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Carry Trade and Capital Market Returns in South Africa

Lumengo Bonga-Bonga * and Sefora Motena Rangoanana

School of Economics, University of Johannesburg, Johannesburg 2006, South Africa
* Correspondence: lbonga@uj.ac.za

Abstract: This paper assesses the extent to which carry trade operations affect the performance of equity and bond markets in a target country, South Africa, by considering the US and the euro area as the funding countries. A two- and three-factor capital asset pricing model (CAPM) is employed to assess whether the pricing of equity and bond markets in South Africa depends on the US dollar/rand and euro/rand carry trade returns. Moreover, the paper uses the quantile regression technique to assess whether this pricing varies with the distribution of the equity and bond returns. The findings support that the US- and euro-funded carry trade are essential factors for the pricing of equity and bond markets in South Africa. Moreover, the results of the two-factor model show a negative relationship between the equity excess return and the US-carry trade returns at lower quantiles of the equity market returns. The positive relationship is observed in the upper quantiles of the equity market. The negative relationship means that carry trade activities reduce equity market returns during a bear market as investors close out their position when conditions in the equity market become unfavourable. The results of the three-factor model, controlling for the global volatility or uncertainty, show that carry trade investors exit the equity market to invest in the bond market when global uncertainty rises. This finding shows that carry trade investors choose less risky assets during rising global uncertainty.

Keywords: carry trade; capital markets; capital asset pricing model (CAPM); quantile regression

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1. Introduction

Currency carry trade is an investment strategy in which individuals and institutional investors such as hedge fund managers buy currency pairs with high-interest rate spreads. The strategy involves investors borrowing funds in a low-interest currency and investing in a high-interest rate currency. The failure of the uncovered interest parity (UIP) hypothesis to hold gives rise to carry trade profits. The UIP hypothesis suggests that there should be an equilibrium between anticipated changes in exchange rates and interest rate differentials across countries. Notably, for UIP to hold, a condition of a one-to-one relationship must exist in order to counterbalance the discrepancies in changes in exchange rates and interest rate differentials between two countries (see Fama 1984; Hodrick and Srivastava 1986).

The failure of the UIP hypothesis, which triggers carry trade profit, occurs when interest rate differential spreads outweigh the movements in exchange rates of the concerned countries. Although carry trade investors capitalise on the interest rate spreads and speculate on potential appreciation of target currencies, the activities are subject to abruptions and extraordinary volatilities, which may generate substantial losses due to a sharp fall in the value of target currencies.

There are several ways of executing carry trades. A possible strategy for carry trade involves investors sourcing funds in currencies with low-interest rates and employing the funds in capital markets of a target country for investment purposes, then realising possible profit when closing out positions in the target country. Consequently, many studies have investigated the link between carry trade operations and capital markets of the target country (see Tse and Zhao 2012; Fung et al. 2013; Lee and Chang 2013). For example, Cassino and Wallis (2010) report that during the 2008 global financial crisis, investors

who held yen carry trades reversed their position due to the fall in the US stock market. Relatedly, Lettau et al. (2014) examine the link between the carry trade and the equities and commodities markets. They found that equity market returns from cyclical stocks dominate the speculative activities of carry trade investors.

It is important to note that studying the link between carry trade and capital markets is essential for global risk management, as it can help predict currency crash risk. Brunnermeier and Pedersen (2008) investigate the relationship between carry trade funding and asset market liquidity. Their model reveals that, as liquidity dries up in the markets, it can cause currency crashes. Thus, the activities of carry trade investors can have a considerable impact on the overall stability of the financial system.

Past studies have assessed the link between carry trade and capital markets without accounting for market conditions. Moreover, studies showing the role of carry trade operations in pricing assets are inexistent. Our paper remedies this shortcoming and contributes to the existing literature in three ways. Firstly, the paper assesses how carry trade operations affect different capital markets, i.e., the equity and bond markets, using asset pricing theory. This paper assesses how carry trade operations contribute to the pricing of equity and bond markets in South Africa based on the capital asset pricing model (CAPM). Secondly, the paper assesses how the above pricing varies according to the distribution of the two asset market returns. Lastly, the paper distinguishes between the US dollar/South African rand carry trade, and the euro/South African rand carry trade in the pricing process of capital markets in South Africa. Such a distinction is important for policymakers to understand which of the carry trade operations is vital in pricing asset markets in South Africa.

South Africa is a popular emerging economy, and such economies, in general, are often targets for carry trade investors because they usually offer significantly higher yields than those seen in developed economies. The attractiveness of the South African currency, the rand, has also since been restored following the global financial crisis. In recent years, the rand suffered mild volatility in the foreign exchange market. Heath et al. (2007) mentioned that the rand has a low-frequency correlation of 0.36 between the carry-to-risk ratio and foreign exchange turnover. It is the highest after the Norwegian Krone and the Australian dollar, making it a desirable target currency. Moreover, the case of South Africa, as an attractive hub for carry trade operations, is compelling because the Johannesburg Securities Exchange (JSE) is one of Africa's most prominent and progressive security exchanges. The securities exchange falls under the world's top 20 exchanges and has the advanced infrastructure to attract and encourage local and foreign investment.

The paper aims to identify the importance of carry trade operations in pricing capital markets in the target currency (the rand). Determining which capital market is affected by carry trade operations is essential for asset managers, investors and policymakers. Given that the carry trade operations link currency and capital markets, investors and policymakers should be interested in the link between these different markets for asset allocation, portfolio management and regulation in the capital markets.

In order to assess how carry trade operations are priced in the equity and bond markets, the paper uses two- and three-factor CAPM and the quantile regression to analyse how the pricing process varies according to different quantiles. Monthly data from August 2000 to June 2022 obtained from DataStream is used. Carry trade is constructed using interest rate differentials and changes in exchange rates between South Africa, the US and the euro (US dollar/rand and euro/rand).

The rest of the paper is organised as follows: Section 2 outlines the literature review, Section 3 provides the methodology of the paper, Section 4 presents the empirical results, and Section 5 provides a conclusion, which outlines areas of further study and offers policy recommendations.

2. Literature Review

Many studies have assessed the importance of carry trade operations and how they interact with different markets. For example, a study by Christiansen et al. (2011) shows that investment currencies have positive exposure to equity markets and that this exposure increases during turbulent times. Bonga-Bonga and Maake (2021) assess the extent of risk spillovers between the currency carry trade and asset markets, namely the equity and bond markets, in South Africa. The results of this study show evidence of volatility spillover between the carry trade returns and the two asset market returns, with the U.S. dollar-funded strategy transmitting more shocks to the South African equity market compared to the bond market. Moreover, the synchronisation of the dynamic correlation between each asset market and the currency carry trade returns shows that any possibility of arbitrage is prevented in the currency carry trade market.

A study by Dupuy (2015) argues that an imitative factor of the tail risk behaviour in the currency market should be considered a prime factor in the pricing of carry trade returns. Tail events and the vulnerability of unwinding leveraged carry positions are likely to cause extreme losses. Investors, therefore, expect a reward of more significant mean returns for investing in high-interest rate currencies.

Liquidity is also of prime importance in carry trades operations. However, liquidity crunches are likely to cause currency bubbles or crashes. Fong (2010) finds that factors such as funding liquidity create currency crashes. When investors become risk-averse due to unfavourable market conditions, they tend to be exposed to a liquidity squeeze.

Brunnermeier and Pedersen (2008) also document liquidity spirals in currency markets. They argue that when the liquidity provided by carry traders reaches capital constraints and positions are closed, the price drop in equities and fixed income instruments exacerbates market illiquidity.

Several studies assess the link between carry trade and different financial markets; however, most studies focus on carry trade and the equity market association. For example, Tse and Zhao (2012) analyse this relationship using the U.S. stock market and G10 currencies. The study considers a portfolio of the liquid currencies taking long and short positions. The S&P 500 index on future contracts proxies the U.S. stock market. The authors used daily data covering January 1995 to September 2010, and employed VAR (vector autoregression) and the generalised autoregressive conditional heteroskedasticity (GARCH) models and found a high correlation between carry trade returns and the stock market. The results provide the insight that factors driving volatilities in both markets are more interrelated with volatility innovations than stock.

Fung et al. (2013) extend the work of Tse and Zhao (2012) by assessing the carry trade and stock market connection using Asian stock markets (Australian, Indian, Japanese and Korean). Their objective is to determine whether carry trade returns and the stock market returns relationship exhibit the same characteristics even for equity markets as the the U.S. The study by Fung et al. (2013) involves the Australian dollar and the Japanese yen. The analysis of volatility spillover in the two markets employs VAR, dynamic conditional correlation (DCC) multivariate GARCH and constant conditional correlation (CCC) multivariate GARCH with daily data covering January 1995 to September 2011. The authors find a significant unilateral causality in currency carry trade that flows to the Asian stock markets, and that volatility flows are more distinct during recessions and persist for some time post-recession.

Contrary to the findings of Tse and Zhao (2012), Fung et al. (2013) identify a bidirectional volatility spillover effect between carry trades and stock market returns. The volatility spillover from the equity market to the carry trade market is visible mainly in the equities market during financial crises. In contrast, carry-to-stock spillover linkages occur during post-crisis periods.

Liu and Yang (2017) further affirm the bidirectional volatility spillover between carry trade and equity returns by employing the conditional value at risk (CoVaR) model with data covering 2000–2012. The period witnessed financial distress: the asset bubble, the

credit crisis and the European debt crisis. The analysis uses the carry trade portfolio data of the G-10's most liquid currencies and the stock returns from the U.S., Europe and the Asia-Pacific regions. The findings reveal the existence of a systemic contagion, which concurrently flows from both markets, and a noticeable interconnection between the two markets is evident in the extreme events of economic instability.

Lee and Chang (2013) investigate the linkage spillover in carry trade returns and the U.S. stock returns by implementing a Markov-switching VAR (MSVAR) model. The MSVAR model captured the degree to which the spillover in carry trade returns and stock returns switched in bear and bull markets using G-10 currencies. The data runs from January 1994 to March 2012. The two-state mean/variance M.S. model findings show that the spillover intensity is higher in bear markets than in bull markets. The results also provide evidence of a positive association uncovered by previous studies. The authors further identify that carry trade returns Granger cause stock returns more strongly in bear markets than in bull markets.

Many studies have examined the interrelationship between carry trade and different financial markets, both equity and bond. Christiansen et al. (2011) studied the association between carry trade returns and the bond and equity market by applying a non-linear model, the logistic smooth transition regression (LSTR) model, in which the foreign exchange volatility acts as a transition function. The authors find that the returns to carry have high exposure to stock market returns and that the exposure is mean reverting when the foreign exchange volatility is high. The study further reveals a negative correlation between the bond and carry trade markets.

Various strands of the literature focus on the relationship between the carry trade and the equities market, but little has been done on the bond market. One paper close to ours is Fung et al. (2013), which investigates the contemporaneous relationship between carry trade returns and Asian equity returns by focusing on mean causality and volatility spillover analysis, employing VAR-DCC and-CCC multivariate GARCH. Our paper extends Fung et al. (2013) by investigating whether the carry trade returns can be considered a factor for pricing the equity and bond markets in South Africa. Two- and three-factor CAPM models are used to this end. Moreover, the paper adds to the literature by assessing how asset pricing is affected by the distribution of the different asset returns by employing a quantile regression model.

This study is vital for global risk management, as it can help predict currency crash risk. When global funds move smoothly in a booming liquidity condition, investors tend to have sufficient funding to participate in carry trade activities. Due to increased funding availability, carry trade thrives in the foreign exchange market. When investors face funding constraints, market-wide liquidity drops, leading to drop-in carry trade positions, often involving the closing out of positions, which ultimately affects the exchange rates of the concerned currencies. In response to the exchange rates market, the currency's appreciation is witnessed in the low-interest rate currencies, and the depreciation occurs in target currencies. These movements aggravate crash risk and induce significant losses.

The debate concerning the link between carry trade returns and equity markets has been extensively explored in the literature, despite the controversy regarding ordinary return-volatility spillovers and the direction of Granger causality. Prior studies reviewed in this study provide conflicting results, even from the perspective of a time-series model and non-linear model. What remains prevalent is that the activities of carry trade investors have a considerable effect on the overall stability of the financial system. Most carry trade activities do not provide a full hedge against exchange rate movements or trading positions. Abrupt depreciation and the sharp decline in asset prices in the target currency may result in significant losses, leading to widespread loan defaults and liquidity crunches in financial markets.

To the best of our knowledge, no study has been conducted that investigates the relationship between carry trades and capital markets based on CAPM analysis in an emerging market economy such as South Africa. Moreover, no study has ever assessed

the pricing of capital market returns based on carry trade operation by distinguishing the distribution of these returns.

3. Methodology and Data

This study assesses how carry trade returns in the US dollar/rand, and euro/rand positions affect the equity and bond market returns in South Africa in the different quantiles of the distribution of the carry trade returns.

The quantile regression technique was proposed by Koenker and Bassett (1978). According to the authors, in cases where the errors of a model do not follow a normal distribution, the ordinary least squares (OLS) method provides inefficient estimates of parameters. Consequently, the quantile regression method may remedy this shortcoming, given that the association amongst variables at a prespecified quantile of the independent variable does not necessarily depend upon how the errors are distributed. Koenker and Hallock (2001) claim that quantile regression provides a strong characterization of the data and offers an inclusive way of estimating relationships between variables.

Unlike in the case of OLS regression, where square residuals are minimized in order to obtain parameter estimates, quantile regression estimates are obtained by minimizing the absolute values of the residuals (e_i), that is, by minimizing a sum that gives asymmetric penalties (in quantile α) given by $(1-\alpha) \mid e_i \mid$ for overprediction and $\alpha \mid e_i \mid$ for underprediction. Thus, quantile regression offers the capability to describe the conditional percentiles of the target variable against the covariates.

Assume a continuous random variable Y, which can be defined by a probability distribution as follows:

$$\mathrm{F(y) = Prob(Y = y)} \tag{1}$$

If we have $0 < \alpha < 1$, and α is a real number between 0 and 1 indicating the quantile in question, Equation (1) can be rewritten as follows:

$$\mathrm{Q}(\alpha) = \inf\{\mathrm{y{:}F(y)} \geq \alpha\} \tag{2}$$

which shows that αth is a quantile of X.

To obtain the α quantile of Y, as quantiles are formulated to solve an optimization problem, for any $0 < \alpha < 1$, the piecewise function is presented as thus:

$$\rho\_\alpha\ (\mu) = \mu(\alpha - \mathrm{I}(\mu < 0)) \tag{3}$$

In the present study, quantile regressions are expressed as follows:

$$Y_t = \alpha_0 + \beta_{\alpha 1} X_t + C_{\alpha 2} Z_t + \mu_\alpha \text{ with } Quant_\alpha(Y|X) = W_0 + \beta_{\alpha 1} X_t + C_{\alpha 2} Z_t \tag{4}$$

where Y_t are the capital markets returns (bond or equity market) and, X_t represents the carry trade returns, depending on carry trading position. Z_t represents the control variable, which depends on the model. The two-factor model controls for the global bond or global equity returns, while, for the three-factor model, we include the global bond and global equity returns as well as the role of volatility index (VIX). μ_α is the random error.

Notably, the asset pricing theory (APT) is used in modelling Equation (4), with a two-factor model (carry trade returns and global equity or bond returns) and a three-factor model (adding VIX to the previous two factors).

Equation (4) is estimated based on equity or bond excess returns (nominal returns minus risk-free rate). We make use of a three-month treasury bill (3-TB) from South Africa and, for the global bond excess returns calculation, we construct the global 3-TB from principal components, using 3-TB rates for 23 countries that constitute the MSCI index. The study uses monthly data on all the variables.

Figure 1 shows the graphical representation of the risk-free global rate constructed from principal component analysis compared to the US 3-month Treasury bill. It is worth noting that the risk-free global rate closely reflects the US 3-month Treasury bill. Thus, the

two variables can be used interchangeably mainly when calculating global bond or equity excess returns. The increasing rate observed from the beginning of 2022 is attributed to the increasing global risk triggered by the Russia-Ukraine war. However, the sharp contraction of the global economy and deep uncertainty at the peak of the COVID-19 pandemic prompted many central banks to decrease key interest rates, as shown in Figure 1.

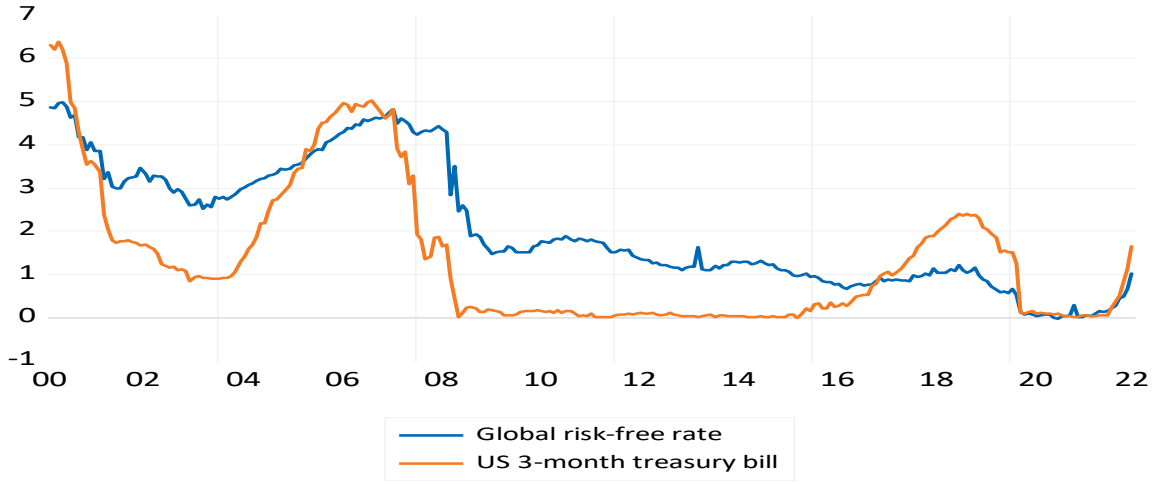

Figure 1. Global risk-free rate and US 3-TB.

Carry trade excess returns are constructed following Brunnermeier et al. (2008); Christiansen et al. (2011); Burnside et al. (2011) and Caballero and Doyle (2012). According to these authors, carry trade returns are computed from the perspective of foreign investors, in this case, European and US investors. For example, we will assume that a US investor borrows 1 US dollar at month t at the interest rate $(1 + i_{Ft})$, where i_F is the interest rate in the US, and then invests in an asset denominated in the South African rand. Interest rate is $(1 + i_{Dj,t})$, where i_D is the interest rate in South Africa.

Our study quotes all exchange rates s_t in terms of South African rand per unit of the foreign currency. Hence, ignoring the transaction cost, we have the following equation representing the UIP condition:

$$(1 + i_D) = \frac{E_t(S_{t+k})}{S_t}(1 + i_F) \tag{5}$$

Taking the log of Equation (5) yields

$$E_t(S_{t+k}) - S_t = i_D - i_F \tag{6}$$

If we assume no transaction costs or taxes, and that investors are rational and risk neutral then the UIP condition can be expected to hold.

From the left-hand side, $E_t(S_{t+k}) - S_t$ is the expected rate of depreciation of the currency and $i_D - i_F$ represents the interest rate differential.

From Equation (6), we have excess returns of the carry trade

$$CT_t = (DIR_t) - \Delta s_{t+1} \tag{7}$$

where $\Delta s_{t+1} = s_t^i - s_{t-1}^f$ and $IDR_t = (i_D - i_F)$.

CT_t represents the excess returns to carry and, DIR_t represents the differences in interest rates of the target and the funding currency. i_{t-1}^i and i_{t-1}^f are the one-month lagged interest rate of the investment and the funding currency, respectively.

Δs_{t+1} represents the change in the investment currency, s_t^i is the log one-month spot exchange rate of the investment currency and s_{t-1}^i is the log one-month lagged spot

exchange rate of the target currency (rand appreciation). Carry trade profits are realized when the UIP condition fails to hold and the excess returns are positive. In the context of this study, we use US dollar/rand carry trade as well as the euro/rand carry trade.

Many calculations for carry trade returns have been explored in the literature, such as that adopted by Burnside et al. (2011).

$$CT_t = \Delta s_t - \left(i_{t-1} - i^*_{t-1}\right) \tag{8}$$

Equation (8) shows that the excess returns of the carry trade are similar to the forward rate bias, provided the covered interest parity holds. When the potential loss associated with changes in exchange rate is less than the interest rate differentials, carry trade strategy is profitable.

The above equation defines s_t as the log exchange rate of the domestic currency per foreign currency. Carry traders earn returns by borrowing funds in the domestic currencyand investing in the foreign currency as outlined by Equation (8).

The appreciation of an investment currency (foreign currency) is represented by Δs_t, and the interest rate differential is represented by $i_{t-1} - i^*_{t-1}$. Since the study depicts South Africa as a domestic currency as well as an investment country, Equation (7) is used for carry trade returns.

Monthly data sample spans only from August 2000 to June 2022 due to data availability. The key variables used in the study are obtained from the DataStream database. For example, proxies for different capital markets include returns from the South African All Share index and 10-year Treasury bill for equity market and the bond market, respectively. Global stock market volatility is represented by VIX.

Figure 2 shows that the short-term interest rate is higher in South Africa than in the US and the euro area. This finding justifies why South Africa is the target country in the carry trade strategy. The figure also shows how interest rates in the euro and US reached a zero-bound level amidst the 2008 financial crisis, which led the US, especially, to resort to quantitative easing as a response to increase liquidity in the financial markets and to support global economic recovery. As an emerging market, South Africa has higher interest rates than the US and euro area, accounting for the relatively high inflation in South Africa.

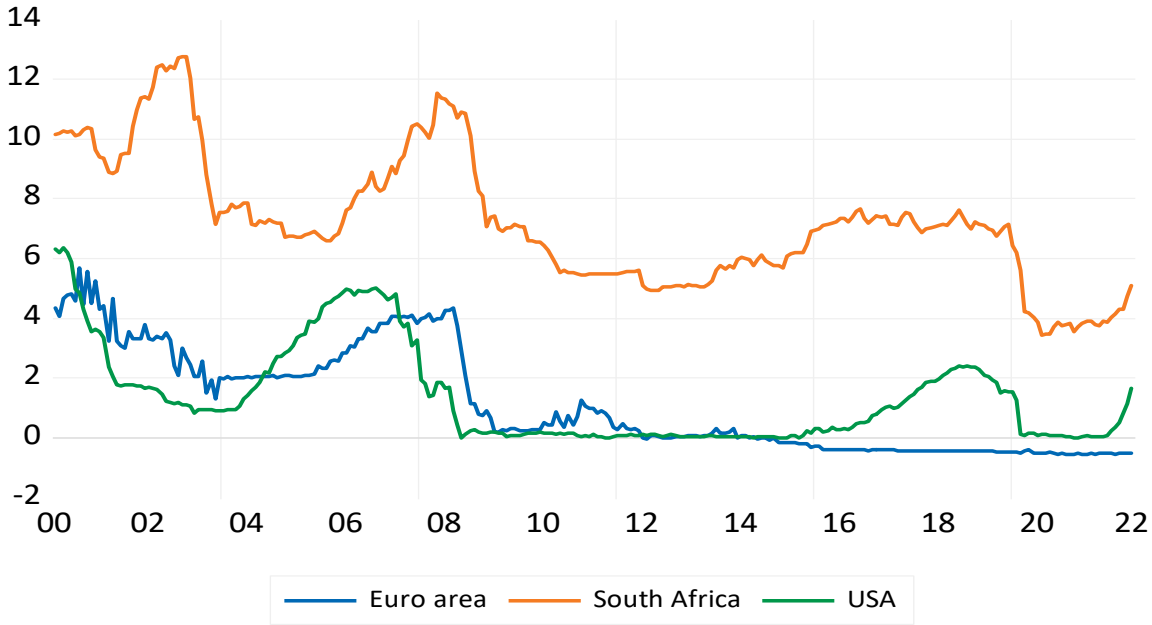

Figure 2. Short-term interest rates in the US, Euro area and South Africa.

4. Results Estimation

This section presents the estimation of the model represented in Equation (8) by distinguishing between the bond and equity markets. The model follows the two- and three-factor models. The estimations are based on quantile regression, as explained in the methodology section.

4.1. Two-Factor Model and the Equity Market

Table 1 presents the results of the quantile regression estimation as in Equation (8) for a two-factor model in the case of the US carry trade position. The results show a negative relationship between the All-Share excess return and the US-carry trade returns at lower quantiles of the equity market returns. The negative relationship means that carry trade activities reduce equity market returns during a bear market.

Since the study adopts the perspective of US and European investors who invest in South Africa, the negative relationship implies that, during a bear market in the South African equity market, foreign carry traders close out their position to cash in their profit. Given that this operation entails a high supply of local assets, this leads to a drop in their prices and translates to negative returns. However, during a bull market, i.e. the upper tail of the equity market returns in South Africa, carry trade investors increase the demand for local assets, which translates into a rise in their price.

Table 1. Equities market results analysis (US carry trade).

All Share Excess Returns	**Quantiles**						
Variable	5%	10%	25%	50%	75%	90%	95%
MSCI excess returns	1.049 ***	0.967 ***	0.909 ***	0.747 ***	0.631 ***	0.517 ***	0.419 ***
US CT	−0.575 ***	−0.441 ***	−0.264 ***	−0.0036	0.227 ***	0.417 ***	0.601 ***

*** indicate statistical significance at the 1% level, respectively.

Moreover, the empirical results presented in Table 1 show that MSCI excess market returns are significantly positive across all the quantiles of equity market returns in South Africa, showing the dependence of the South African equity market on the global equity market. It is worth noting that the positive link between the South African and global equity markets is more pronounced in lower quantiles. This finding agrees with several studies that find that markets are more correlated during financial distress, explaining market contagion effects (see Bonga-Bonga 2018).

Figure 3 shows the trend of the carry trade and MSCI returns coefficients, as reported in Table 1, with the dot line representing the 95% confidence interval. These coefficients vary with the different quantiles. Carry trade coefficients show positive value in the upper quantiles and negative values in the lower quantiles. As explained above, the negative coefficients indicate that, when carry traders close out positions during the crisis periods, equity prices drop more, as the action of carry traders selling off domestic assets may trigger herding behaviour in the market.

Table 2 presents the quantile regression results assessing the relationship between equity market excess returns and the euro-carry trade returns. Just as in the case of the US-carry trade returns, the reported results show that this relationship is negative in lower quantiles and positive in the upper quantiles. However, the influence of the euro carry on excess equity returns in South Africa is relatively higher than that of the US carry trade. An important observation from the results reported in Tables 1 and 2 is that the relation between equity markets and the two carry trade returns, euro and the US, are statistically not significant at the median quantile, 50%. This finding shows that capital movement in the equity due to carry trade operation is not active during the normal conditions in the equity market. By contrast, Euro and the US carry trade investors are active in the South African equity market in extreme conditions.

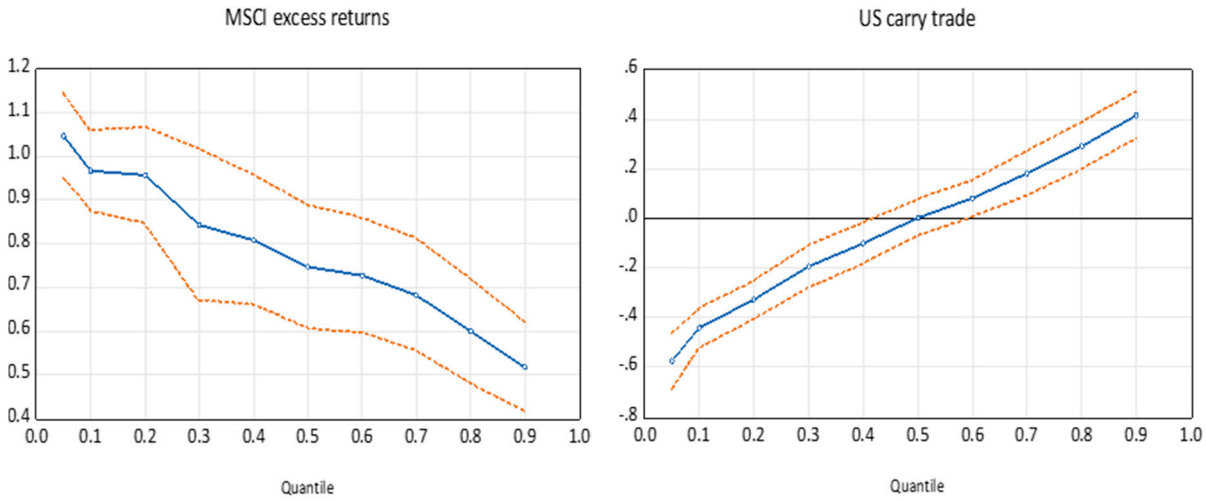

Figure 3. US dollar-denominated carry trade and the equity market. Note: The dotted line represents the 95% confidence interval; the solid lines show the coefficients for each quantile.

Table 2. Equities market results analysis (euro carry trade).

All Share Excess Returns	**Quantiles**						
Variable	5%	10%	25%	50%	75%	90%	95%
MSCI excess returns	0.976 ***	0.965 ***	0.884 ***	0.802 ***	0.656 ***	0.641 ***	0.598 ***
Euro CT	−0.557 ***	−0.445 ***	−0.257 ***	−0.036	0.256 ***	0.499 ***	0.663 ***

*** indicate statistical significance at the 1% level, respectively.

Figure 4 displays the coefficients of the euro-funded carry trade and the MSCI excess returns, as reported in Table 2. The results show the time-varying coefficient according to the different quantiles. Moreover, it shows that the absolute value of the coefficients of the carry trade returns is higher at the extreme quantiles.

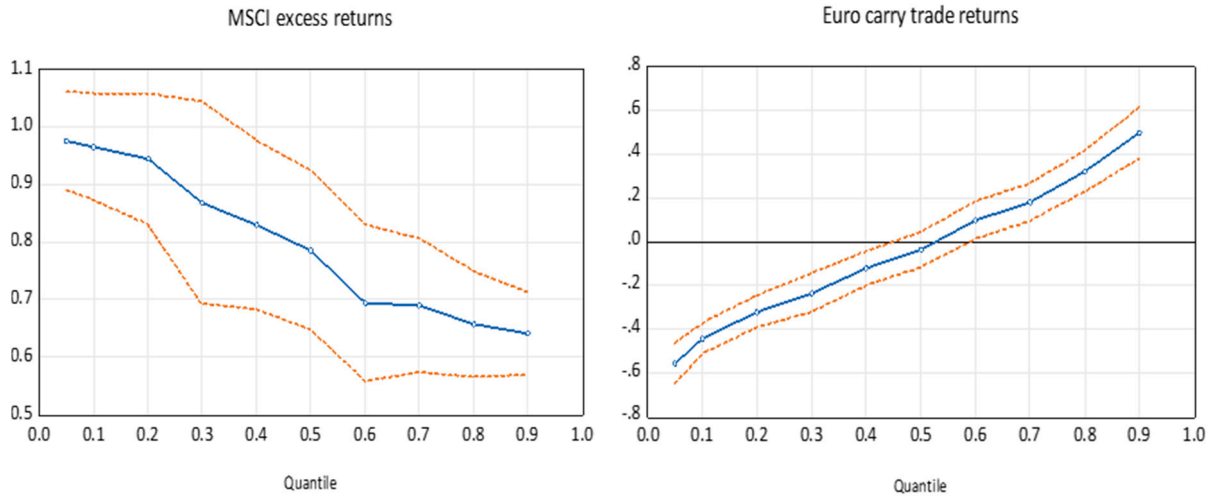

Figure 4. Euro-denominated carry trade and the equity market. Note: The dotted line represents the 95% confidence interval; the solid lines show the coefficients for each quantile.

4.2. Two-Factor Model and the Bond Market

The literature shows that there is a thriving growth in the bond market. Lagarde (2014) shows that significant funds have been directed into many emerging bond markets, and become increasingly important in comparison to equity flows and international loans. Hence, the study of bond returns is crucial in the context of carry trade.

The estimated results of Equation (4) in the case of the relationship between the bond market returns and US carry trade returns for a two-factor model are reported in Table 3.

Table 3. Bond market results analysis (US carry trade).

SA 10 yr Bond EXCESS Returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
Global bond excess returns	0.340 ***	0.316 ***	0.306 ***	0.312 ***	0.348 ***	0.366 ***	0.524 ***
US CT	−0.266 ***	−0.180 ***	−0.039 ***	0.022 ***	0.235 ***	0.296 ***	0.411 ***

*** indicate statistical significance at the 1% level, respectively.

The results in Table 3 highlight a positive relationship between South African excess bond returns and the global excess bond returns. The magnitude of the relationship is higher in the upper tails of the quantile distribution showing the increasing correlation between the local and global bond markets during bull markets. This finding contradicts the observed relationship between local and global equity markets, which shows a high correlation during bear markets. We test the significance of the statistical difference between the coefficients reported in Table 3 at 5% and 95% quantiles. The results of the Wald test reported in Table 4 show that the null hypothesis of equality of the coefficients of global bond excess returns at 0.5% and 95% are not rejected. The equality of these coefficients may be because the bond market is less risky, thus interconnecting equally during different states of the global economy.

Table 4. Test of equality of coefficients at different quantiles.

Type of Test	Quantiles	Probability
Wald test	0.05 and 0.95	0.8861

The same results as those reported in Table 3 are found with the Euro carry trade operation, reported in Table 5. The explanation for these findings is that bonds are less risky than equities. Although their sell-off may impact their price or face value (the reason behind the negative value), this only depends on the supply and demand mechanism and not on market conditions. The same pattern is reported in the case of the Euro carry trade returns and the South African bond market, whereby the relationship is higher in the upper quantiles, as reported in Table 5.

Table 5. Bond market results analysis (euro carry trade).

SA 10 yr Bond Excess Returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
Global bond excess return	0.278 ***	0.242 ***	0.292 ***	0.322 ***	0.443 ***	0.614 ***	0.618 ***
Euro CT	−0.274 ***	−0.224 ***	−0.068 ***	0.077 ***	0.207 ***	0.350 ***	0.422 ***

*** indicate statistical significance at the 1% level, respectively.

4.3. Three-Factor Model and the Equity Market

The three-factor model adds the global risk aversion, the VIX, in the estimation of Equation (4). Including VIX in the model is vital as it assists in assessing the relation between carry trade returns and asset markets (bond and equity markets) by accounting for global risk and uncertainty.

The results reported in Table 6 show that the relationship between the US carry trade and the South African equity market returns are negative across the quantiles. This finding signifies that the US carry trade investors avoid emerging equity markets such as the South African equity market during periods of global uncertainty. The closing out of their positions in these markets leads to the observed negative relationship, as reported in

Table 6. To assess whether the magnitude of the negative relationship is equal across all the quantiles, we conducted the Wald test of equality of coefficients across all the quantiles. The results reported in Table 7 show that the null hypothesis of equality of all the coefficients across quantiles is not rejected. This finding entails that carry trade investors withdraw their investments in the South African equity market when global uncertainty rises, regardless of the state of the South African equity market.

Table 6. Equities market results analysis (US carry trade).

All Share Excess Returns	**Quantiles**						
Variable	5%	10%	25%	50%	75%	90%	95%
MSCI excess returns	0.692 ***	0.655 ***	0.801 ***	0.827 ***	0.777 ***	0.896 ***	0.953 ***
US CT	−0.226 ***	−0.204 ***	−0.160 ***	−0.146 ***	−0.125 ***	−0.252 ***	−0.293 ***
VIX	−0.155	−0.129	−0.040	0.070 **	0.027	0.306	0.406

***, ** indicate statistical significance at the 1%, 5%, level, respectively.

Table 7. Test of equality of coefficients at all quantiles.

Type of Test	**Quantiles**	**Probability**
Wald test	all quantiles	0.1198

4.4. Three-Factor Model and the Bond Market

Analysis using a three-factor model that accounts for global uncertainty shows the relationship between the US carry trade returns and the bond excess returns in South Africa is different from its relationship with the equity market. The results reported in Table 8 show the positive relationship between the US carry trade returns and the bond excess returns regardless of the state of the economy. This result shows that carry trade investors may still choose to invest in the emerging bond markets when global uncertainty rises. Compared with the equity markets reported in Table 6, the results reported in Table 8 may inform of the possible portfolio reallocation by carry trade investors from the South African equity to bond markets.

Table 8. Bond market results analysis (US carry trade).

SA 10 yr Bond Excess Return	**Quantiles**						
Variable	5%	10%	25%	50%	75%	90%	95%
Global bond excess returns	0.551 *	0.530 **	0.482 ***	0.314 ***	0.329 ***	0.456 ***	0.542 ***
US CT	0.234 ***	0.175 ***	0.159 ***	0.187 ***	0.187 ***	0.215 ***	0.246 ***
VIX	−0.239 ***	−0.166 ***	−0.108 ***	−0.045	0.007	0.052 **	0.093 ***

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Another interesting finding from the results reported in Tables 6 and 8 is that the relationship between VIX and the asset market is negative in the lower quantiles and positive in the upper quantiles. Moreover, the magnitude of this relationship is higher with the equity market than with the bond market, certainly supported by the fact that the equity market is riskier than the bond market. More importantly, the finding that the sign of the relationship between VIX and asset markets varies across quantiles shows that the principle of risk-return trade-off supported by many theories and studies holds only at the high quantiles of asset markets.

4.5. Economic Implications of the Findings

The findings of this paper provide insights for policymakers and global investors in understanding how carry trade operations affect the pricings of bond and equity markets. Global investors should be aware that carry trade operations negatively affect equity markets during periods of turmoil. Then, they must close out carry trade positions during these

periods to avoid possible loss due to high depreciation of the target country's currency—in this case, the currency of South Africa. Moreover, the findings of this paper show that global investors should set their carry trade strategy by choosing less risky assets, such as bonds, during rising global uncertainty. While past studies show that carry trade returns display regime-specific patterns, performing poorly during bear market states, this paper suggests that global investors who choose to invest in the bond market may conserve the value of carry trade investment during periods of global uncertainty.

5. Conclusions

This paper assessed the link between carry trade operations and asset markets in an emerging market, especially South Africa. Given that a possible strategy for carry trade involves investors sourcing funds in currencies with low-interest rates and employing the funds in capital markets of a target country for investment, it was worth assessing whether the US- and euro-funded carry trade influence south African bond and equity markets. The results of the empirical analysis based on the two-factor model show a negative relationship between the All-Share excess return and the US-carry trade returns at lower quantiles of the equity market returns. The positive relationship is observed in the upper quantiles of the equity market. The negative relationship means that carry trade activities reduce equity market returns during a bear market as investors close out their position when conditions in the equity market become unfavourable. The same results are observed for the euro carry trade. However, the influence of the euro carry trade on excess equity returns in South Africa is relatively higher than that of the US carry trade. The trend of the results analysing the link between the US- and euro-funded carry trade and the bond markets on the one hand is similar to that of the equity market in South Africa, on the other.

The results of the three-factor model, controlling for the global volatility or uncertainty, show that carry trade investors exit the equity market to invest in the bond market when global uncertainty rises. This finding shows that carry trade investors choose less risky assets during rising global uncertainty. Another salient finding of the paper is that the relationship between global risk and asset market returns is negative in the lower quantiles and positive in the upper quantiles of stock market returns. This finding signifies that the principle of risk-return trade-off holds only at the high quantiles of asset markets or the peak of asset markets.

The findings of this paper are vital for carry trade investors who may choose the South African asset markets as an investment hub to secure profit from carry trade operations. They need to know that the bond market is the best option for carry trade operations when global uncertainty rises. For future research, we suggest that other markets are considered, and other nonlinear models are used to assess the link between carry trade operation and asset markets.

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