Journal of Financial Economics 113 (2014) 325–347

Contents lists available at ScienceDirect

Journal of Financial Economics

journal homepage: www.elsevier.com/locate/jfec

Crash-neutral currency carry trades ☆

Jakub W. Jurek *

Princeton University, Bendheim Center for Finance, United States

ARTICLE INFO

Article history:
Received 5 September 2013
Accepted 6 October 2013
Available online 14 May 2014

JEL classification:
G12
G15
F31

Keywords:
Carry trade
Crash risk
Foreign exchange option
Forward premium anomaly
Uncovered interest rate parity

ABSTRACT

Currency carry trades exploiting violations of uncovered interest rate parity in G10 currencies deliver significant excess returns with annualized Sharpe ratios equal to or greater than those of equity market factors (1990–2012). Using data on out-of-the-money foreign exchange options, I compute returns to crash-hedged portfolios and demonstrate that the high returns to carry trades are not due to peso problems. A comparison of the returns to hedged and unhedged trades indicates crash risk premia account for at most one-third of the excess return to currency carry trades.

1. Introduction

Currency carry trades are simple strategies designed to exploit violations of uncovered interest rate parity by investing in currencies with higher interest rates, while borrowing funds in currencies with lower interest rates. Over the period from 1990 to 2012, such strategies delivered Sharpe ratios between 0.40–0.55, matching or exceeding those of common equity market factors (Fama-French/Carhart). Simultaneously, carry trades have exhibited negatively skewed returns and a positive exposure to equity market downside risks, as captured by equity index put-writing strategies. Taken together, these facts suggest that the excess returns to currency carry trades may reflect compensation for exposure to the risk of rapid devaluations of currencies with relatively higher interest rates. This paper investigates this hypothesis by constructing the returns to crash-hedged currency carry trades using a unique data set of foreign exchange options, which includes all G10 cross-rates (45 currency pairs). A comparison of the returns to hedged and unhedged trades indicates that crash risk premia account for less than one-third of the total excess return earned by currency carry trades over this period.

Returns to currency carry trades are comprised of the ex ante known interest rate differential (carry), and an uncertain currency return component, capturing the change in the value of the long currency relative to the funding (short) currency. Uncovered interest parity (UIP) predicts that the currency return should exactly offset the

☆ I thank David Backus, David Bates, John Campbell, Mikhail Chernov (discussant), Joshua Coval, Itamar Drechsler, John Heaton (discussant), Stefan Nagel, Monika Piazzesi, Erik Stafford, Adrien Verdelhan (discussant), Zhikai Xu, and seminar participants at Duke University, Yale University, the Fall 2008 NBER Asset Pricing Meeting, the 2008 Princeton-Cambridge Conference, the 2008 Princeton Implied Volatility Conference, the 2008 Conference on Financial Markets, International Capital Flows and Exchange Rates (European University Institute), the 2009 Oxford-Princeton Workshop on Financial Mathematics and Stochastic Analysis, the 2009 American Finance Association Meetings, the Society for Quantitative Analysts and the Harvard Finance Lunch (Fall, 2007) for providing valuable comments. I am especially grateful to Zhikai Xu for research assistance and J.P. Morgan for providing the FX option data.

* Tel.: +1 609 258 4037; fax: +1 609 258 0771.
E-mail address: jjurek@princeton.edu

http://dx.doi.org/10.1016/j.jfineco.2014.05.004
0304-405X/© 2014 Published by Elsevier B.V.

interest rate differential, such that investors would be indifferent between holding the two currencies. In practice, this relationship is frequently violated, and currencies with relatively higher interest rates either appreciate, or do not depreciate sufficiently to offset the carry.[1] As a consequence, a carry trade investor in G10 currencies who went long (short) the currencies with the highest (lowest) one-month interest rates, weighting the positions in proportion to the interest rate differential, would have earned 5.21% per annum (t-stat: 2.62) over the period from 1990 to 2012 (Table 1). However, these returns are punctated by infrequent, but severe episodes of rapid depreciations, which induce a negative skewness exceeding that of the equity market excess return.

I investigate the excess returns to currency carry trades in G10 currencies from the perspective of the associated FX option market, with the aim of addressing two questions.[2] First, do the high measured excess returns reflect a "peso problem" owing to the exposure to currency crash risks, which have not materialized—or, are insufficiently represented—in the sample? Second, to the extent that the high observed excess returns are not a reflection of a statistical measurement problem, what fraction of the excess return can be attributed to currency crash risk premia? To address these questions, I exploit a unique G10 exchange rate option panel data set, which includes daily price quotes for all 45 cross-rate pairs at five distinct strikes, to construct crash-neutral currency carry trades in which the exposure to rapid depreciations in the relatively higher interest rate currency has been hedged using a put option overlay.[3] I then compare the returns to the unhedged currency carry trades with those of the corresponding FX option hedged portfolios.

First, I find that the excess returns to crash-hedged currency carry trades remain positive and statistically significant, indicating that "peso problems" (Rietz, 1988) are unlikely to provide an explanation for the high measured excess returns in G10 currencies. This finding contrasts with the results in Burnside, Eichenbaum, Kleshchelski, and Rebelo (2011), and reflects two major differences in the identification strategy. First, unlike them I do not rely on options, which are at-the-money (50δ) to hedge crash risk, but rather focus attention on portfolios hedged using out-of-the-money (10δ) options. This results in higher estimates of the mean returns to the crash-hedged portfolios. Second, I hedge currency pairs (J/I) directly in their associated exchange rate option, rather than separately hedging the long and short legs of the trade using J/USD and I/USD options. This is a much more efficient hedging scheme, since it avoids paying for exposure to US dollar risk in each option contract. I show that hedging using X/USD options produces downward biased estimates of crash-hedged returns, consistent with evidence of a US dollar risk factor in the cross-section of currency returns (Lustig, Roussanov, and Verdelhan, 2011; Lustig, Roussanov, and Verdelhan, 2014).

Second, I provide a simple, empirical decomposition of the excess returns to currency carry trade returns into diffusive and jump (crash) risk premia. I show that the mean return to an appropriately constructed portfolio of crash-neutral currency carry trades provides an estimate of the diffusive risk premium, while the difference between the mean returns of the unhedged and hedged portfolios provides an estimate of the jump risk premium. The point estimates of the crash risk premium in G10 currencies range from 0.20% to 0.50% per annum, depending on the portfolio weighting and option hedging schemes, and account for less than 10% of the excess returns of the unhedged carry trade (Table 3). These estimates are robust to the portfolio rebalancing frequency (monthly vs. quarterly), and the imposition of constraints on the net dollar exposure of the portfolio (non-dollar-neutral vs. dollar-neutral). The inclusion of a conservative estimate of option transaction costs—an ask-to-mid spread equal to 10% of the prevailing implied volatility—raises estimates of the crash risk premium to 1.3% to 1.6% per annum, or 20–30% of the total portfolio currency risk premium (Table 5). In a related exercise, I show that in order to drive the point estimate of mean realized return of the hedged carry trade to zero, option-implied volatilities would have had to have been roughly 40% higher than the values reported in the data. These results indicate that, when viewed from the perspective of FX option prices, tail risks appear to play a modest role in determining currency risk premia.

Since the unhedged currency carry trade portfolio is a mimicking portfolio for the "slope" risk factor (Lustig, Roussanov, and Verdelhan, 2014), the analysis effectively provides a decomposition of the HML_{FX} risk premium in G10 currencies. However, it is crucial to highlight that this decomposition is not structural in nature, since I do not have an asset pricing model to estimate. Jurek and Xu (2014) address this concern by calibrating a multi-country model of stochastic discount factor dynamics inspired by the time-changed Lévy modeling framework of Carr and Wu (2004), which formally pins down currency dynamics, risk premia, and FX option prices.[4] Their analysis provides

[1] Froot and Thaler (1990), Lewis (1995), and Engel (2013) survey the vast theoretical and empirical literature on exchange rates. The leading explanations of UIP violations are generally subdivided into: exchange rate risk premiums, private information, near-rational expectations, and peso problems.

[2] Bates (1996) was the first to use currency option data to infer jump risks from dollar/yen and dollar/mark exchange rates. Bhansali (2007) scales interest differentials using FX option-implied volatilities to assess the attractiveness of carry trades. Burnside, Eichenbaum, Kleshchelski, and Rebelo (2011) and Farhi, Fraiberger, Gabaix, Ranciere, and Verhelhan (2009) examine returns to currency carry trades hedged using X/USD options. Koijen, Moskowitz, Pedersen, and Vrugt (2013) study the dynamics of carry trades across different asset classes.

[3] The crash-hedged currency carry trades combine the position of the standard currency carry trade with a foreign exchange option struck at a fixed delta. This implies the option roughly has a fixed probability of expiring in-the-money, or equivalently, will be struck further away from at-the-money as option-implied volatilities increase. This construction reflects the view that a "crash" is a return realization, which is viewed as large from the perspective of an investor's ex ante assessment of volatility. In the robustness section, I also examine returns to carry trades hedged at fixed moneyness (Table 6).

[4] The model in Jurek and Xu (2014) drives the dynamics of country-level pricing kernels using a combination of common (global) and country-specific components, both of which follow jump-diffusions. The loading of each country on the global component is allowed to vary,