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Benefits of wavelet-based carry trade diversification[☆]



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ABSTRACT

This study investigates carry trade diversification opportunities and linkages of major carry trade currencies on five different investment horizons. Using daily data on eight currencies and LIBOR rates, we examine the temporal structure of correlations and assess portfolio diversification benefits with wavelet techniques. Our results indicate that positive and economically significant carry trade excess returns are observed on all investigated investment horizons. We document that strategies built on the basis of wavelet correlation lead to significant diversification benefits. These findings indicate the importance of the dynamic structure of exchange rate correlations to currency arbitrage strategies.

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1. Introduction

The volume of transactions in the global currency market on some days reaches four trillion U.S. dollars. In annual terms, the global currency market trading volume is 12 times more than that of all the world's stock markets (Triennial Central Bank Survey, 2010). Interestingly, only 10% of the volume is associated with the maintenance of international trade while the rest is partly attributed

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to speculative activity. The most popular strategy for speculative currency trading is the carry trade. In order to execute the carry trade, investors sell borrowed currency at a low interest rate and buy investment instruments denominated in currencies with high interest rates. The interest rate parity condition predicts that the national currency will depreciate if the domestic interest rate is higher than the foreign interest rate. However, the evidence suggests that in the real world it is strengthened indicating Uncovered Interest Parity failure¹. The existence of these excess returns has received vast attention in the recent literature².

Earlier studies show that diversification across several currencies leads to carry trade risk reduction. [Burnside et al. \(2006\)](#) show that the Sharpe ratio generated by an equally weighted portfolio of carry trade strategies is positive and statistically different from zero. Continuing their research [Burnside et al. \(2008\)](#) find that diversification among currencies boosts the Sharpe ratio. An equally weighted carry trade portfolio appears to provide a higher Sharpe ratio and other benefits of diversification in comparison to individual carry trade strategies and stock market benchmark. Inter alia, [Burnside et al. \(2011a\)](#) and [Bakshia and Panayotov \(2013\)](#) show that returns are better for portfolios of currencies and that diversification leads to a higher Sharpe ratio and decrease in volatility. These studies imply that diversification across currencies is the key factor to portfolio features adjustment.

The purpose of the study is three-fold: (i) to examine carry trade returns in excess of Uncovered Interest Parity (UIP) on different time scales (ii) to analyze the temporal structure of the correlations of the most liquid carry trade currencies; and (iii) to investigate carry trade diversification opportunities with a focus on these correlations. For these purposes we use wavelet correlation analysis, which allows breaking the time series of exchange rate returns into a series of wavelet coefficients and revealing the temporal structure of the correlations³.

This study attempts to add to the carry trade literature in two respects. First, the study extends the analysis of carry trade diversification opportunities and examines the temporal structure of correlations among the most common carry trade currencies. Knowing correlation structure, we are able to maximize the diversification benefits in carry trade portfolio construction. Second, the study investigates carry trade excess returns on five different time scales. Therefore the study aims to extend the existing literature that employs static correlation and a single investment horizon approach in portfolio construction.

We find that positive and economically significant excess returns are observed on different investment horizons, namely the one-day, one-week, one-month, quarterly, and yearly horizons. Individual currency carry trades show a positive Sharpe ratio on every horizon⁴. Most importantly, the findings of the study suggest that strategy building on the basis of wavelet correlation analysis leads to significantly higher Sharpe ratios than those of Equally Weighted portfolio and S&P 500. For example, on the 3-month horizon the Sharpe ratios are twice as high for Wavelet portfolio. The results are even more pronounced in the pre-crisis sample. Further, wavelet diversified portfolios

¹ In similar vein, if the forward premium is positive, the evidence suggests that in practice the currency will strengthen over time ([Fama, 1984](#); [Engel, 1995](#); [Obstfeld and Rogoff, 2001](#); [Lewis, 2011](#); [Doukas and Zhang, 2013](#)).

² Two broad classes of explanations are proposed: (i) excess returns as a premium for risk; (ii) excess returns stems from market inefficiency. The risk premium class of explanation stems from the idea that investors are not risk neutral, and the bias in the forward rate's prediction of the spot rate reflects a risk premium (see e.g. [Villanueva, 2007](#); [Lustig et al., 2011](#); [Menkhoff et al., 2011](#); [Baillie and Chang, 2011](#)). Market inefficiency explanations assess the forward premium puzzle under the condition that investors make mistakes when forming expectations and/or in processing information (see e.g. [Krasker, 1980](#); [Lewis, 1989](#); [Kaminsky, 1993](#)). Another way to look at the puzzle is the market microstructure approach considering limits to speculations (see e.g. [Lyons, 2001](#); [Evans and Lyons, 2002](#)). Finally, it should be noted that the strategy of investing in high interest rate currencies and borrowing in currencies with low rates is associated with a negative skewness. Thus, carry trades are exposed to crash risk ([Brunnermeier et al., 2009](#)).

³ Study by [Nekhili et al. \(2002\)](#) indicates the importance of scale-based analysis. The Wavelet Analysis of financial time series and maximum overlap discrete transform (MODWT) techniques have been used extensively to study the co-movements of major stock market indices. See, e.g. [Graham and Nikkinen \(2011\)](#), [Graham et al. \(2012\)](#), [Kiviahio et al. \(2012\)](#), [Nikkinen et al. \(2012\)](#) and [Loh \(2013\)](#).

⁴ The results of the study are consistent with previous findings of carry trade excess returns over uncovered interest parity (e.g. [Fama, 1984](#); [Engel, 1995](#); [Fan and Lyons, 2003](#); [Gagnon and Chaboud, 2007](#); [Galati et al., 2007](#); [Clarida et al., 2009](#)).

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