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Foreign exchange risk and the predictability of carry trade returns

Gino Cenedese [a], Lucio Sarno [b,*], Ilias Tsiakas [c]

[a] Bank of England, Threadneedle Street, London EC2R 8AH, United Kingdom
[b] Cass Business School, City University London and CEPR, United Kingdom
[c] Department of Economics and Finance, University of Guelph, Guelph Ontario N1G 2W1, Canada

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ABSTRACT

This paper provides an empirical investigation of the time-series predictive ability of foreign exchange risk measures on the return to the carry trade, a popular investment strategy that borrows in low-interest currencies and lends in high-interest currencies. Using quantile regressions, we find that higher market variance is significantly related to large future carry trade losses, which is consistent with the unwinding of the carry trade in times of high volatility. The decomposition of market variance into average variance and average correlation shows that the predictive power of market variance is primarily due to average variance since average correlation is not significantly related to carry trade returns. Finally, a new version of the carry trade that conditions on market variance generates performance gains net of transaction costs.

1. Introduction

The carry trade is a popular currency trading strategy that invests in high-interest currencies by borrowing in low-interest currencies. This strategy is at the core of active currency management and is designed to exploit deviations from uncovered interest parity (UIP). If UIP holds, the interest rate differential is on average offset by a commensurate depreciation of the investment currency and the expected carry trade return is equal to zero. There is extensive empirical evidence dating back to Bilson (1981) and Fama (1984) that UIP is empirically rejected. In practice, it is often the case that high-interest rate currencies appreciate rather than depreciate. As a result, over the last 35 years, the carry trade has delivered sizeable excess returns and a Sharpe ratio more than twice that of the US stock market (e.g., Burnside et al., 2011). It is no surprise, therefore, that the carry trade has attracted enormous attention among academics and practitioners.[1]

An emerging literature argues that the high average return to the carry trade is no free lunch in the sense that high carry trade payoffs compensate investors for bearing risk. The risk measures used in this literature are specific to the foreign exchange (FX) market as traditional risk factors used to price stock returns fail to explain the returns to the carry trade (e.g., Burnside, 2012). In a cross-sectional study, Menkhoff et al. (2012a) find that the large average carry trade payoffs are compensation for exposure to global FX volatility risk. Christiansen et al. (2011) further show that the level of FX volatility also affects the risk exposure of carry trade returns to stock and bond markets. Mueller et al. (2012) show that FX excess returns also carry a negative price of correlation risk. Lustig et al. (2011) identify a slope factor in the cross section of FX portfolios, constructed in similar fashion to the Fama and French (1993) "high-minus-low" factor. Burnside et al. (2011) argue that the high carry trade payoffs reflect a peso problem, which is a low probability of large negative payoffs. Finally, Brunnermeier et al. (2009) suggest that carry trades are subject to crash risk that is exacerbated by the sudden unwinding of carry trade positions when speculators face funding liquidity constraints.[2]

* Corresponding author at: Faculty of Finance, Cass Business School, 106 Bunhill Row, London EC1Y 8TZ, UK. Tel.: +44 20 7040 8772.

E-mail addresses: gino.cenedese@bankofengland.co.uk (G. Cenedese), lucio.sarno@city.ac.uk (L. Sarno), itsiakas@uoguelph.ca (I. Tsiakas).

[1] The empirical rejection of UIP leads to the well-known forward bias, which is the tendency of the forward exchange rate to be a biased predictor of the future spot exchange rate (e.g., Engel, 1996; Sarno, 2005).

[2] Similar arguments based on crash risk and disaster premia are put forth by Farhi et al. (2013) and Jurek (forthcoming).

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This paper investigates the intertemporal tradeoff between FX risk and the return to the carry trade. We contribute to the recent literature cited above by focusing on four distinct objectives. First, we set up a predictive framework, which differentiates this study from the majority of the recent literature that is primarily concerned with the cross-sectional pricing of FX portfolios. We are particularly interested in whether current market volatility can predict the future carry trade return. Second, we evaluate the predictive ability of FX risk on the full distribution of carry trade returns using quantile regressions, which are particularly suitable for this purpose. In other words, we relate changes in FX risk to the large future losses or gains of the carry trade located in the left or right tail of the return distribution respectively. Third, we define a set of FX risk measures that captures well the movements in aggregate FX volatility and correlation. These measures have recently been studied in the equities literature but are new to FX. Finally, fourth, we assess the economic gains of our analysis by designing a new version of the carry trade strategy that conditions on the FX risk measures.

The empirical analysis is organized as follows. The first step is to form two carry trade portfolios, which are rebalanced monthly: an advanced economy portfolio that includes ten major currencies relative to the US dollar for the sample period of January 1985 to April 2013; and a global portfolio of 22 currencies relative to the US dollar for the sample period of January 1998 to April 2013. Our main measure of FX risk is the market variance defined as the variance of the returns to an equally weighted portfolio of currencies (the "FX market portfolio" hereafter). The market variance is then decomposed in two components: the cross-sectional average variance and the cross-sectional average correlation of all bilateral exchange rates, implementing the methodology used by Pollet and Wilson (2010) to predict equity returns. Next, using quantile regressions, we assess the predictive ability of these risk measures on the full distribution of carry trade returns. Quantile regressions provide a natural way of assessing the effect of higher risk on different parts (quantiles) of the carry return distribution. Finally, we design an augmented carry trade strategy that conditions on the risk measures and the return quantiles, which is implemented out of sample and accounts for transaction costs.

Our main finding is that FX market variance has a significant negative effect on the left tail of future carry trade returns. This implies a negative predictive relation between risk and realized returns in FX. It also indicates that higher market variance is significantly related to large losses to the carry trade, potentially leading investors to unwind their carry trade positions. Furthermore, more than 95% of the time-variation in the FX market variance can be captured by a decomposition into average variance and average correlation. The decomposition allows us to determine that the predictive power of market variance is primarily due to average variance: average variance also has a significant negative effect on the left tail of future carry trade returns, but average correlation does not contribute to the predictability of carry trade returns. Finally, an augmented carry trade strategy that conditions on market variance and the return quantile performs better than the standard carry trade, even when accounting for transaction costs.

Taken together, these results imply the existence of a meaningful predictive relation between market variance and carry trade returns, especially when returns are in the left tail of the distribution. In particular, our empirical analysis shows that information in both market variance and the return quantile is useful for predicting future carry trade returns. In this context, our main finding is that market variance predicts currency returns when it matters most, namely when returns have large negative values, whereas the relation is weaker in normal times. To be more precise, our trading strategy shows that when the carry trade displays a large loss, then market variance provides useful information about whether subsequent losses will occur.

The remainder of the paper is organized as follows. In the next section we discuss the theoretical foundations of the testable hypotheses we examine in this paper. In Section 3, we describe the FX data set and define the measures for risk and return to the carry trade. Section 4 presents the predictive quantile regressions. In Section 5, we report the empirical results, followed by a discussion of the augmented carry trade strategies in Section 6. Finally, Section 7 concludes.

2. Theoretical motivation and testable implications

2.1. Market variance and the ICAPM

Since the Intertemporal Capital Asset Pricing Model (ICAPM) of Merton (1973, 1980), a class of asset pricing models has developed which suggests an intertemporal tradeoff between risk and return. These models hold for any risky asset in any market and hence can be applied not only to equities but also to the FX market. For the carry trade, the intertemporal risk-return tradeoff may be expressed as follows:

$$r_{C,t+1} = \mu + \kappa MV_t + \varepsilon_{t+1}, \quad (1)$$

$$MV_t = \varphi_0 + \varphi_1 AV_t + \varphi_2 AC_t, \quad (2)$$

where $r_{C,t+1}$ is the return to the carry trade portfolio from time t to $t+1$; MV_t is the conditional variance of the returns to the FX market portfolio at time t, termed the FX market variance; AV_t is the equally weighted cross-sectional average of the variances of all exchange rate excess returns at time t; AC_t is the equally weighted cross-sectional average of the pairwise correlations of all exchange rate excess returns at time t; and ε_{t+1} is a normally distributed error term at time $t+1$. These variables will be formally defined in the next section. It is important to note now, however, that the return to the FX market portfolio is simply an equally weighted average of all exchange rate excess returns. The recent literature on cross-sectional currency pricing typically uses the FX market portfolio as a standard risk factor (e.g., Lustig et al. (2011); Menkhoff et al., 2012a,b).

Eq. (1) is a general characterization of the theoretical prediction that there is a positive linear relation between market variance and future excess returns. The coefficient κ on market variance reflects investors' risk aversion and hence is assumed to be positive: as risk increases, risk-averse investors require a higher risk premium and the expected return must rise. There is an extensive literature investigating the intertemporal risk-return tradeoff, mainly in equity markets, but the empirical evidence on the sign and statistical significance of the relation is inconclusive. Often the relation between risk and return is found insignificant, and sometimes even negative.[3]

Eq. (2) shows that market variance can be decomposed into average variance and average correlation (with $\varphi_1, \ \varphi_2 > 0$), as shown by Pollet and Wilson (2010) for equity returns. This decomposition is an aspect of our analysis that is critical for determining whether the potential predictive ability of market variance is due to movements in average variance or average correlation. In other words, the decomposition is used to clarify what is the source of the predictive information content of market variance. For example, Goyal and Santa-Clara (2003) show that the equally weighted market variance only reflects systematic risk, whereas average variance captures both systematic and idiosyncratic risk. In light of the above, the first testable hypothesis of the empirical analysis

[3] See, among others, French et al. (1987), Chan et al. (1992), Glosten et al. (1993), Goyal and Santa-Clara (2003), Ghysels et al. (2005), and Bali (2008).