 to 10.2 per cent, and a cost of 100 basis points to 9.9 per cent. At these cost levels it still grows faster than the 50/50 mix, but the margin narrows considerably, which reinforces the caution expressed in Section 5.3.

6. DISCUSSION

The results confirm the basic case for diversification in a volatile market. Mixing Nigerian equities with deposits halved volatility, cut the maximum drawdown from 70 to about 40 per cent and raised compound growth, because the deposit leg cushioned the crashes that dominate equity outcomes. The volatility-managed rule went further. It used the persistence of Nigerian market volatility documented by Emenike (2010) and Atoi (2014) to reduce exposure after turbulent months, and over this sample that produced the highest growth and the best risk-adjusted return.

The bootstrap and sensitivity results temper this conclusion. The volatility rule's advantage depends heavily on a single episode: it reduced equity exposure early in 2008, before the deepest losses, and it was fully invested for much of 2023 and again from mid-2025, when the market rose most strongly. In 2017–2021, a period without a great crash, it was the worst of the risky strategies. Its performance also depends on the look-back window, and with a 24-month window it loses its edge. This matches the warning of Cederburg et al. (2020) that volatility-managed strategies look better in-sample than they are likely to be in practice, and the finding of DeMiguel et al. (2009) that simple fixed mixes are hard to beat.

The real-return results put all of this in perspective. Whatever the allocation rule, a Nigerian investor holding naira equities and deposits over 2007–2025 lost purchasing power. The deposit proxy's real loss reflects the persistently negative real interest rates of the period. The equity loss reflects the 2008–2009 crash and the long stagnation that followed, which a decade of moderate returns could not make up. Only in 2022–2025, when the index more than tripled, did equities outpace inflation, and even that rally did not make up for the earlier losses. Risk management changed the size of the loss, not its sign.

6.1 Implications

For individual investors and pension funds, the results support holding a diversified mix rather than concentrating in either equities or deposits, and they suggest that simple volatility-based adjustments can reduce crash exposure. They also show that neither equities nor deposits should be assumed to preserve real value in Nigeria over long horizons. Investors concerned about purchasing power need assets whose returns are linked more directly to inflation or to foreign currency. For regulators of pension and collective investment schemes, the deep and prolonged equity drawdown is a reminder that long holding periods do not guarantee recovery in a market that can take fifteen years to regain a previous peak.

6.2 Limitations

The equity series excludes dividends, which have historically been an important part of Nigerian equity returns, so the equity and mixed strategies understate total returns. Adding a dividend yield of several per cent a year would improve the relative performance of equities and might make their real return positive in some sub-periods. The deposit proxy assumes a monthly accrual at the quoted twelve-month rate, which no actual product offers. Transaction costs, taxes and fees are ignored. Real returns are approximated from year-on-year inflation, and the CPI rebasing of January 2025 affects the comparison across that date. Finally, the results come from one market over one long period that contains a single great crash, and their statistical precision is limited, as the bootstrap shows. A natural extension would use the total-return version of the index, actual Treasury bill returns and an explicit inflation-linked asset.

7. CONCLUSION

Over February 2007 to December 2025, a volatility-managed mix of Nigerian equities and deposits grew faster and had a better risk-adjusted return than equities alone, deposits alone or a fixed 50/50 mix. Diversification of any kind cut the maximum drawdown from about 70 to about 40 per cent. The advantage of the volatility rule over a fixed mix was large in point terms but statistically fragile and sensitive to its design. Above all, every strategy lost purchasing power: real annual returns ranged from –3.2 to –5.7 per cent, and dollar returns were also negative. Portfolio rules can reduce the damage that volatility does to Nigerian savers, but they cannot by themselves overcome persistently negative real returns.

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