**Title: Evaluating the East African Currency Carry Trade**

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# DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.



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This Research Project has been submitted for examination with my approval as the Supervisor.

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# List of Abbreviations

**UIP** -Uncovered Interest Parity

**CIP** - Covered Interest Parity

**CCBS** - Cross-Currency Basis Swap

**BIS** - Bank for International Settlements

**TED** - the Treasury-Eurodollar rate

**LIBOR** - The London Interbank Offered Rate

**VIX** - Volatility Index

**VECM** - Vector Error Correction Model

**FX** - Foreign Exchange

**ADF** - Augmented Dickey–Fuller

**FEER** - Fundamental Effective Exchange Rate

**RIP** - Real Interest Parity

**PPP** - Purchasing Power Parity

**NSE 20** - Nairobi Stock Exchange 20-Share Index

**G10** - 11 industrialized nations, including Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States

**KFW** - Kreditanstalt für Wiederaufbau

**ARDL** - Autoregressive Distributed Lag

**GFC** - Great financial Crisis

# ABSTRACT

This paper seeks to uncover the nature and diversification benefit of the East African Currency Carry Trade and its sensitivity to global financial system shocks on KESRWF, KESUGX and KESTZS currency pairs as well as the diversification benefit of the strategy to Kenyan equities. To do so, the study employs a Carry trade returns model to compute returns and Fixed-Effects model to estimate sensitivity of returns to global risk factors and employs Mean-Variance optimization to determine optimal portfolio weights. The study finds that the carry trade done on these currencies does sufficiently diversify the NSE 20 Index, and use of Mean-Variance optimisation improves risk-adjusted returns compared to an equal-weight portfolio. Furthermore, the East African Currency Carry trade is insulated from global risk factors, which are proxied by VIX Futures and the TED Spread.

# 1. INTRODUCTION

## 1.1 Background

The carry trade is defined by Galati (2007) as a leveraged cross-currency position designed to capitalize on interest rate differentials and periods of low volatility. The strategy involves borrowing funds in a low-interest-rate currency (the funding currency) and investing in a higher-yielding asset in another currency (the target currency). Similarly, Hsu (2020) describes the carry trade as a set of systematic rules that exploit yield differences across currencies to generate returns.

Typically, the carry trade involves borrowing in a low-interest-rate currency, such as the Japanese yen, and investing in high interest-rate securities, such as those denominated in South African Rand. The investor uses part of the interest earned to repay the borrowed amount while keeping the remainder as profit, provided that exchange rates remain stable. A key distinction of this strategy is that it involves selling short the funding currency and using the proceeds to fund a long position in the target currency. Investors engaging in carry trades can choose to hedge against exchange rate risks using derivatives like forwards or options or bear the full risk of currency fluctuations.

This strategy is of particular interest in international finance, given the substantial changes it causes to global capital flows and asset prices. For instance, Galati (2007) reported that foreign yen-denominated claims (these being yen owed by foreigners both inside and outside Japan) peaked at $1.05 trillion, while Swiss franc denominated claims grew to and peaked at $678 billion in early 2007, showing a significant preference by foreigners to borrow in these currencies. The timing of these positions is also notable, as carry trade unwinds often precede or coincide with periods of financial stress, such as the global financial crisis of 2008 notably, where these claims fell sharply thereafter. Furthermore, it cannot entirely be explained away as ordinary borrowing activity by foreigners as the claims would not have fallen so sharply thereafter if that were the case. This historical linkage raises concerns for regulators about the systemic risks posed by such leveraged positions.

Regulators are particularly wary of the potential for sudden unwinds of carry trades, where leveraged actors exit positions in response to adverse news. This dynamic can lead to a rapid

spike in volatility, with the high-interest rate currency crashing and the funding currency strengthening sharply. These episodes of volatility are bad as they are detrimental to trade and currency stability, introducing uncertainty to exporters and importers. Such events have been observed in several historical carry trade unwinds, underscoring their significance to financial markets and asset prices.

For example, between August 7th and 8th, 1998, the U.S. dollar depreciated by 15% against the Japanese yen. Similarly, in August 2007, the Australian and New Zealand dollars fell nearly 10% against the yen. By August 27th, 2008, the Australian dollar had lost almost a third of its value relative to the yen (Burroughs, 2008). Another noteworthy event was the Swiss franc's dramatic appreciation following its de-pegging from the euro on January 15, 2015, where it rallied by 30% against the euro and 25% against the U.S. dollar in a single day (Graham, 2015). This carry trade unwind had significant real economy consequences, particularly for Eastern European households with Swiss franc-denominated mortgages. The franc's rapid appreciation led to mass defaults as borrowers faced steep repayment burdens (McCauley, 2010).

It is evident from the examples mentioned earlier that typical carry trade crashes often feature significant rallies in funding currencies, while target currencies experience substantial depreciation. What causes this is currency carry traders being margin called and forced to close their short positions by buying back the funding currency by their brokers. This pattern characterizes a classic carry trade crash and poses a risk of financial contagion into other asset classes and across financial institutions. To illustrate, when brokers issue margin calls to speculators, these investors may be forced to liquidate not only the assets they initially borrowed funds to purchase but also other unrelated assets to meet their margin requirement. This phenomenon potentially explains the observed correlation between carry trade crashes and broader stock and bond market selloffs, particularly during the Great Financial Crisis, as highlighted by Melvin (2009).

This is the crash risk typically discussed in carry trade literature, which gives the carry trade its characteristic negatively skewed distribution of returns. The carry trade often delivers stable returns over extended periods, only to erase these gains during sharp crashes that can result in disastrous losses for investors. This phenomenon is likened to "taking the escalator up and the

elevator down" in terms of returns, such that returns come slowly but losses come swiftly. Despite this being common knowledge in the finance industry, investors are nonetheless drawn to the deceptively high Sharpe ratios associated with this strategy and the seemingly low interest rates of funding currencies. It is no free lunch, and the implicit cost is the potential for substantial losses during financial crises.

Regulators are also cautious about this trade due to its estimated size. They occasionally intervene to discourage speculation, as seen in 2014 when the People's Bank of China gradually increased the upper bound of their managed exchange rate. This intervention aimed to increase Yuan volatility and widen the trading band (on the Yuan, which is a pegged currency), making the currency less attractive as a target currency for carry trades. Similarly, the Japanese Ministry of Finance does occasionally intervene in foreign exchange markets to introduce volatility, discouraging excessive speculation on the yen a (common funding currency) due to Japan's persistently low interest rates.

Conventional foreign exchange theories, such as market efficiency and Exchange Rate Parity, suggest the carry trade should be unprofitable in the long run, as arbitrageurs exploit inefficiencies to maintain market equilibrium. Yet, speculators persist, aiming to reap excess returns. This begs the question of what motivates such behaviour by speculators despite their knowledge of theorized market efficiency. One plausible explanation is that the carry trade provides a reward or risk premium not fully accounted for by classical theories regarding exchange and interest rate linkages.

Numerous explanations for carry trade drivers have been proposed. For instance, "Peso problems" could explain why certain currencies fail to depreciate as predicted by Uncovered and Covered Interest Rate Parity. The theory posits that markets price in potential crashes by incorporating higher interest rates required during such events, as discussed by Bilson (1981) and Rogoff (1996). However, Burnside et al. (2011) found that carry trade returns were not significantly explained by the risk factors they tested.

Studies, including those by Asness et al. (2013), Burnside et al. (2011), and Okunev (2003), have also explored whether momentum applies specifically to currencies. These studies found evidence of momentum factors in selected major currency pairs. Central bank interventions in managed exchange rate regimes have also been examined as a potential driver of carry trade profitability. This is hypothesized because of the perceived stability and low volatility of pegged exchange rate regimes, which should be attractive to speculators. Some hypothesize that interventions eliminate crash risk, but literature such as the findings of Accominotti (2019) contradicts this. Accominotti demonstrates that excess returns in pegged regimes are negligible, with floating regimes contributing all the excess returns observed in their currency carry trade models.

It has been posited by Burnside et al. (2008), Brunnermeier et al. (Brunnermeier, 2008), Mancini et al. (2013) , and Abankwa (2021) that carry trade returns can be explained by liquidity risk, where speculators bear the risk of poor liquidity during carry trade crashes and are compensated for consistently providing liquidity in target currency markets that are typically less liquid than developed market currencies. Sovereign default risk for target currency nations has also been suggested as a potential driver of the risk premium. However, Lustig et al. (2019) dispute this, finding in their tests of credit ratings that sovereign default risk is not a plausible explanation for local currency bond excess returns. There appears to be a consensus that a wide variety of interrelated factors drive carry trade returns, but agreement on whether each posited factor is a definitive driver remains inconclusive. The divergence in findings can often be attributed to the econometric methods employed, the heterogeneity of market regimes, and the varying timeframes under examination.

Given the historical impact of carry trade unwinds on some of the world's most deep and liquid currency markets and the consistent interest shown by investors, the potential effects of such capital flow reversals on smaller and less liquid markets, such as the East African foreign exchange and fixed-income markets, warrant closer examination. Furthermore, academic inquiry into the implications of carry trades in the East African context has been sparse.

For example, the recent sharp appreciation of the Kenyan shilling in the first quarter of 2024, following a series of rate hikes by the Central Bank of Kenya and remarks by the governor regarding elevated foreign interest in infrastructure bonds, highlights the need for further study. The oversubscription of the bond auction held during this period underscores the relevance of understanding whether such events signal the viability and size of a Kenyan shilling carry trade. Additionally, could the significant shilling depreciations during global financial crises such as the 2008 Financial Crisis and the 2011 Greek Debt Crisis have been driven by the unwinding of carry trades by speculators during these periods? In addition to this is the fact that Kenyan interest rates after the global financial crisis fell below 2%. This implies the possibility of it having been used as a funding currency versus other east African currencies at the time.

Furthermore, the sparse literature on the East African carry trade presents a wide gap for exploration. This lack of coverage could stem from the perceived low liquidity of East African fixed income and foreign exchange markets, leading to reduced attention on the subject. Consequently, heterogeneity in transaction costs and market conditions in this region may influence the outcomes of any studies conducted. Addressing these gaps provides an opportunity to contribute meaningfully to carry trade literature by contextualizing its application and viability in East Africa.

My research seeks to analyse the distributional properties of carry trade returns in East Africa, assess their correlation with the NSE 20 Index, and determine the diversification benefits of incorporating this strategy into a portfolio containing the NSE 20 Index. Additionally, the study will evaluate how the East African carry trade strategy responds to global risk factors, particularly given the well-documented susceptibility of carry trades in other regions to global risk-off events. By examining these factors, the research aims to position East African carry trade within the broader global financial landscape.

## 1.2 Problem Statement

While the carry trade is a well-documented strategy in international finance, its application and impact in East Africa, particularly Kenya, remain underexplored. This gap in the literature is significant, as it has potential implications for financial market stability within the region. The absence of empirical studies focusing on the Kenyan context leaves a critical void in understanding how global financial ebbs and flows impacts carry trade returns. Given the history of volatility of the Kenyan shilling and its importance as a regional currency with regards to trade, investigating whether carry trade activities between it and other East African currencies are viable. Furthermore, it is crucial to assess to what extent the East African Carry Trade can serve as a diversifying asset to Kenyan Equities.

## 1.3 Research Objectives

### *1.3.1 General Research Objective*

The primary objective of this research is to examine the impact of global risk factors on the performance of the East African Currency Carry Trade, with a focus on identifying the return characteristics of these strategies as well as their diversification potential.

### 1.3.2 Specific Research Objectives

To analyse the distributional properties of carry trade returns in the Kenyan market, including skewness, kurtosis, and stationarity, and evaluate the correlation between carry trade returns and the performance of the NSE 20 index.

To assess the diversification benefits of the carry trade strategy for investors in the Kenyan market.

To measure the effect of global risk factors on the performance of carry trades involving the Kenyan shilling.

## 1.4 Research Hypotheses

Carry trade returns on the Kenya Shilling exhibit negative skewness and are correlated with the NSE 20 index

The carry trade strategy provides significant diversification benefits to investors in the Kenyan market.

Global risk factors significantly affect the returns of carry trades involving the Kenyan shilling.

### 1.5 Scope of the Study

This study will focus on the Kenyan, Tanzanian, Rwandan and Ugandan financial market, specifically analysing the impact of carry trade strategies on the performance of the Kenyan shilling. The research will cover data from 2012-2023, allowing for a comprehensive examination of the factors influencing currency fluctuations and the role of global financial stresses on it within the East African context. The study will employ quantitative methods to assess the viability and risks associated with the carry trade in Kenya.

### 1.6 Significance of the Study

The findings of this research will have significant implications for both investors and policymakers. For institutional investors, the study provides insights into a relatively unexplored investment strategy within the Kenyan context, offering potential opportunities for portfolio diversification. For policymakers, the research highlights the need for increased vigilance and regulatory oversight, given the potential for unwinds of carry trade activities to contribute to financial instability.

Understanding the dynamics of the carry trade in Kenya could also inform the development of more effective monetary and fiscal policies aimed at maintaining currency stability and promoting sustainable economic growth. There is extensive literature also published by global central banks particularly on the carry trade and the East African Central Banks could benefit from giving the topic more attention in future.

# 2. LITERATURE REVIEW

This section of the paper goes through the existing literature of the subject matter of this research. This chapter begins by discussing the most relevant theoretical drivers and explanations for the carry trade, and its two key components: exchange rates and interest rates, as well as the relationship between the two components. Afterwards, the empirical studies formerly done to evaluate the existence and statistical nature of the subject matter are reviewed.

## 2.1 Theoretical Literature Review

Various arguments and theories in academic finance literature attempt to explain the sources of carry trade returns and the factors that drive them. These include the risk premia argument tested by Daniel (2017), the liquidity argument proposed by Mancini (2013) and Abankwa (2021), the exchange rate fundamentals argument by Jorda (2012), and the sovereign default risk premium argument discussed by Borri (2015).

The carry trade is defined by Galati (2007) as a leveraged cross-currency position designed to capitalize on interest rate differentials and low market volatility. This strategy involves borrowing funds at a low interest rate in one currency (the funding currency) and investing in a higher-yielding asset in another currency (the target currency). Hsu (2020) further describes the carry trade as a set of mechanical rules that exploit cross-country differences in interest rates by selling low-interest-rate currencies and purchasing high interest- rate currencies.

The expression for the returns on a long/short carry strategy, when transaction costs are ignored, is provided by Daniel (2017) as follows:

Where:

$$Z_{t+1} = \left[\frac{(1 + i_t^*)S_{t+1}}{S_t} - \left(1 + i_t^{\$}\right)\right] y_t \tag{2.1}$$

- $Z_{t+1}$ denotes the payoff of the trade at time t + 1,
- $i_t^*$ denotes the one-period target/foreign currency interest rate,
- $i_t^{\$}$ denotes the one-period funding currency interest rate (in this case, the dollar, as an example),
- $S_{t+1}$ denotes the spot exchange rate of $ per unit of target currency at time t + 1,
- $S_t$ denotes the spot exchange rate of $ per unit of target currency at time t,
- $y_t$ denotes the trade quantity or investment amount at time t, defined as:

$$y_t = \begin{Bmatrix} +1 & if\ i_t^* > i_t^{\$} \\ -1 & if\ i_t^* < i_t^{\$} \end{Bmatrix} \tag{2.2}$$

indicating that one goes short the foreign currency and long the decided upon funding currency if it has a lower interest rate than the funding currency, and vice versa if the interest rate differential is positive.

### *2.1.1 Uncovered Interest Rate Parity*

The typical economic logic of rational expectations, as outlined in the Uncovered Interest Parity (UIP) theory, suggests that the carry trade should not be a viable strategy. According to UIP, the interest rate differential between two currencies should be offset by the expected depreciation of the target currency (the higher-interest-rate currency being invested in) relative to the funding currency (the lower-interest-rate currency used for borrowing).

This implies that even an unhedged carry trade would yield zero net returns, as the depreciation of the target currency would negate the income generated from the interest rate differential. UIP can be considered a stricter form of Covered Interest Parity (CIP). While CIP asserts that the forward market prices in the interest rate differential to eliminate arbitrage opportunities, UIP extends this logic to the spot market, proposing that over time, spot exchange rates adjust

to reflect these interest rate differentials, thereby eroding any potential profits from the carry trade.

The expression for uncovered interest parity is as follows:

$$\frac{1+i}{1+i^s} = \frac{E_t(S_{t-k})}{S_t} \tag{2.3}$$

where:

$i$ denotes the interest rate of the funding currency,

$i^s$ denotes the interest rate of the target currency,

$E_t(S_{t-k})$ denotes the expected future spot exchange rate of the funding currency against the target currency some time k after time t (present),

$S_t$ denotes the current spot exchange rate of the funding currency against the target currency at time t (present).

Keynes (1923) laid the groundwork for Uncovered Interest Parity (UIP) through his explanation of Covered Interest Parity (CIP). Foundational literature on the carry trade, such as Meese (1983), challenged UIP by demonstrating that time-series analysis between exchange rates and interest rate differentials revealed deviations from UIP. They found that exchange rates exhibit near-random walk behaviour, enabling currency speculators to profit from interest rate differentials without necessarily expecting an offsetting exchange rate movement to erode their gains. Fama (1984), in his seminal work, observed that high-interest-rate currencies tend to appreciate against low-interest-rate currencies, contrary to UIP, thereby highlighting the potential profitability of the carry trade for speculators.

Contemporary studies, such as Mehl (2009) and Lothian (2017), suggest that UIP holds in mature economies but fails for emerging market currencies. For example, Kisaka (2017) found a negative and statistically significant coefficient of the forward premium on the Kenyan

shilling, indicating a deviation from UIP. Conversely, Nwiado (2016) observed a long-run relationship between interest rates and exchange rates in Nigeria, Kenya, and Egypt, suggesting that UIP holds in these cases. However, Othieno (2012) found no evidence supporting UIP between Uganda and Kenya when tested individually, partially contradicting these findings.

The carry trade literature further challenges UIP. Various actors including asset managers, financial institutions, households (e.g., via trading accounts or foreign currency mortgages, as noted by Zurawski (2009) , and McCauley (2010)), and non-financial institutions such as emerging market corporations engage in carry trades (Valentina Bruno, 2017). This strategy is often profitable in the long run, as evidenced by Hsu (2020) and Galati (2007), who report high Sharpe ratios despite the inherent crash risk. Galati (2007), in a BIS research paper, estimates the size of the carry trade to be in the trillions of dollars, which raises questions about UIP's validity in explaining the persistence of this strategy. If UIP were entirely accurate, rational economic actors would presumably abandon the carry trade rather than persist in exploiting its returns.

The core implication of UIP is that even an unhedged carry trade should yield no returns in the long term, a premise that appears inconsistent with empirical evidence and the substantial global engagement in this strategy.

### *2.1.2 Covered Interest Parity*

Covered Interest Parity (CIP) posits that the interest rate differential between two countries should be equal to the differential between the forward exchange rate and the spot exchange rate. CIP represents a "no-arbitrage" condition, ensuring that arbitrage opportunities do not arise from differences in interest rates between countries when hedged using forward contracts. Forward contracts, though central to CIP's equilibrium function, are not the only derivative used for hedging. For instance, Caballero (2015) highlights that exchange rate options can serve as a superior and effective hedge in certain scenarios.

Specifically, if an investor sought to arbitrage between the interest rates of two countries by borrowing in a low-interest-rate currency to invest in a high-interest-rate currency, hedging the currency risk with a forward contract would eliminate any profits. This is because the forward price of the high-interest-rate currency would incorporate an expected depreciation commensurate with the interest rate differential. The cost of the forward contract used for hedging exchange rate risk effectively cancels out the income gained from the interest rate differential.

The concept of interest parity dates to Keynes (1923), who noted that some currencies often traded at a forward discount relative to the pound. A forward discount implies that a currency, such as the dollar, could be purchased at a lower price in the forward market compared to the spot market. This early observation laid the groundwork for the formal development of interest parity theory.

Keynes concluded that the forward discount to the spot exchange rate could be attributed to investors' preference for holding dollars at the time, driven by higher interest rates in the United States compared to Britain. He linked the forward discount to interest rate differentials, asserting that the price relationship reflected these disparities. Keynes reached this conclusion through real-time observations of the London forward foreign exchange market, which had emerged after the "unpegging" of major exchange rates following World War I. He noted that the forward discount against the pound typically coincided with a positive interest rate differential between the U.S. and Britain, providing empirical support for the role of interest rates in explaining forward discounts.

The no-arbitrage condition can be expressed as:

$$\frac{F}{S} = \frac{1 + r_d}{1 + r_f} \tag{2.4}$$

where:

$F$ is the forward exchange rate (domestic price of foreign currency),
$S$ is the spot exchange rate (domestic price of foreign currency),
$r_d$ is the domestic interest rate of an asset with maturity t,
$r_f$ is the foreign interest rate of a similar asset with maturity t.

As shown in the equation, the forward discount corresponds to the difference in returns between foreign and domestic fixed-income securities. Du (2018) examined deviations from covered interest rate parity (CIP) among G10 currencies following the 2008 financial crisis. Their findings revealed persistent deviations and arbitrage opportunities in the Cross-Currency Basis Swap (CCBS) market, which could not be explained by credit risk or transaction costs. Conversely, Wong (2018) also identified persistent CIP deviations but proposed an alternative explanation. They argued that these deviations were not arbitrage opportunities but rather rationally priced risk premia.

Rime (2022) investigated the breakdown of CIP in the post-GFC CCBS market and attributed it to the segmentation of international money markets and variations in funding liquidity across currencies. They posited that the traditional interpretation of CIP as a no-arbitrage condition might no longer hold, as FX derivative pricing is increasingly shaped by FX hedging demand rather than arbitrage activity. Similarly, Borio (2018) supported this perspective, emphasizing that CIP violations can be explained by FX hedging imbalances and the balance sheet costs incurred by banks, which limit the ability of market participants to exploit these deviations.

## 2.2 Empirical Literature review

### *2.2.1 Covered interest rate parity*

Several studies have examined the validity of covered interest parity (CIP) and, where deviations occur, explored the factors that drive these deviations, particularly in light of the global financial crisis and the stringent banking regulations that followed. Du (2018) challenged the validity of CIP by utilizing cross-currency basis data to assess deviations. The cross-currency basis measures deviations from CIP by calculating the difference between the dollar cash interest rate, proxied by LIBOR (the London Inter-Bank Offered Rate), and the average synthetic interest rates derived from dollar swaps with the G10 currencies. In their analysis, Du averaged the basis for each currency but found wider divergences in currencies such as the Japanese yen, where the basis exceeded the LIBOR interest rate itself. They also used repo rates in the short term, as these are secured and eliminate the default risk typically present with LIBOR, which is unsecured.

A cross-currency basis of zero indicates no arbitrage opportunity between the cash and currency swap markets; however, if the basis is positive or negative, an arbitrage opportunity exists, allowing one to borrow in the lower interest rate market and lend in the higher interest rate market. To assess this, Du applied two methodologies: difference-in-difference regression and event studies. The event study aimed to evaluate the impact of news shocks—specifically monetary policy shocks—on the currency basis and interest rate spread between LIBOR rates and the yield on KFW bonds denominated in each of the G10 currencies. These KFW bonds served as a proxy for risk-free currency interest rates in Germany, given the collateralized nature of these bonds and the guarantee provided by the German government. The event window for the analysis spanned five minutes before and 105 minutes after the policy meetings to capture the effects of changes in interest rate policy on the currency basis and whether divergences resulted. Du found that the cross-currency basis diverged when monetary policy deviated from estimates. Furthermore, using difference-in-difference regression, Du discovered that contracts affected by changes in banking regulation—specifically one-week and one-month forwards exhibited statistically significant differences in CIP deviations, as banks had to recognize these contracts towards quarter-end, leading to their liquidation if in excess to meet regulatory requirements. In contrast, unaffected contracts, such as the three-

month forwards, remained “untreated” by the banks. Du explained the emerging divergence from CIP by emphasizing the more stringent banking regulations that hindered banks from exploiting these arbitrage opportunities enough to eliminate the CIP deviations. Wong (2018), after testing for exogeneity and stationarity, employed both restricted and unrestricted regression models. They regressed overnight index swaps of foreign and domestic currencies for seven currency pairs, interest rate swaps of foreign and domestic currencies, and used the forward premium as the dependent variable. The results showed that the unrestricted and restricted models provided an R2 ranging between 0.62 and 0.80, with two outliers. Their adjusted R2 values fell only slightly, indicating that the restrictions applied in the model were sound.

Borio (2018) used data from three different currencies (the yen, euro, and Australian dollar) as well as data on bank hedging demand from Japan, various eurozone banks, and Australia. They used the implied cross-currency position of BIS-reporting banks as a proxy for bank hedging demand, nonfinancial corporates’ cross currency debt securities liabilities as a proxy for non-financial corporates’ hedging demand, and institutional holdings of USD denominated bonds hedged for currency risk as a proxy for hedging demand in the USD/JPY currency pair. To assess risk, they used the credit default swap spreads for the three nations, and the VIX index was used as a proxy for funding liquidity risk. Market liquidity was proxied by bid-ask spreads on the various currency pairs. The methodologies employed included unit root tests to examine the stationarity of the spreads, the autoregressive distributed lag (ARDL) bounds test to check for cointegration, Granger causality tests to determine the effect of FX hedging demand on CIP deviations, and the use of an Error Correction Model (ECM) that incorporated the residuals from the cointegration equation.

The unit root tests failed to reject the null hypothesis of a unit root for longer maturity CIP deviations, indicating that CIP was non-stationary in the long run and did not hold. The ARDL test identified cointegration in seven out of nine currency pairs. Additionally, the Granger causality test found that changes in FX hedging demand tended to Granger cause CIP deviations, but CIP deviations did not Granger cause changes in FX demand. The ECM model

further revealed that FX hedging demand influenced the long run level of CIP deviations, with more net short (long) FX hedging demand for USD correlating with more negative (positive) CIP deviations.

### *2.2.2 Uncovered Interest Parity*

Othieno (2012) employed a cointegrated vector autoregressive (VAR) approach to test for the presence of parity relations between Kenya and Uganda. They utilized Kenyan and Ugandan Consumer Price Index (CPI) level data, T-bill rates for both countries, and the KES/UGX exchange rate. Using the Augmented Dickey-Fuller (ADF) test, they found that the series for deviation from Purchasing Power Parity (PPP) would be stationary at the 1%, 5%, or 10% significance level if the calculated ADF statistic was less than the critical values of -3.5713 (for the 1% significance level), -2.5923 (for the 5% significance level), and -2.599 (for the 10% significance level), respectively. All the calculated ADF statistics were significant, except for the statistic showing real interest parity between Kenya and Uganda, which was significant at the 5% level. From the analysis, they concluded that the Purchasing Power Parity and Uncovered Interest Parity relationships do not hold between Kenya and Uganda.

Kisaka (2017) used a vector error correction model (VECM) instead of the Granger causality test and found that the null hypothesis (that the coefficient of the error correction term is equal to 1) was rejected at all horizons, with the coefficient being negative. They concluded that the forward premium puzzle exists in the foreign exchange market in Kenya. Additionally, the first difference of the forward premium variable was found to be significant at all horizons. Thus, they concluded that the foreign exchange rate market exhibits the forward premium puzzle, that foreign exchange rates and interest rates are non-stationary, and that the forward premium contains information that can improve the accuracy of foreign exchange rate forecasts.

On the other hand, Nwiado (2016) collected panel exchange rate data from Kenya, Ghana, Cape Verde, Nigeria, Egypt, and Botswana for the period 2003–2012. After conducting a Johansen Fisher cointegration test, they found that the null hypothesis of no cointegration was

rejected for some countries, but not all. They chose to use a panel data analysis to account for heterogeneity between countries, which could not be addressed by a cross-sectional analysis. Additionally, after conducting unit root tests, they failed to reject the null hypothesis that none of the exchange rates were stationary.

They concluded that both exchange rates and interest rates for all currencies had unit roots, meaning they were stochastic, deterministic, and trend non-stationary time series data. This finding was consistent with the cross-sectional work done by Kisaka (2017), which concluded the same for the Kenyan shilling.

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On the other hand, Nwiado (2016) collected panel exchange rate data from Kenya, Ghana, Cape Verde, Nigeria, Egypt, and Botswana for the period 2003–2012. After conducting a Johansen Fisher cointegration test, they found that the null hypothesis of no cointegration was rejected for some countries, but not all. They chose to use a panel data analysis to account for heterogeneity between countries, which could not be addressed by a cross-sectional analysis. Additionally, after conducting unit root tests, they failed to reject the null hypothesis that none of the exchange rates were stationary. They concluded that both exchange rates and interest rates for all currencies had unit roots, meaning they were stochastic, deterministic, and trend non-stationary time series data. This finding was consistent with the cross-sectional work done by Kisaka (2017), which concluded the same for the Kenyan shilling.

### 2.3 Conceptual Framework

The key theories driving carry trade returns, as discussed above, are the Uncovered Interest Parity (UIP) and Covered Interest Parity (CIP) relationships. The former strongly suggests that a shilling carry trade should not be possible, whereas the latter implies that a hedged or covered carry trading strategy should not be feasible either.

3-month T-bill rates from other East African countries were chosen during this period because they were the most liquid markets in the region with the lowest barriers to capital flows, thus presenting an attractive carry trade opportunity for institutions with access to Kenya Shilling-denominated credit. Additionally, I used the Kenyan repo rate, with a fixed arbitrary spread, to represent the borrowing rate that institutions without access to the repo market would have had to pay. These three data points, alongside spot exchange rate data, were used to compute carry trade returns, without factoring in transaction costs. To track the relationship between the Kenya shilling carry trade and global systemic risk factors, I selected the VIX (Volatility Index) as a proxy for global financial system risk. This would help in observing whether the “East

African carry trade" is immune to or isolated from global systemic risk. To assess the diversifying properties of the strategy, I decided to use the NSE 20 index returns as a proxy for Kenyan equity market returns. I constructed a portfolio consisting of the three carry trades as assets, alongside the NSE 20 index, and created a portfolio consisting solely of the carry trades themselves.

# 3. METHODOLOGY

## 3.1 Introduction

This chapter represents the methodology of the research. It gives a detailed description of the type of data used, its treatment as well as the various sources of said data, the research design employed, the econometric model and techniques used in analysing the data. This chapter also provides a clear outline of how the research questions of this research will be answered as well as tested. This chapter will help in the presentation of results in the following chapter.

This study aims to evaluate the profitability and risk characteristics of carry trade strategies using the Rwandan Franc, Ugandan Shilling, and Tanzanian Shilling, with the Kenyan Shilling serving as the funding currency. The methodology outlined in this section provides a detailed approach to computing carry trade returns, testing their statistical properties, and analysing the diversification benefits and resilience of these strategies in the context of global financial risk and liquidity indicators.

## 3.2 Research Design

The research employs a portfolio construction and panel regression approach naive carry trade returns and then conducts various statistical tests to evaluate the properties of these returns. A mean variance portfolio is constructed to assess diversification benefits relative to the NSE 20 Index, and a panel regression is performed to explore the relationship between carry trade returns and global financial risk indicators.

The research design is thus structured to systematically investigate the profitability, risk characteristics, and resilience of carry trades in the East African context.

## 3.3 Research Question and Hypothesis

### *3.3.1 Research Question:*

Are carry trade strategies using East African currencies profitable, and what are their risk and return characteristics?

Hypotheses:

1. The carry trade returns are negatively skewed, consistent with findings in existing literature.

2. The carry trade strategy offers diversification benefits relative to the NSE 20 Index.

3. The carry trade returns are significantly influenced by global financial system risk (as proxied by the VIX) and funding liquidity (as proxied by the TED spread).

### *3.3.2 Population and Sample*

The population for this study includes exchange rates and interest rates across East African currencies from Q1 2014 to Q1 2024. The sample consists of 91-day T-bill auction data from Kenya, Rwanda, Tanzania, and Uganda, as well as exchange rate data for KES/UGX, KES/TZS, and KES/RWF.

Additionally, data on the VIX, 3-month LIBOR rate, 3-month U.S. T-bill rate, and the NSE 20 Index will be used.

## 3.5 Data Collection Methods

The secondary data for this study will be collected from multiple sources:

91-day T-bill auction yields, and Repo rates will be obtained from the Central Bank of Kenya, National Bank of Rwanda, the Bank of Uganda, and the Bank of Tanzania websites.

Exchange rate data for the KES/UGX, KES/TZS, and KES/RWF pairs will be sourced from the Central Bank of Kenya.

VIX data will be sourced from Yahoo Finance.

NSE 20 Index data will be obtained from the Nairobi Stock Exchange.

3-month LIBOR rate and 3-month U.S. T-bill rate will be retrieved from the FRED Database for computing the TED spread.

## 3.6 Data Analysis Technique

The analysis begins with the computation of naive carry trade returns using the interest rate differential of the target currencies (RWF, UGX, TZS) and the funding currency (KES) as the parameter that determines whether the shilling is either bought or sold against the other

currency. For instance, if Kenyan T-bill yields are higher than Tanzanian T-bill yields, the model borrows and sells Tanzanian shillings against Kenya shillings and Kenyan 3-month T-bills are purchased. Alternatively, if Tanzania yields rise higher than Kenyan yields, Kenya shillings are borrowed and sold to buy Tanzanian shillings and allocated to 3-month Tanzanian T-bills.

### *3.6.1Return Computation*

I designed my research to use the conventional carry trade return model employed by Juan Laborda (2014) and Kent Daniel (2017), adjusted to account for quarterly time periods:

$$Z_{t+1} = \left[ \frac{(1 + i_t^*)^{\frac{1}{4}} * S_{t+1}}{S_t} - (1 + i_t^{KES})^{\frac{1}{4}} \right] y_t \quad (3.1)$$

where:

$Z_{t+1}$ denotes the payoff of the trade at time t+1 (one quarter or three months period),

$i_t^*$ denotes the one-year target/foreign currency interest rate (e.g., Rwandan Franc, Ugandan Shilling, Tanzanian Shilling),

$i_t^{KES}$ denotes the one-year funding currency interest rate (in this case, the Kenyan Shilling),

$S_{t+1}$ denotes the spot exchange rate of Kenya Shillings (KES) per unit of target currency at time t + 1 (a quarter later),

$S_t$ denotes the spot exchange rate of Kenya Shillings (KES) per unit of target currency at time t (the current quarter),

$y_t$ denotes the trade quantity or investment amount at time t.

The rule used in computing returns being that the higher interest rate currency is taken as the target currency whereas the lower interest rate currency is taken as the funding currency for each quarter. Preliminary tests will then be conducted to evaluate the statistical properties of these returns, including mean, variance, skewness, kurtosis, stationarity, and unit root tests. Correlation and co-movement tests against quarterly NSE 20 all share index returns as a benchmark will also be done. The Sharpe ratio will be calculated using the 91-day T-bill rate as the risk-free rate.

### *3.6.2 The Mean-Variance (Markowitz) portfolio.*

The mean-variance portfolio is a portfolio optimization method developed by Harry Markowitz in his 1952 paper titled Portfolio Selection. This method considers two variables: mean returns and variance of returns. The objective is to minimize variance at a given level of returns or, conversely, to maximize

returns at a given level of variance. In other words, as per Markowitz (1952), the rule suggests that investors (or should) consider expected return as desirable and variance of returns as undesirable. This rule can be taken as a maxim and hypothesis about investment behaviour.

Building on this, a mean-variance portfolio of the carry trades will be constructed to evaluate the diversification benefits in comparison to the NSE 20 Index. The portfolio's performance will be assessed against the NSE 20 Index to determine its potential for allocation by regional portfolio managers.

The decision to utilize mean-variance optimization is based on the explicit link it draws between risk and return—both of which are relevant and easily computable statistical measures that will provide insights into the desirability of the East African carry trade from a portfolio management perspective.

Given that the carry trade strategy is inherently leveraged, and that leverage ratios depend on discretionary factors, a leverage ratio of 4:1 has been chosen, which is in line with industry norm not usually exceeding five times leverage.

The returns and variance of a 4-asset portfolio, consisting of the NSE-20 All Share Index (NSE20), Kenya Shilling/Rwanda Franc carry returns (KESRWF), Kenya Shilling/Tanzania Shilling carry returns (KESTZS), and Kenya Shilling/Uganda Shilling carry returns (KESUGX), will be calculated as follows:

$$\mu_P = \mu_{KRW} * w_{KRW} + \mu_{KUG} * w_{KUG} + \mu_{KTZ} * w_{KTZ} + \mu_{NS20} * w_{NS20} \quad (3.2)$$

$$\begin{aligned}\sigma_p^2 = {} & w_{KRW}^2\sigma_{KRW}^2 + w_{KUG}^2\sigma_{KUG}^2 + w_{KTZ}^2\sigma_{KTZ}^2 + w_{NS20}^2\sigma_{NS20}^2 + \\ & 2w_{KRW}W_{KUG}Cov(\mu_{KRW},\mu_{KUG}) + 2w_{KRW}W_{NS20}Cov(\mu_{KRW},\mu_{NS20}) + \\ & 2w_{KUG}W_{KTZ}Cov(\mu_{KUG},\mu_{KTZ}) + 2w_{KUG}W_{NS20}Cov(\mu_{KUG},\mu_{NS20}) + \\ & 2w_{KRW}W_{KUG}Cov(\mu_{KRW},\mu_{KUG}) + 2w_{KTZ}W_{NS20}Cov(\mu_{KTZ},\mu_{NS20})\end{aligned} \quad (3.3)$$

Where:

$\mu_i$ denotes mean returns for each asset, and $\mu_P$ denotes mean portfolio returns.

$w_i$ denotes portfolio weights.

$\sigma_i^2$ denotes individual asset variance while $\sigma_p^2$ denotes portfolio variance.

$Cov(\mu_i, \mu_j)$ denotes covariance of asset returns.

$KRW$ denotes the Kenya shilling / Rwanda Franc carry strategy

$KUG$ denotes the Kenya shilling / Uganda Shilling carry strategy

$KTZ$ denotes the Kenya Shilling / Tanzania Shilling carry strategy

The Portfolio optimization will be done via minimization of Portfolio variance such that the constraints are as follows:

No short selling, such that:

$$(w_{KRW}, w_{KRW}, w_{KRW}, w_{KRW} \geq 0) \tag{3.4}$$

And weights add up to 100% such that $(w_{KRW} + w_{KRW} + w_{KRW} + w_{KRW} = 1)$

Variance is then minimized as such: $Min(\sigma_p^2)$ , following the below steps:

Portfolio variance is given in vector form as:

$$\sigma_p^2 = w^T \sum w \tag{3.5}$$

Whereby $w$ is the vector of portfolio weights:

$$[w_{KRW}, w_{KUG}, w_{KTZ}, w_{NS20}] \tag{3.6}$$

And $\sum w$ is the covariance matrix of asset returns, that would be expressed like so in matrix form:

$$\begin{bmatrix} \sigma_{KRW}^2 & Cov(R_{KRW}, R_{KUG}) & Cov(R_{KRW}, R_{KTZ}) & Cov(R_{KRW}, R_{NS20}) \\ Cov(R_{KUG}, R_{KRW}) & \sigma_{KUG}^2 & Cov(R_{KUG}, R_{KTZ}) & Cov(R_{KUG}, R_{NS20}) \\ Cov(R_{KTZ}, R_{KRW}) & Cov(R_{KTZ}, R_{KUG}) & \sigma_{KTZ}^2 & Cov(R_{KTZ}, R_{NS20}) \\ Cov(R_{NS20}, R_{KRW}) & Cov(R_{NS20}, R_{KUG}) & Cov(R_{NS20}, R_{KTZ}) & \sigma_{NS20}^2 \end{bmatrix} \tag{3.7}$$

The covariance matrix is then inverted such:

$$\left(\sum w\right)^{-1} \tag{3.8}$$

Afterwards, the inverted matrix is multiplied by a vector of ones whereby $1 = [1,1,1,1]^T$ to get $(\sum w)^{-1} * 1$ , then multiply this by the vector of ones to obtain the scalar:

$$1^T * (\sum w)^{-1} * 1 \tag{3.9}$$

The inverted matrix that was multiplied by the vector of ones is then divided by the scalar to obtain the optimal portfolio weights $w^*$ as follows:

$$w^* = \frac{(\sum w)^{-1} * 1}{1^T * (\sum w)^{-1} * 1\,.} \tag{3.9}$$

### 3.6.3 Panel Regression

Finally, a panel regression analysis will be performed, with the equal-weighted carry trade returns as the dependent variable and the VIX and TED spread as independent variables. This regression will test the resilience of the carry trade strategy to global financial and funding liquidity shocks.

A panel regression of the three carry trade returns was chosen due to its ability to control for unobserved heterogeneity. Panel regression allows for controlling unobserved heterogeneity by accounting for individuals' specific effects (fixed or random). This is particularly useful when there are country specific factors in the study that might influence carry trade returns but are not directly observable or measurable. In this study, each country (Rwanda, Uganda, Tanzania) may have unique characteristics influencing carry trade returns, such as specific monetary policies or economic conditions. Panel regression, therefore, controls for these country-specific factors, providing more accurate estimates of the effects of the VIX and TED spread.

Additionally, panel regression models help mitigate endogeneity issues, particularly through fixed effects, if the Hausman test allows for it. By controlling for time-invariant unobserved variables, fixed effects models reduce bias that might result from omitted variable bias.

Exchange rate volatility was decided to be included as a control variable in the model. This is because exchange rate volatility can significantly impact carry trade returns by influencing the risk-adjusted returns from currency pairs. High volatility may lead to large fluctuations in

returns, affecting the overall profitability and risk profile of carry trades in ways that are not necessarily linked to global financial factors.

The exchange rate of each pair in this study is computed using the quarterly standard deviation of daily changes in the exchange rate for each currency pair over the same period. Including this control variable will allow the model to account for the inherent risk in currency movements that may not be captured by the VIX or TED spread.

Hence, the Panel regression will be specified as follows:

$$CarryReturn_{it} = \alpha + \beta_1 TED_t + \beta_2 VIX_t + \beta_3 FX.Vol_{it} + \varepsilon_{it} \quad (3.11)$$

Whereby:

$CarryReturn_{it}$ is the equal-weighted carry trade log return for country i at time t.

$\alpha$ is the intercept.

$VIX_t$ is the VIX index at time t, representing global financial system risk.

$TED_t$ is the TED spread at time t, representing funding liquidity risk.

$FX.Vol_{it}$ represents the exchange rate volatility for country iii at time t.

$\beta_1$ , $\beta_2$ , $\beta_3$ are the coefficients for the respective variables.

$\varepsilon_{it}$ is the error term.

*Estimation Method:*

The panel regression will likely be estimated using a fixed effects model to control for unobserved heterogeneity across the different countries in the sample. The fixed effects model is appropriate as it controls for country specific characteristics that may influence carry trade returns but remain constant over time.

Alternatively, a random effects model could be considered if the assumption of no correlation between the individual effects and the explanatory variables holds. A Hausman test will be conducted to determine the appropriate model between fixed and random effects.

*Diagnostic Tests:*

Serial Correlation: Panel data may exhibit autocorrelation, where the error terms are correlated over time. Tests like the Breusch-Godfrey test will be employed to detect this issue.

Heteroskedasticity: The variance of the error terms may not be constant across entities. To detect heteroskedasticity, tests such as the Breusch-Pagan test will be applied.

Cross-Sectional Dependence: To detect if the residuals are correlated across entities, which can bias standard errors, the Pesaran CD test will be used.

### 3.8 Conclusion

This methodology outlines a comprehensive approach to evaluating the selected carry trade strategies in East Africa. It covers calculating returns, assessing their statistical properties, constructing a diversified portfolio, and testing the strategy's resilience to global financial risks. By systematically analysing these elements, the study aims to provide insights into the profitability and risk characteristics of carry trades. The findings have implications for regional portfolio managers and investors regarding the potential inclusion of carry trades in their portfolios.

# 4. RESULTS AND ANALYSIS

# Panel regression

## 4.1 Introduction

This chapter presents the results of the panel data analysis on the East African carry trade, focusing on the impact of key financial variables such as TED spread, VIX futures, currency return, and currency volatility. The data spans from Q1 2013 to Q1 2024, enabling a comprehensive examination of trends and relationships over time. Descriptive statistics, diagnostic checks, and the final model selection are discussed, culminating in the interpretation of coefficients to uncover the economic implications of each factor on carry returns.

Portfolio optimization will also be needed to evaluate the diversification benefits of the three carry strategies to the NSE20 all share index.

## 4.2 Summary Statistics

The summary statistics provide an overview of the key variables used in this study. Table 1 outlines the mean, standard deviation, minimum, and maximum values for the primary variables, offering insights into the data's central tendencies and variability.

***Table 4.1: Summary Statistics***

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| TED Spread | 0.27 | 0.208 | 0.013 | 1.35 |
| VIX Futures | 18.82 | 6.97 | 11.32 | 51.33 |
| Currency Return | 0.030 | 0.048 | -0.179 | 0.200 |
| Currency Volatility | 0.246 | 0.281 | 0.031 | 2.204 |

*The descriptive statistics reveal variability across key variables. The average TED spread is 0.27, with a notable range, indicating periods of differing funding market stress. VIX futures, a proxy for market volatility, average at 18.82, with peaks that may correspond to global financial uncertainty such as the global financial crisis. Currency return and volatility also display significant variation, reflecting fluctuations in East African currency stability.*

## 4.3 Diagnostic Checks

### *4.3.1 Stationarity Tests*

To ensure reliability, stationarity was tested using the Fisher-type unit root test based on the augmented Dickey–Fuller (ADF) approach. Results showed that TED spread, VIX futures, and currency return are stationary at levels, with p-values less than 0.05, as summarized in Table 2. Currency volatility required differencing to achieve stationarity, as shown in Table 2.

***Table 4.2: Stationarity Results***

| Variable | P-value | Stationarity |
|---|---|---|
| TED Spread | 0.0000 | Stationary |
| VIX Futures | 0.0000 | Stationary |
| Currency Return | 0.0002 | Stationary |
| Currency Volatility | 0.0246 | Non-stationary at levels, stationary after first difference |

These results confirm that most variables are stationary at levels, while currency volatility is stationary after differencing, making them suitable for further analysis.

### *4.3.2 Multicollinearity test*

Variance Inflation Factor (VIF) tests were conducted to assess multicollinearity among independent variables. All VIF values were below 2, with a mean VIF of 1.22, indicating no significant multicollinearity concerns.

***Table 4.3: VIF Results***

| Variable | VIF |
|---|---|
| TED Spread | 1.32 |
| VIX Futures | 1.32 |
| Currency Volatility | 1.01 |
| Mean VIF | 1.22 |

This suggests that multicollinearity does not significantly impact the model, allowing reliable interpretation of coefficients.

### *4.3.3 Heteroskedasticity*

The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity indicated that heteroskedasticity is present (p-value = 0.0000). Robust standard errors were applied to the model to address this issue, ensuring valid inferences.

## 4.4 Discussion of Results

### *4.4.1 Model Selection and Tests*

#### *4.4.1.1 Fixed Effects vs. Random Effects*

The Hausman test compared the fixed and random effects models, yielding a chi-squared statistic of 0.85 with a p-value of 0.3574. Since the p-value is significantly greater than 0.05, the null hypothesis is not rejected, indicating that the random effects model is preferred due to its efficiency under the null hypothesis.

#### *4.4.1.2 F-test for Fixed Effects vs. Pooled OLS*

To further evaluate model suitability, an F-test compared the fixed effects model to pooled OLS. The p-value of 0.0733, less than 2.5 hence suggesting no significant difference, allowing pooled OLS with robust standard errors to be used for simplicity and efficiency.

#### *4.4.1.3 Breusch-Pagan Test for Random Effects*

The Breusch-Pagan Lagrange Multiplier (LM) test yielded a p-value of 0.2213, hence further supporting the use of pooled OLS over the random effects model due to the lack of significant entity effects.

#### *4.4.1.4 Autocorrelation Test*

The Portmanteau test for within-group correlation yielded a p-value of 1.000, indicating no evidence of within-group correlation and supporting the assumption of independence over time.

### 4.4.2 Interpretation of Coefficients

The results of the pooled OLS regression with robust standard errors are presented in Table 4. The regression evaluates the influence of TED spread, VIX futures, and currency volatility on currency return.

**Table 4.4: Pooled OLS Regression Results**

| Variable | Coefficient | Std. Error | t-value | p-value | Significance |
|---|---|---|---|---|---|
| VIX Futures | 0.00048 | 0.00065 | 0.73 | 0.470 | Not significant |
| Currency Volatility | -0.052 | 0.0143 | -3.66 | 0.000 | *** |
| TED Spread | 0.00217 | 0.0221 | 0.10 | 0.922 | Not significant |
| Constant | 0.0337 | 0.0121 | 2.79 | 0.006 | ** |

*Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10*

#### *4.4.2.1 VIX Futures*

The coefficient for VIX futures is 0.00048, with a p-value of 0.470, indicating no statistically significant impact on currency return. This suggests that global market volatility, as proxied by the VIX, does not significantly influence the returns in this East African carry trade setting.

#### *4.4.2.2 Currency Volatility*

The coefficient for currency volatility is -0.052, significant at the 1% level (p-value = 0.000). This negative coefficient indicates that a 1% increase in currency volatility corresponds with a 0.052-point reduction in currency returns. The result implies that increased volatility in currency pairs is detrimental to returns, potentially due to instability impacting carry trade

profitability. This is in line with the conventional finance literature regarding the inverse relationship between asset price volatility and asset returns.

#### *4.4.2.3 TED Spread*

TED spread's coefficient is 0.00217, but it is not statistically significant (p-value = 0.922). This suggests that, within the sample period, TED spread fluctuations do not play a critical role in driving currency return in this carry trade setup. This goes against the findings of (Brunnermeier, 2008) where they find that the TED spread had a strong negative effect on carry returns but primarily for developed market currencies. This is likely because the rise in TED spreads coincided more closely with constrictions in funding liquidity in developed market. Eat African markets seem to be far more insulated to these funding liquidity shocks due to their low level of interconnectedness of the financial systems. Not to the more plausible explanation that Kenya shilling, Uganda shilling and Tanzania shilling funding markets are likely not very connected to the dollar funding market. Second order effects hence are seemingly weak.

### 4.5 Conclusion

The pooled OLS regression, with robust standard errors to control for heteroskedasticity, highlights currency volatility as a key determinant negatively impacting returns in the East African carry trade. While TED spread and VIX futures do not show significant effects, the currency pair volatility findings illuminate a lot to portfolio managers and regulators what is most relevant to carry returns. It seems the east African carry trade is fairly insulated from global shocks, after accounting for the most plausible endogenous variable. This finding specifically within the context of carry trades is supported by the findings of (Gino Cenedese, 2014) where they find that high foreign exchange market variance does tend to signal future negative carry trade returns.

Initially it is theorized that the East African carry trade would at least be partially driven by foreign speculators such as global macro funds as they get margin called on their other positions in other jurisdictions hence forcing them to even unwind unaffected positions, but it seems their footprint in East African financial markets is not large enough to witness such a contagion effect. That is, during global crises they would be forced to close all positions be they profitable or loss making in order to survive, alongside redemptions by panicked investors as a second

order of the crises, (where VIX futures and TED spread tend to also rise significantly). But it can be said that this is unlikely as per our regression test, that is, at the very least these events do not tend to coincide.

In conclusion, it can be said that the main concern to portfolio managers when managing their carry portfolios should be matters such as divergences in monetary policy between East African central banks and factors such as trade imbalances and capital flows that may drive currency volatility and movements more directly.

It may also interest foreign portfolio managers to give a small allocation to this strategy as a diversifier that is to a significant extent insulated against global financial market shocks.

# Portfolio Optimization

To evaluate the diversification properties of the east African carry trade to the NSE 20 all share index, a four-asset portfolio optimization is used where each individual carry strategy is taken as an asset and assumed an investment universe comprising these assets and the NSE 20 index. This is done for the period Q1 2014 to Q1 2024.

### 4.6 Analysis of Asset Returns:

#### *4.6.1 Correlation Matrix*

A correlation matrix of the 4 assets to get an idea of the diversification potential of these assets is constructed:

| | *4X.QTR.KESRWF* | *4X.QTR.KESUGX* | *4X.QTR.KESTZS* | *NSE20.QTR* |
|---|---|---|---|---|
| 4X.QTR.KESRWF | 1 | | | |
| 4X.QTR.KESUGX | 0.633880194 | 1 | | |
| 4X.QTR.KESTZS | 0.547834099 | 0.550247082 | 1 | |
| NSE20.QTR | -0.274526409 | -0.208280031 | -0.20767825 | 1 |

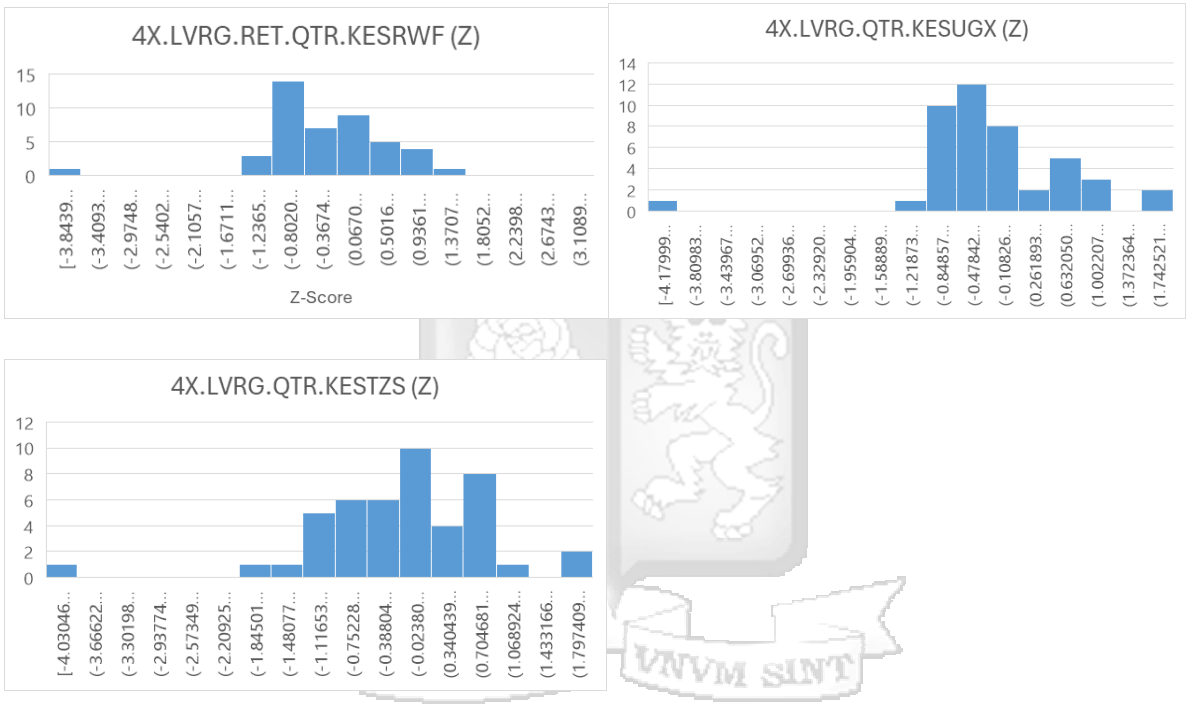
***Figure 4.1: A correlation matrix of the 4 assets in the portfolio***

It was found that the three carry strategies are fairly corelated with one another, likely explained by the common component in their returns that is Kenyan 91-day treasury bill yields used in all three calculations as well as the currency pairs generally being correlated because of the Kenya shilling component. These correlations, however, are not very strong. It is observed that

the NSE 20 is inversely correlated against all three carry strategies hence already hinting at the diversification potential of these three assets early on.

### *4.6.2 Distribution of asset returns*

***Figure 4.2: Histogram of the z-scores of the asset's returns***




*Histogram of Z-scores of carry trade returns. KESUGX and KESTZS exhibit visibly negatively skewed returns*

In line with the mainstream literature on the topic, it is found that the East African carry trade seems to be generally negatively skewed, with the quarterly returns on the three East African carry trades having the following Skewness figures: The KESRWF carry trade strategy exhibited the lowest degree of negative skewness at -0.18, KESUGX carry trade strategy had a skewness of -1.01 whereas KESTZS carry trade strategy exhibited a skewness of -1.15.

Within the usual interpretation of Skewness figures, KESTZS and KESUGX exhibit highly negatively skew while KESRWF is not significantly skewed, which was an unexpected

outcome. It is also interesting to note that the degree of negative skewness tracks with the returns of the three strategies such that the highest and second highest returning strategies had the highest and second most negatively skewed distribution of returns.

### 4.7 Obtaining the Weights

Unlike the Panel regression, annual returns and variance are used given the high transaction costs involved in east African foreign exchange and fixed income markets. In addition to this, for sake of applicability of the strategy, a more realistic rebalancing horizon of a year, or every 4 quarters is hence chosen. The optimization, done on Python yields very interesting results with regards to weights, but an analysis of the Sharpe ratios of these individual assets explains them. It is found that, in line with the international academic literature on the carry trade, these east African carry strategies do indeed have high Sharpe ratios relative to the stock index.

The Kenya Shilling / Rwanda franc carry trade has an average Sharpe ratio of 0.4, the Kenya Shilling / Uganda shilling carry trade had an average Sharpe ratio of… the Kenya Shilling / Uganda Shilling carry trade had an average Sharpe ratio of 0.2, the NSE 20 index (not including dividends) has the lowest average Sharpe ratio of -1.5, whereas the Kenya Shilling / Tanzania Shilling carry trade boasted the highest average Sharpe ratio of 4.1.

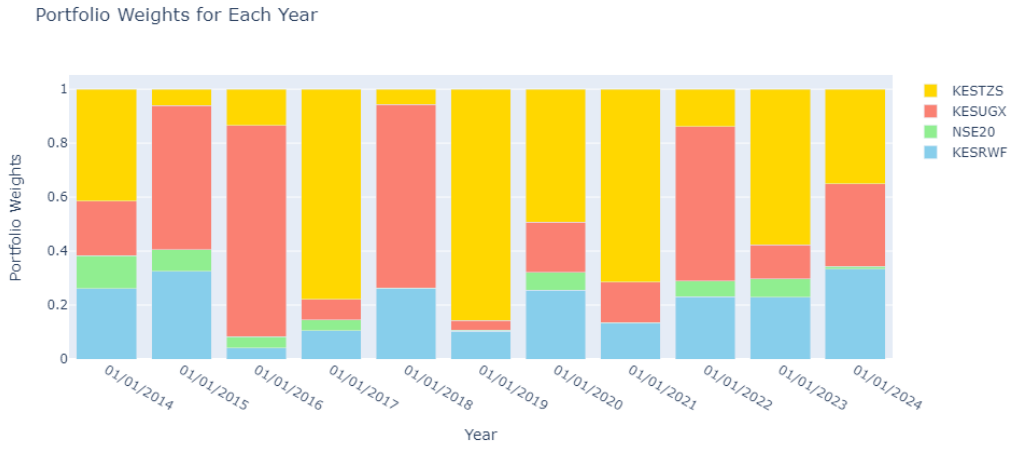



***Figure 4.3: The MVO portfolio weights in a stacked bar chart***

*The weighting allocated to the NSE20 is consistently very low given it has the poorest risk adjusted return and allocation to KESTZS is consistently very high given its superior Sharpe ratio*

The poor risk adjusted returns of the NSE 20 index is largely driven by the poor ten years it has had since peaking around 2015 where it has not seen its highs since then, being dragged down by poor capital gains. The KES/TZS carry strategy on the other hand has consistently very high Sharpe largely driven by it having very few years of negative returns as well as very low volatility compared to every other asset in the investment universe.

Using the past year's returns and standard deviation, the weights are applied to the following year's allocation, leading to an improvement of Sharpe ratio across the board compared to that of majority of the assets on an individual basis. This yields an average Sharpe ratio of 2.66522, which was heavily skewed by 2023 whereby the shilling was heavily shorted versus the other currencies, yielding very high returns as it gradually weakened during that year and the trade made a good amount off of the yield differential also.

### 4.8 Comparison to equal weight strategy

To further evaluate the diversification benefits of the carry trade strategy, an equal weight 4-asset portfolio is created that allocated to the three carry strategies and the NSE20 index, so as to also evaluate the benefits of applying mean-variance optimization in managing a set of carry trading strategies that can individually be treated as assets.

***Table 4.5: comparison of the MVO portfolio and the equal weight portfolio***

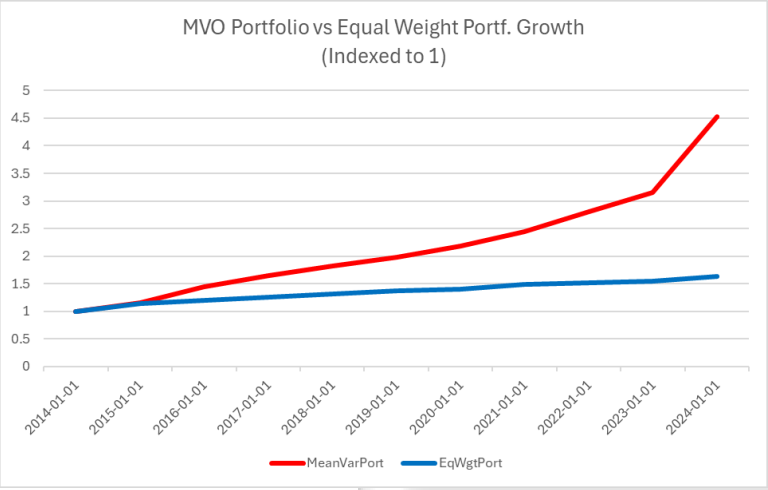
| DATE | MVO. PORT.RET | PORTF. STD.DEV | SHARPE | EQ.WGT. PORT.RET | EQ.WG. STDDEV | SHARPE |
|---|---|---|---|---|---|---|
| 2015-01-01 | 0.1519 | 0.0275 | 2.4265 | 0.1325 | 0.0209 | 2.2543 |
| 2016-01-01 | 0.2496 | 0.0454 | 3.1069 | 0.1153 | 0.0508 | 0.1340 |
| 2017-01-01 | 0.1404 | 0.0767 | 0.7155 | 0.0442 | 0.0528 | -0.7820 |
| 2018-01-01 | 0.1054 | 0.0318 | 0.7735 | 0.0782 | 0.0529 | -0.0491 |
| 2019-01-01 | 0.0936 | 0.0433 | 0.4705 | 0.0220 | 0.0426 | -1.2010 |
| 2020-01-01 | 0.0985 | 0.0235 | 1.1271 | 0.0243 | 0.0221 | -2.1577 |
| 2021-01-01 | 0.1198 | 0.0159 | 3.1930 | 0.0030 | 0.0591 | -1.1162 |
| 2022-01-01 | 0.1485 | 0.0283 | 2.6742 | 0.0461 | 0.0185 | -1.4416 |
| 2023-01-01 | 0.1246 | 0.0298 | 1.0398 | 0.0868 | 0.0206 | -0.3371 |
| 2024-01-01 | 0.4365 | 0.0249 | 11.1252 | 0.3310 | 0.0583 | 2.9387 |

*The MVO portfolio had consistently positive Sharpe ratio while the Equal Weight portfolio had negative Sharpe in all years but three.*

Not only did the MVO portfolio display superior absolute returns to the Equal weight portfolio but on average had a much better Sharpe ratio of 2.66522 as compared to -0.17576 for the equal weight. This is largely explained by the equal weight portfolio dogmatically allocating 25% weight to the NSE20 regardless of risk adjusted returns. As a result, this led to under allocating to the higher Sharpe ratio assets which were the three carry strategies.

It must be said, however, that this is potentially attributable to the period chosen because the performance of Kenyan equities in the past 10 years has been far below its annualized return since the inception of the MSCI Kenyan Equities index of 13% in dollar terms.

***Figure 4.4: MVO portfolio versus Equal-Weight portfolio performance scaled to 1***




*The MVO portfolio thoroughly outperforms the Equal weight portfolio by a factor of almost three. Which is a poor showing especially given that the carry strategies are levered 4 times.*

# 5. CONCLUSION

## 5.1 Summary of Findings

### *5.1.1 Panel Regression*

This study set out to find out the relationship between global risk factors and the East African Carry Currency Trade, as well as finding out the diversification properties of the East African Currency Carry Trade to Kenyan Equities. This was to answer the question of whether the East African Currency Carry Trade is indeed exposed to global shocks. Specifically, it examined the effects of two mainstream global financial market risk measures on East African Currency Carry Trade returns. These risk factors were namely: the TED Spread and VIX futures. The motivation behind this analysis stems from the episodes seen on the Kenya shilling over the years, notably in 2011 and early 2024

The analysis was carried out using balanced and unbalanced panel data from 19 and 33 African countries, respectively, across the years 2005 to 2022.It is found that the global risk factors had a statistically insignificant effect on East African Currency Carry Trade returns. In the pooled OLS regression done, the coefficients were as follows: 0.00048 ($p = 0.470$) for VIX Futures and 0.00217 ($p = 0.922$) for the TED Spread. Both were insignificant whereas the only explanatory variable that did exhibit statistical significance was Currency volatility, with the coefficients -0.052 ($p = 0.000$). These panel regression results suggest that global risk factors as proxied by VIX futures contract prices and the TED spread do not have direct influence on East African Currency Carry Trade returns, but currency volatility does. It is hence proven that for each one percent increase in currency pair volatility, East African Currency Carry Trade returns fall by 0.052 percentage points, which is small, but statistically significant, which is in line with the carry trade literature where less volatile currency pairs tend to be favoured for carry trades even if they have smaller interest rate differentials. A counterintuitive result found however, was that despite the coefficients of the global risk factors being statistically insufficient, they were not even slightly negative.

Finally, diagnostic tests highlighted some concerns. The Durbin-Watson test indicated no significant autocorrelation in total exports and imports but did reveal positive autocorrelation in the proportion models, suggesting serial correlation in these variables. Additionally, the

Breusch-Pagan test confirmed the presence of heteroskedasticity in the model but was adjusted for using robust Standard Errors.

### *5.1.2 Mean-Variance Optimized Portfolio*

When Mean-Variance Optimization was carried out on the quarterly returns of the portfolio comprised of the three East African Currency Carry Trades and the NSE 20 Index, it was found that the carry trades consistently dominated the NSE 20 in terms of weighting such that they were given very large weightings relative to the Index. This is explained by the superior risk-adjusted returns of these three strategies if treated as assets on their own, considering that the NSE 20 was the only asset with a negative Sharpe ratio for this period of -1.5.

In terms of their diversifying potential, the three currencies carry trade strategies were significantly correlated with one another, largely explained by the Kenya shilling being the unifying factor whereby Kenyan macroeconomic news would affect all three strategies through both the exchange rate channel and the interest rate differential channel. Despite this, they were all significantly negatively correlated against the NSE 20 Index, with correlation coefficients of 0.27, 0.21 and 0.21 for KESRWF, KESUGX and KESTZS carry strategies against the NSE 20 Index respectively.

With regards to the performance of the Mean-Variance Optimization model, it significantly outperformed the naïve equal weight portfolio in terms of risk-adjusted returns, boasting a Sharpe ratio of 2.67 versus the naïve equal weight portfolio's -0.17. Even using a naïve equal weighting, the portfolio still has superior risk-adjusted performance relative to the NSE 20 index on its own, which is itself a diversified portfolio of blue-chip Kenyan equities. This further illustrates the diversification benefits of the strategy to investor portfolios.

Tests for skewness were also carried out to confirm if East African Currency Carry Trades share the characteristics if their emerging and frontier market peers of having significantly negatively skewed returns. Findings indicated that they all were negatively skewed, with figures of -0.18. -1.10 and -1.15 for KESRWF, KESUGX and KESTZS respectively, with only KESRWF not having significantly negatively skewed returns. This aligned with the mainstream currency carry trade literature.

## 5.2 Conclusions

The results of this study contribute novel and much-needed insights into the factors that drive carry trade returns as well as its potential as a mainstream investment in future and viable diversifier to East African equities markets. The findings reveal a counterintuitive discovery, that despite the growing globalization of African financial markets, sections of these markets are still insulated from global shocks. This is such that investment strategies like currency carry trades done on their currencies are unfazed by global financial market shocks. This implies that these strategies would be good diversifiers against such event for local investors that are significantly exposed to global assets such as US equities and Emerging Market Fixed Income. Variables such as volatility of the currency pairs on which carry trades are being done are better predictors of currency carry trade returns, albeit weakly so.

Currency carry trade strategies on East African Currency pairs are also found to be viable diversifiers of the NSE 20 Index, providing significant risk-adjusted returns in periods whereby the Index underperforms, such as during the time window that was examined.

Overall, the study concludes that the East African Currency Carry Trade is indeed negatively skewed and is a viable diversifier to the NSE 20 index as a proxy for the Kenyan equities market. It is also concluded that global risk factors have insignificant impact on East African Currency Carry Trade returns.

## 5.3 Recommendations

### *5.3.1 Recommendations for Policymakers*

Policymakers ought to consider the possibility of this trade leading to heightened volatility in foreign exchange and fixed income markets and put in place contingencies for events such as currency carry trade crash-induced crashes. Policy responses to these events could take the form of currency interventions and providing a floor to fixed income markets through both open market interventions and forward guidance (giving guarantees of future support). This, however, raises the issue of moral hazard which policymakers should be wary of. Therefore, a balance must be struck between supporting financial market stability and letting speculators face the consequences of the risks that they take on. This, however, is not an endorsement of policymakers discouraging the trade altogether as speculators play a key role of acting as

liquidity providers to these markets, hence reducing frictions in currency and fixed income markets and promoting market efficiency. A balance ought to be struck between the promotion of market efficiency while nonetheless ensuring that runaway speculation trades do not endanger the region's financial systems.

### *5.3.2 Recommendations for Market Participants and Allocators*

Asset managers and other financial market professionals ought to consider this as an investment strategy worth making and a good diversifier away from the Kenyan Equities market. Despite its promising diversifying traits however, they ought to be cognizant of the risks involved in taking on such currency carry trade strategies on less liquid east African currencies. To do this, they should implement said strategies with conservative levels of leverage to minimize the risk of extreme losses.

## 5.4 Areas for further Research

Future studies on the topic ought to use more fine-tuned and sophisticated models that incorporate and account for market frictions such as transaction costs and liquidity constraints that tend to adversely impact returns. This is because naïve carry return models do not account for these variables hence may overestimate returns and Sharpe ratios.

Such studies would help better help uncover the real-life applicability and practicality of the East African Currency Carry Trade while considering all the real-life constraints involved for money managers implementing it. Furthermore, investigations that seek to investigate the true size and scale of the trade on a regional and continental level would be very constructive to the growing body of literature.

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