Carry trade and capital market returns in South Africa

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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 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 study makes use of quantile regression technique to assess whether this pricing varies with the distribution of the carry trade returns. The findings support the fact that the US dollar/rand and euro/rand carry trades are important factors for the pricing of equity and bond markets in South Africa. Moreover, for the equity market, specifically, the pricing depends on the different market conditions, especially the distribution of the two carry trade excess returns. However, in the bond market, carry trade contributes to the pricing of the bond market only in extreme tails or bear market.

Keywords: *Carry trade, Capital markets, Capital asset pricing model (CAPM), Quantile regression*

1. Introduction

Currency carry trade is an investment strategy in which individuals and institutional investors such as hedge fund manager 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 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 differentials spreads outweigh the movements in exchange rates of the concerned countries. Although carry trade investors capitalize on the interest rate spreads and speculate on potential appreciation of target currencies, the activities are subject to abruptions and extraordinary volatilities which may potentially generate extremely large losses due to a sharp fall in the value of target currencies or an increase in the value of funding 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 realizing possible profit when closing out positions in the target country. Consequently, the link between carry trade operations and capital markets of the target country has been investigated in a plethora of studies, most studies assess the interrelationship between carry trade and different capital markets such as bond and equity (see, Tse and Zhao, 2012; Fung, Tse and Zhao ,2013 and 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. The repercussions of the reversal overlapped the fall in the US stock market. According to the authors, the reason for the overlap proves that there exists an interconnection between carry trades and equity market, which is influenced by the level of risk aversion and appetite among investors. Relatedly, Lettau, Maggiori and Weber (2014) examine the link between carry trade and the equities and commodities markets. They found that equity market returns, especially returns from cyclical stocks, have a dominant impact on the speculative activities of carry trade investors.

It is important to note that a study of the link between carry trade and capital markets is essential for global risk management, as it can help to predict currency crash risk. Brunnermeier and Pedersen (2008) investigate the relationship between funding liquidity and asset market liquidity. Their model reveals that, as liquidity dries up in the markets, it can cause currency crashes. The activities of carry trade investors can have a considerable impact on the overall stability of the financial system, in that the excessive global capital inflows seeking high-yielding assets can create an irrational expansion in the target currency's financial stability. A build-up of funds can create high deficit that call for tightened macroeconomic policies and changes in exchange rate regimes. Thus, capital inflow reversal from target to funding currencies can cause crash risk.

Past studies assess the link between carry trade and capital markets, without accounting for market conditions and the pricing of capital market based on carry trade operations (see, Brunnermeier, Nagel, Pedersen ,2008; Lustig and Verdelhan ,2011; Burnside ,2011; Christiansen, Ranaldo and Soderlind,2011; Caballero and Doyle ,2012; Tse and Zhao, 2012; Dobrynskaya, 2014). Our study remedies this short coming and contribute to the existing literature in three folds. Firstly, the study assesses how carry trade operations affect different capital markets, i.e. the equity and bond markets using asset pricing theory. By doing so, this study 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 study assesses how the above pricing varies according to the distribution of carry trade returns. Lastly, the study distinguishes between the US dollar /South African rand carry trade and euro/South African rand carry trade in the pricing process of capital 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 yields that are significantly higher than those seen in developed economies. The attractiveness of rand- targeting has also since been restored following global financial crisis. In recent years, the rand suffered mild volatility from the foreign exchange market.

As mentioned by Heath, Galati and McGuire (2007), 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 Australia dollar, making it a very attractive target currency. Moreover, the case of South Africa, as an attractive hub for carry trade operation, is compelling because the Johannesburg Securities Exchange (JSE) is one of Africa's largest and progressive securities exchange. The securities exchange falls under the world's top 20 exchanges and has advanced infrastructure to attract and encourage local and foreign investment

The paper aims at identifying the importance of carry trade operations in the pricing of capital markets in the target currency (the rand). Determining which capital market is affected by carry trade operations is important for asset managers, investors and policy makers. Given the fact that the carry trade operations link currency and capital markets ,if carry trade operations become an important element in pricing equity and -/or bonds markets, asset managers, investors and policy makers should be interested in the link between these different markets for the purpose of 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 study uses the CAPM with two and three factors as well as the quantile regression to analyse how the pricing process varies according to different quantiles. Monthly data spanning from 2000:08 - 2018:12 obtained from DataStream for South Africa's equity and bond markets 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 study, section 4 presents the empirical results and chapter 5 provides a conclusion, outlines areas of further study and offers policy recommendations.

2. Literature Review

Numerous studies have explored the UIP phenomenon. The precursor for carry trade operations shows that the failure of UIP remains one of the enduring conundrums in international finance. Many studies rationalize the systematic excess returns of carry trades in terms currency risk premium, which states that, when investment currencies provide low returns during unfavourable economic conditions, then excess returns from carry trades compensate investors for being exposed to elevated risk. Engel (1984) and Fama (1984) assert the risk premium to be a partial solution to the UIP violation.

In contrast, Koijen, Moskowits, Pedersen and Vrug (2013) study the negative skewness in carry trade and they find that a diversified carry trade strategy which comprise of a portfolio of different asset classes does not exhibit negative skewness. The absence of negatively skewed returns fails to explain crash risk embedded in carry trades, the authors therefore, conclude that the theories of carry trade risk premium are not sufficient in explaining carry trade returns.

A study by Christiansen et al. (2011) show that the carry trade returns are dependent on different economic regimes. They base their findings on the fact that investment currencies have positive exposure to equity markets, and that the exposure increases during turbulent times. They also argue that, if carry trades were priced by a regime-dependent model, they will be less attractive. Regime dependability coupled with large effects of volatility and liquidity has a direct impact on asset return, which therefore, partly explains the UIP violation. Researchers have attributed the discrepancies leading to UIP failure to different risks associated with different countries. Bhansali (2007) and Cenedese, Sarno and Tsiakas (2014) incorporate the risk premium in order to accommodate for different risk in their research, However, inclusion of risk premium did not seem to solve the UIP phenomenon.

A neoteric 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 a larger mean returns for investing high interest rate currencies.

Liquidity is also of prime importance in carry trades as it provides funding. 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 liquidity squeeze.

Brunnermeier and Pedersen (2008) also document liquidity spirals in currency markets. They argue that, when the liquidity provided by carry traders reach 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 US stock market and G10 currencies. The study considers a portfolio of the liquid currencies taking long and short positions.The US stock market is proxied by the S&P 500 index on future contracts.

The authors use daily data covering periods from January 1995 to September 2010 and, employed VAR (vector auto regression) and the generalised autoregressive conditional heteroskedasticity (GARCH) models. High correlation among carry trade returns and the stock market is uncovered, the link proves to follow neither granger causality direction. Results from the exponential generalised autoregressive conditional heteroskedasticity (EGARCH) model show that the volatility flows follows a uni-directional spill-over from equity market to carry trade market. The results also provide the insight that factors driving volatilities in both marketss market are more interrelated with volatility innovations to 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 same characteristics even for equity markets other than the US. The study by Fung et al. (2013) involves the Australian dollar and the Japanese yen. The analysis of volatility spill-over 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 uni-lateral 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 the existence of a bidirectional volatility spill-over effect between carry trades and stock market returns. The volatility spill-over from the equity market to the carry trade market is mostly visible in the equities market during financial crises, while carry to stock spill-over linkages occur during post-crisis periods.

Liu and Yang (2017) further affirm the bidirectional volatility spill-over 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 US, 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 spill-over in carry trade returns and the US stock returns by implementing a Markov-switching VAR (MSVAR)model. The MSVAR model captured the degree to which the spill-over in carry trade returns and stock returns switched in bear and in bull markets using G-10 currencies. The data runs from January 1994 to March 2012.The findings from a two -state mean/variance MS model show that the intensity of the spill-over is higher in bear markets than bull markets. The results also provide evidence of a positive association as 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.

A number of studies have examined interrelationship between carry trade and different financial markets; equity and bond market. Christiansen et al (2011) study 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 transitioning function. The data is derived from G10 countries spanning January 1995 to December 2008.
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 market and the carry trade market.

Various strands of the literature focus on the relationship between carry trade market and equities market, but little has been done on bond market. One paper close to our study is that of 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 study can be seen to extend Fung et al. by investigating whether the carry trade returns can price the equity and bond markets in South Africa by making use of a two-and three-factor CAPM model and identifying how the pricing is affected during different economic conditions (quantiles) by employing a quantile regression model.

This study is important 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 increases in funding availability, carry trade thrives in the foreign exchange market. When investors are faced with funding constraints, market-wide liquidity drops, which consequently lead to a drop-in carry trade position. The drop-in carry trade positions often involve the closing out of position, which ultimately affects the exchange rates of the concerned currencies. As a response in the exchange rates market, the appreciation of the currency is witnessed in the low interest rate currencies and the depreciation occur in target currencies. These movements aggravate crash risk and induce large 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 spill-overs and the direction of granger causality. Prior studies that are reviewed in this study provide conflicting results, even from the perspective of 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 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 large losses ,which may lead to wide-spread 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 the capital markets based on CAPM analysis in an emerging market economy, such as South Africa by distinguishing between different capital markets and employing a quantile regression model.

3. Methodology

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 Basset (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 short-coming given that the association amongst variables at a prespecified quantile of the independent variable does not necessary depend upon how the errors are distributed. Koenker and Hallock (2001) claim that quantile regression provides a strong characterization of the data and it offers an inclusive way for 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, that is, by minimizing a sum that gives asymmetric penalties(in quantile α) given by $(1-\alpha)$ | e_i | for overprediction and α | e_i | 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:

$$F(y) = Prob(Y = y) \quad (1)$$

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:

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

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:

$$\rho_\alpha(\mu) = \mu(\alpha - I(\mu < 0)) \quad (3)$$

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

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

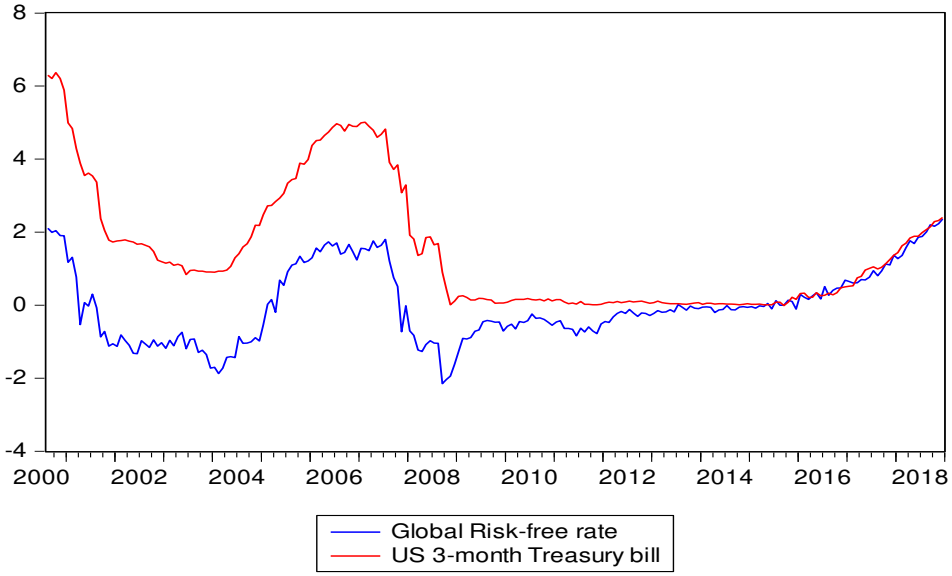
where Y_t are the capital markets returns (bond or equity market) and , X_t represents the carry trade returns, depending on carry trading position. Z_t represents the control variable, which depends on the model. The two-factor model controls for the global bond or global equity returns, while, for 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 (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 global equity and bond excess returns calculation, we construct the global 3-TB from principal component, using 3-TB rates for 23 countries that constitute the MSCI index. The study uses monthly data on all the variables.

Figure 3.1 shows the graphical representation of the 3-TB constructed from principal component analysis in comparison with the US 3-TB. Figure 3.1, it is worth noting that the global 3-TB closely reflects the US 3-TB. Thus, the two variables can be used interchangeably especially when calculating global equity or bond excess returns.

Figure 3. 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 (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 the units of foreign currency per South African rand. Hence, ignoring the transaction cost, we have the following equation representing the UIP condition:

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

Taking the log of Equation (9) yields

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

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 (10),we have excess returns of the carry trade

$$CT_t = (IDR_t) - \Delta s_{t+1} \quad (7)$$

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, IDR_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 the target currency (rand appreciation).Carry trade profits are realized when the UIP condition fails to hold and the excess returns will be 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. (2009).

$$CT_t = \Delta s_t - (i_{t-1} - i_{t-1}^*) \quad (8)$$

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 currency and 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.

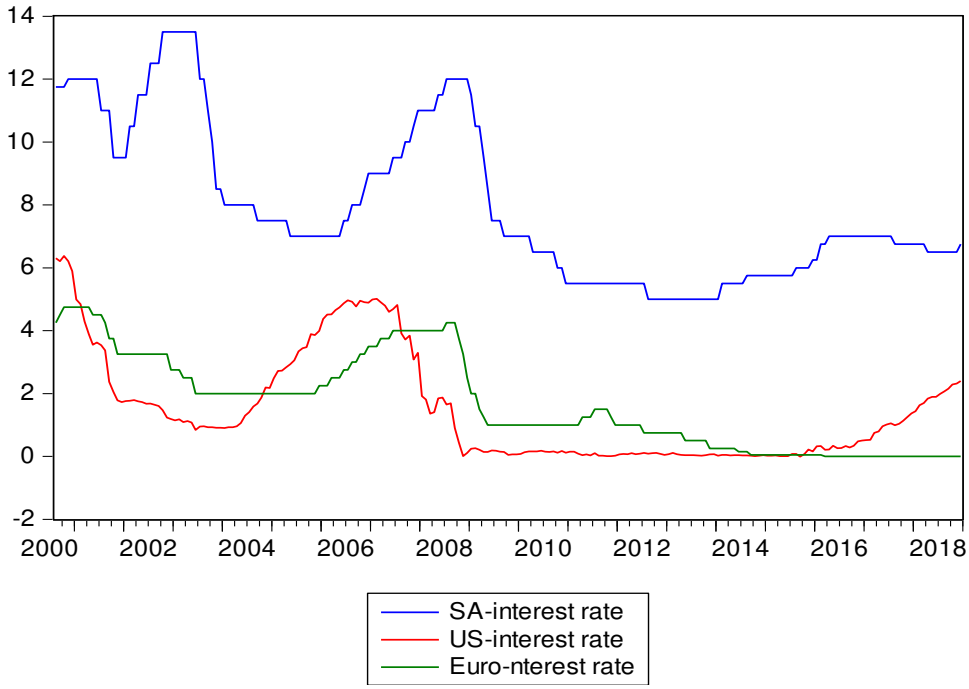
Given our data sample spanning from 2000:01 - 2018:12, the key variables used in the study are obtained from the DataStream database. For example, proxies for different capital markets include returns from the South African; All Share index and

10-year Treasury bill for equity market and the bond market respectively. Global stock market volatility is represented by VIX.

Figure 3.2 shows that interest rate in South Africa is higher than those in the US and euro area. This finding justifies why South Africa is the target country in the carry trade strategy.

Figure 3.2 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 response to increase liquidity in the financial markets and support global economic recovery. As an emerging market, interest rates in South Africa are higher than in the US and euro area to account for relatively high inflation in South Africa.

Figure 3. 2: Official interest rates and their high yield for US, Euro area and South Africa



4. Data and Results Estimation

This section presents the estimation of the model represented in Equation 8 by distinguishing between the bond and equity markets as well as the two- and three-factor models. The estimations are based on quantile regression as explained in the methodology section. Moreover, the section discusses the results obtained from these estimations.

4.1.1 Two factor model and the equity market

Table 4.1.1 presents the results of the estimation of quantile regression as in Equation 8 for a two-factor model in the case of US carry trade position. The results show a negative relationship between the All-Share excess return and the US-carry trade returns. This is evident in all quantiles, with lower quantiles being more pronounced. The negative relationship means that the increase in carry trade returns reduce the equity return in South Africa.

Since the study adopts the perspective of US and European investors who invest in South Africa, the negative relationship implies that, when there is an opportunity of higher returns 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 the drop of their prices and translates to negative returns.

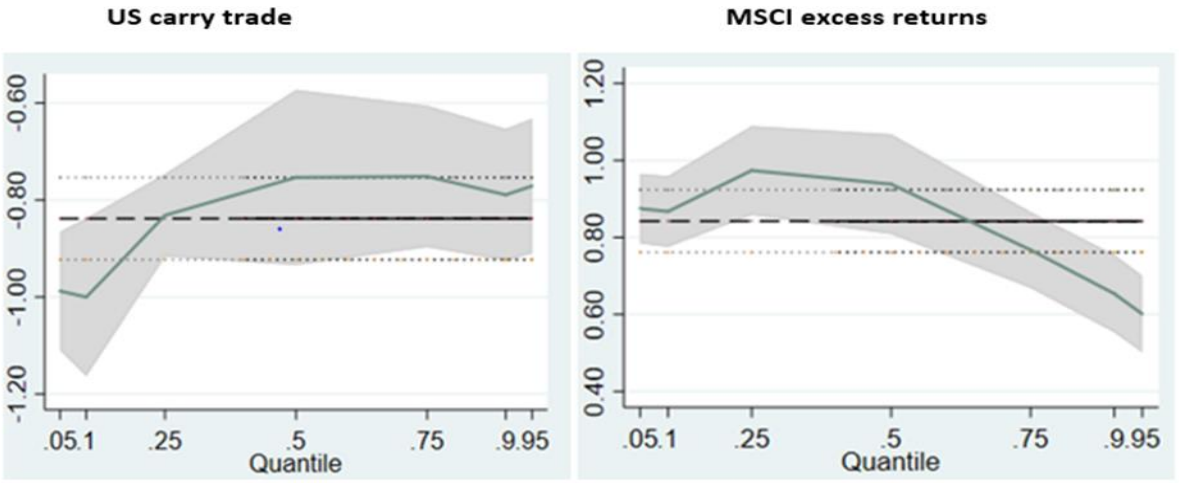
Table 4.1. 1: Equties market results analysis(US carry trade)

All Share excess returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
MSCI excess returns	0.875***	0.867***	0.974***	0.938***	0.767***	0.654***	0.601***
US CT	-0.99***	-1.00***	-0.83***	-0.75***	-0.71***	-0.79***	-0.77***
constant	-3.83***	-3.40***	-3.24***	-2.74***	-1.69***	-0.64***	-0.61***

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

Moreover, the empirical results presented in Table 4.1.1 show that MSCI excess market returns are significantly and positively correlated with the All-Share excess returns, 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 Africa equity market and global equity markets are more pronounced in lower quantiles. This finding is in agreement with a number of studies that find that markets are more correlated during financial distress, explaining the contagion effects (see Bonga-Bonga, 2018).

Figure 4.1. 1: US dollar denominated carry trade and the equity market



The shaded area represents the 95% confidence interval.

Figure 4.1.1 shows the trend of the carry trade and MSCI returns coefficients, as reported in Table 4.1.1, with the shaded area representing the 95% confidence interval. These coefficients vary with the different quantiles. Carry trade coefficients show high a magnitude in the lower quantile. This indicates 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.

The variability of the coefficients of the carry trade and MSCI returns are confirmed with the test of difference of coefficients. The results are reported in Table 5.1 in Appendix B. The results reported in Table 5.1 confirm the variability of the coefficients of the quantile regression with the rejection of the null hypothesis of the equality of the coefficients when comparing the low and high quantiles. For example, from Table 5.1, the null hypothesis of the equality of coefficients of the carry trade returns estimated from Equation 4 for the 5^{th} and 95^{th} quantiles is rejected at the 10 % level of significance. This confirms that negative relationship between carry trade and equity market is more pronounced in the lower quantile, during periods of turmoil, implying that investors rush to close out position in the equity market to limit their losses. Such action may cause panic and band wagon effect that depresses further the performance of the equity market.

Table 4.1. 2: Equties market results analysis(euro carry trade)

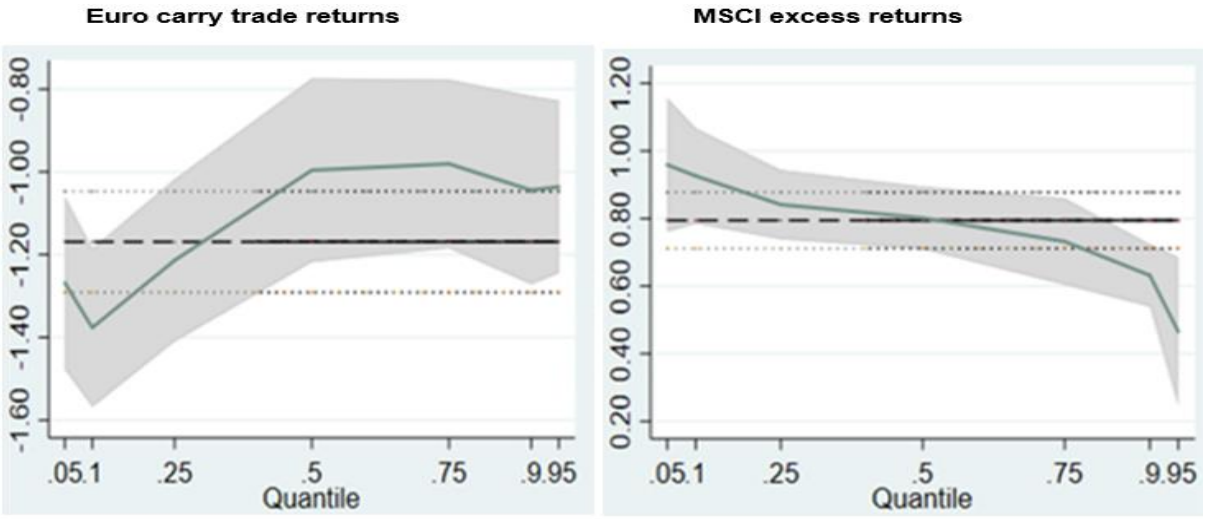
All Share excess returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
MSCI excess returns	0.959***	0.926***	0.841***	0.802***	0.732***	0.632***	0.466***
Euro CT	-1.27***	-1.38***	-1.21***	-1.0***	-0.98***	-1.04***	-1.04***
constant	-2.18***	-0.957	-1.096*	-1.377*	-0.481	0.669	0.531***

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

Table 4.1.2 presents results of the quantile regression assessing the relationship between All Share excess return and the euro-carry trade. The reported results show that this relationship is negative with high magnitudes in lower quantiles compared to high quantiles. These results are similar to those reported in Table 4.1.1 for the case of the US carry trade. However, the magnitude of the influence of the euro carry on excess equity returns in South Africa is relatively higher to the one of the US carry trade.

The difference of coefficient test as reported in Table 5.1, appendix B show that the null hypothesis of the equality of coefficients at the 5th and 95th quantile is not rejected. this may imply that that investors in the Euro carry trade market have similar behaviour during market extreme conditions, i.e., they rush to close out their positions once market conditions are highly favourable in order to cash in high profit or when there is turmoil in the market to limit their losses. These actions explain the high negative relationship between carry trade returns and the performance of the equity market.

Figure 4.1. 2: Euro-denominated carry trade and the equity market



The shaded area represents the 95% confidence level

Figure 4.1.2 displays the coefficients of the euro funded carry trade and the MSCI excess return as reported in Table 4.1.2. The results show the time-varying coefficient according to the different quantiles. Moreover, it shows that carry trade returns are largely negative in lower quantiles.

4.2.1 Two-Factor Model and the Bond Market

The literature shows that there is a thriving growth in the bond market. The International Monetary Fund (Lagarde,2014) show that funds have significantly been

directed into the local-currency bond market, and the progressive flow of funds into the bond market has increased its significance 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 cary trade returns for a two-factor model are reported in Table 4.2.1.

Table 4.2. 1: Bond market results analysis(US carry trade)

SA 10yr bond Excess returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
Global bond excess returns	0.069**	0.065***	0.061***	0.056***	0.059***	0.071***	0.076***
US CT	-0.8***	-0.9***	-0.72***	-0.68***	-0.76***	-0.88***	-1.1***
Constant	-7.73	-6.22***	-5.43***	-3.38***	-0.859	1.425	4.222**

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

The results in Table 4.2.1 highlight that there exists a positive relationship between South African excess bond returns and the global excess bond returns. The magnitude of the relationship is higher in the tails of the quantile distribution showing the possibility of spillover effect of the global bond market into the South African bond market. This finding shows that South Africa is integrated in global markets, especially the global bond market.

Concerning the relationship between the US carry trade returns and the returns in the South African bond market, the results reported in Table 4.2.1 show a negative relationship between the two returns. However, the t-test of difference in the quantile coefficients in Table 5.2 (Appendix B) shows that the null hypothesis of the equality coefficients is not rejected, especially between the 5^{th} and 95^{th} quantile and all other quantiles. These findings show that the relationship between US carry trade returns and bond market is not necessary influenced by the condition of the market, i.e. whether the market is normal, bear or bull. The rationale behind this finding may be that the bond yields in South Africa react the same way to carry trade returns, be it during the bull and bear markets. The same results are found with the euro carry trade operation, reported in Table 4.2.2. The rationale behind these findings are that bonds are less risky than equities and although its sell off may impact on its price or face value (the reason behind the negative value); however, the magnitude of this relationship is only dependent on the supply and demand mechanism and not market conditions.

The quantile graphs depicting the relationship of the different markets are reported in Appendix A in order to preserve space. The graphs, Figure 4.2.1 and Figure 4.2.2 presents the results as provided in Tables 4.2.1 and 4.2.2 respectively.

Table 4.2. 2 : Bond market results analysis(euro carry trade)

SA 10yr bond excess returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
Global bond excess return	0.081***	0.073***	0.052***	0.065***	0.066***	0.082***	0.078***
Euro CT	-1.44***	-1.43***	-1.05***	-0.96***	-1.04***	-1.13***	-1.36***
Constant	-3.38***	-3.378**	-3.46**	-1.592**	0.626	3.487**	5.535**

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

4.3.1 Three-Factor Model and the Equity Market

The three-factor model adds the global risk aversion, the VIX, in the estimation of Equation 4. The inclusion of VIX in the model is crucial. VIX is important in the pricing of equity and bond assets as it gauges investors' willingness to put capital at risk. Prior research shows that VIX is a useful proxy in the foreign exchange market to gauge the risk aversion and uncertainty among investors. Brunnermeier et al. (2008) incorporate weekly VIX in their model to measure investors attitude towards funding and find that the issue of liquidity in carry trades is often correlated to the volatility in the market.

Table 4.3. 1: Equties market results analysis(US carry trade)

All Share excess returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
MSCI excess returns	0.905***	0.95***	1.007***	0.945***	0.761***	0.683***	0.598***
US CT	-1.04***	-1.1***	-0.88***	-0.89***	-0.79***	-0.86***	-0.81***
VIX	0.046	0.065	0.023	0.048**	0.024	0.026	0.02
Constant	-4.31***	-4.0***	-3.37***	-2.98***	-1.89***	-0.68	-0.56

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

The results reported in Table 4.3.1 show a positive, but insignificant relationship between the All-Share excess returns and VIX in all quantiles except the 50th quantile with a 5% significant level.

This finding may imply that global risk affects the pricing of the equity market during normal periods, but not during extreme conditions. This may be because extreme conditions are anticipated to the pricing of equity markets in South Africa. The positive relationship between equity returns and VIX explains the required premium in

emerging markets economies by investors as compensation for the global risk. The inclusion of VIX in the euro funded carry trade position exhibits a similar relationship and the results are reported in Table 4.3.2 and figures 4.3.1 and 4.3.2 in Appendix A.

4.4.1 Three-Factor model and the bond market

The results of the relationship between the US carry trade returns and the bond excess returns in South Africa in a three-factor model are similar to those in the two-factor model. However, the results reported in Table 4.4.1 show the negative relationship between VIX and the bond market returns in South Africa, which is significant during relatively a normal period. Jubinski and Lipton (2012) show that there exists a negative relationship between bond prices and VIX, because an increase in VIX triggers higher anticipation of the systematic risk, which ultimately prompts investors to seek for relatively safe and default-free securities. The negative relationship signifies that global risk reduces investors' appetite to hold emerging market bonds, which reduces the price bonds (increase their yield). The reduction in bond prices due to global volatility may reflect the effect of flight to quality. For example, Beber, Brandt and Kavajecz (2009) show that the high magnitude of VIX, reflecting an increase in global risk, had an effect on flight to quality in the Sovereign Eurobonds at the detriment of emerging market bonds.

Table 4.4. 1: Bond market results analysis(US carry trade)

SA 10yr bond excess return	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
Global bond excess returns	0.066*	0.054**	0.061***	0.0526***	0.057***	0.073***	0.074***
US CT	-0.8***	-0.8***	-0.59***	-0.53***	-0.84***	-0.8***	-1.15***
VIX	-0.06	-0.03	-0.08***	-0.07	-0.02	-0.02	-0.004
Constant	-7.0***	-6.1***	-4.64***	-2.93***	-0.80	1.24	4.35**

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

5. Conclusion

Carry trade strategies executed from US and euro-funded positions into South African capital markets (equity and bond market) seem to have similar results.

In the case of the equity market, the relationship between US-funded carry trade returns and the All-Share excess returns is negative. This is also the case with the euro-funded carry trade returns, however, the magnitude of the negative effect of the euro-funded carry trade returns on both market excess returns are higher than the US dollar-funded carry trade. The possible reason behind that difference may be the high

risk associated with Euro compared to US-dollar as currencies. The US dollar being the world's reserve currency is certainly associated with lower currency risk premium compared to Euro.
The important insight from these findings for policy makers in South Africa is that carry trade operations that target the country may be detrimental to its capital markets, especially the equity and bond markets, given the negative relationship between carry trade returns and returns in the two capital markets. At the time South Africa needs long-term capital flows to sustain economic growth that is trapped below 3% for decades, carry trade operation attracts only short-term capitals. Besides, the short fall of only attracting short-term capitals, this study shows that when investors close out positions in the two capital markets to cash their profits, carry trade operations may not only affect negatively their performance but also lead to capital outflow, which is detrimental for economic growth in the country.

In the current study, we examined the relationship between US-funded, euro-funded carry trade strategies and the capital markets (equity and bond market) of the investment currency, which in our case is South Africa. The study assesses how the US dollar/rand and euro/rand carry trades are priced in the South African equity and bond markets. The study further assesses whether the pricing of the two capital markets depends on market conditions or the distribution of the carry trade returns. Thus, the study makes use of the two and three factors CAPM with carry trade as an important factor for the pricing of the two capital markets. Quantile regression is used to account for market conditions for the pricing process.

Overall, the empirical results show that the US dollar/rand and euro/rand carry trades are important factors for the pricing of equity and bond markets in South Africa. Moreover, for the equity market, specifically, the pricing depends on market conditions, especially the distribution of the two carry trade excess returns. however, the study shows that the relationship between US carry trade returns and bond market is not necessary influenced by the condition of the market, i.e. whether the market is normal, bear or bull. The rationale behind this finding may be that the bond yields in South Africa react the same way to carry trade returns, be it during the bull and bear markets. The rationale behind this finding is attributed to the fact that bond markets are less risky than equity markets and their pricing are more influenced by conditions related to supply and demand.

Furthermore, the study finds that the magnitude of the negative effect of the euro-funded carry trade returns on both market excess returns are higher than the US dollar-funded carry trade. The study attributes the possible reason behind that difference to high-risk premium associated with the Euro compared to the US-dollar, as currencies. The US dollar being the world's reserve currency is certainly associated with lower currency risk premium compared to Euro.

Our study is important to investors, asset managers and policy makers because the speculative nature of carry trade has implications on the overall stability of capital markets that are dependent on global capital flows, especially when the related markets are exposed to extreme economic distress. Moreover, it is important to the South African government to monitor the extent of carry trade operation given that they are short-term investments that may affect negatively on capital flows. Studies have shown that carry trade operation may lead to currency crash.

Our study opens another avenue for future research in which the relationship between capital markets return and carry trade returns can be studied over other non-traditional asset classes such as natural resources and real estate, to uncover how carry trade can affect their pricing process. This aspect can provide diversification benefits, which could help eliminate some of the hypersensitive risk inherent to traditional asset classes.

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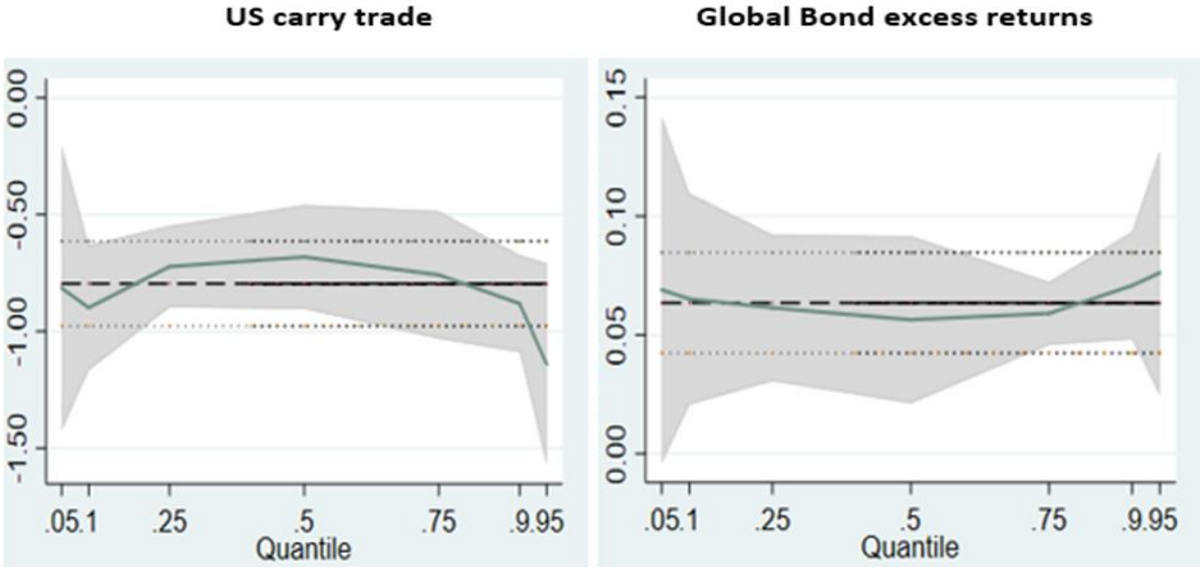
Appendices

Appendix A

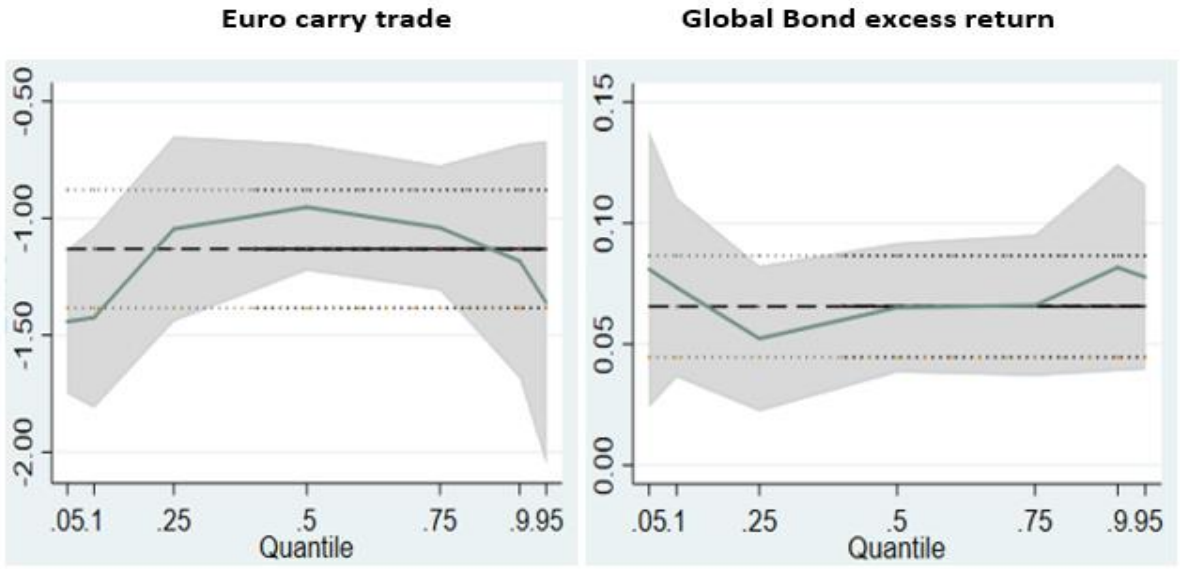
Two-factor model

Figure 4.2. 1: US dollar denominated carry trade and the bond market



The shaded area represents the 95% confidence interval.

Figure 4.2. 2: Euro denominated carry trade and the bond market



Three-factor model

Figure 4.3. 1: US dollar denominated carry trade and the equities market

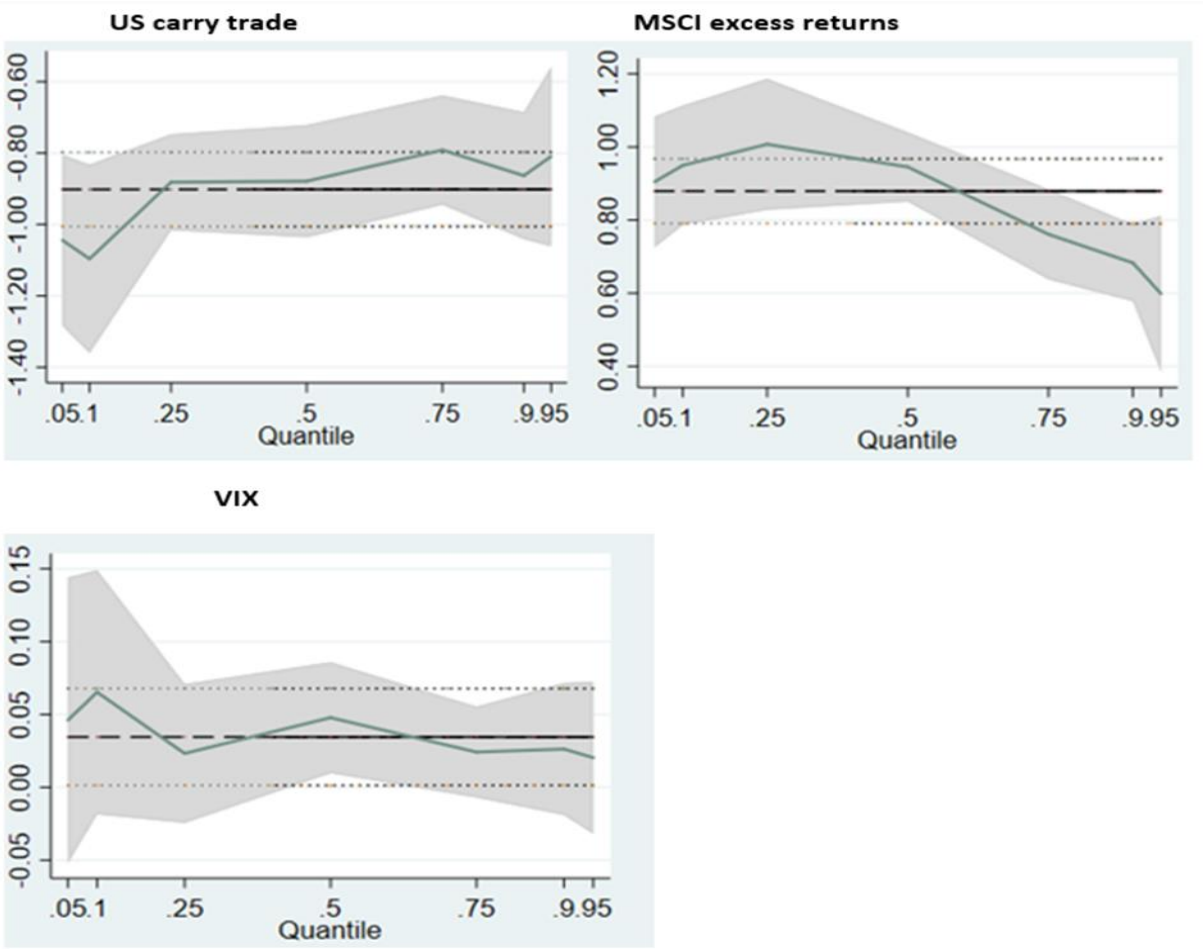


Table 4.3. 2: Equties market results analysis(euro carry trade)

All-Share excess returns	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
MSCI excess returns	0.71***	0.855***	0.835***	0.764***	0.673***	0.577***	0.497***
Euro CT	-1.1***	-1.17***	-1.19***	-1.05***	-0.91***	-0.98***	-1.04***
VIX	-0.1***	-0.09*	-0.05**	-0.04*	-0.0391*	-0.052**	-0.021
Constant	-0.101	-0.497	-0.262	-0.362	-0.166	1.375	1.712*

Figure 4.3. 2: Euro denominated carry trade and the equities market

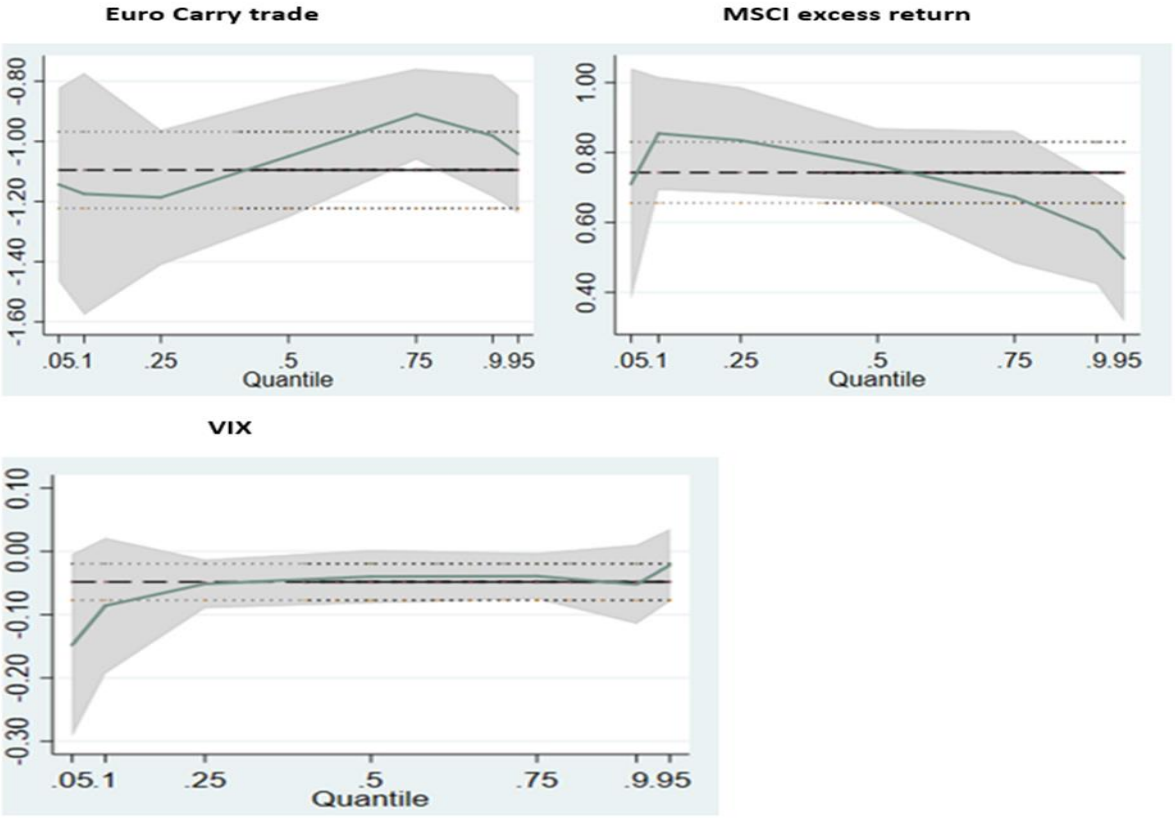


Figure 4.4. 1: US dollar denominated carry trade and the bond market

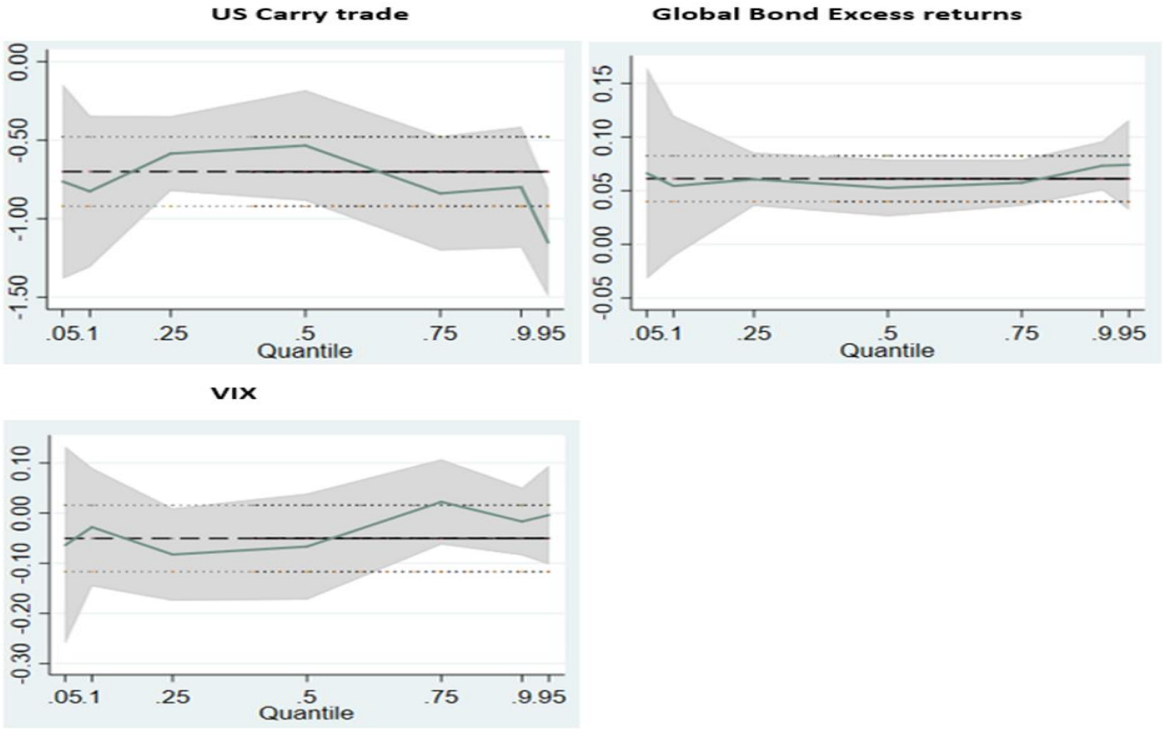
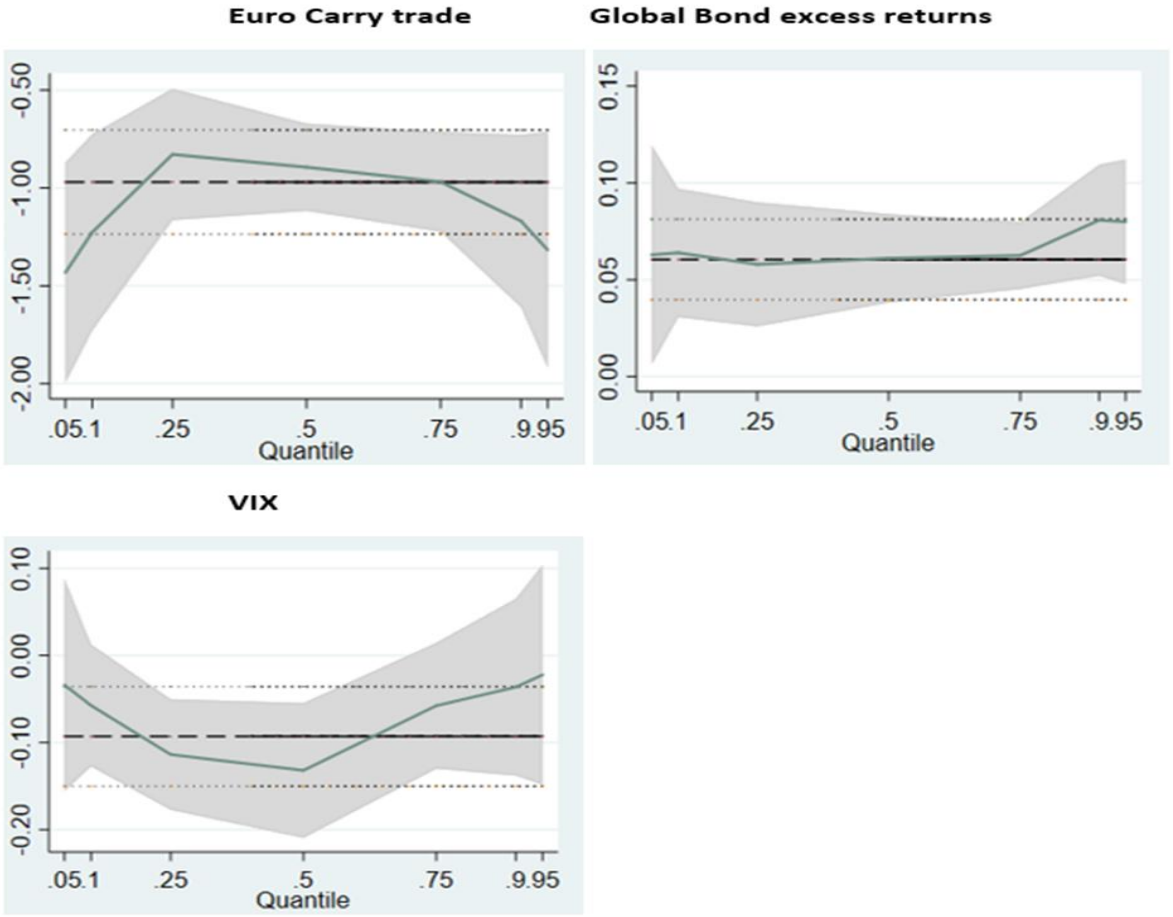


Table 4.4. 2: Bond market results analysis(euro carry trade)

SA 10yr bond excess return	Quantiles						
Variable	5%	10%	25%	50%	75%	90%	95%
Global ond excess returns	0.063**	0.0639***	0.058***	0.061***	0.063***	0.081***	0.08***
EuroCT	-1.4***	-1.23***	-0.83***	-0.89***	-0.97***	-1.17***	-1.3***
VIX	-0.03	-0.06	-0.11***	-0.13***	-0.056	-0.036	-0.022
Constant	-2.987*	-3.182*	-2.586**	0.489	1.254	4.041**	5.67***

Figure 4.4. 2: Euro denominated carry trade and the bond market



Appendix B

Table 5. 1: Test of difference: equity market

Equity market

		US carry trade		Euro carry trade	
		2-Factor Model	**3-Factor Model**	**2-Factor Model**	**3-Factor Model**
Quantiles	Variables				
5% versus 95%					
	MSCI excess returns	0.601***	0.306***	0.493***	0.213
	carry trade	-0.217*	-0.234*	-0.232	-0.102
	VIX		0.026		-0.126*
10% versus 90%					
	MSCI excess returns	0.213***	0.266**	0.294***	0.278***
	carry trade	-0.211***	-0.236	-0.332***	-0.193
	VIX		0.039		-0.034
25% versus 75%					
	MSCI excess returns	0.206***	0.246***	0.109	0.162**
	carry trade	(0.08)	-0.0901	-0.233*	-0.277**
	VIX		-0.0009		-0.012

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

Table 5. 2: Test of difference: bond market

Bond market

		US carry trade		Euro carry trade	
		2-Factor Model	**3-Factor Model**	**2-Factor Model**	**3-Factor Model**
Quantiles	Variables				
5% versus 95%					
	Global Bond excess returns	-0.007	-0.008	0.003	-0.017
	carry trade	0.325	-0.388	-0.081	-0.117
	VIX		-0.06		-0.012
10% versus 90%					
	Global Bond excess returns	-0.006	-0.019	-0.008	-0.017
	carry trade	-0.017	-0.027	-0.242	-0.058
	VIX		-0.011		-0.021
25% versus 75%					
	Global Bond excess returns	0.002	0.003	-0.014	-0.005
	carry trade	0.036	0.254	-0.005	0.14
	VIX		-0.105**		-0.056

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