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ON RETURN AND RISK IN CARRY TRADES: A CASE OF THE PAK RUPEE

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Abstract

This paper examines return and risk in Japanese-yen-, Swiss-franc- and US dollar-funded carry trades in the Pak rupee over the period 1995:01-2010:06. Results show that carry trades outperform the S&P 500, Swiss and Nikkei 225 stock market indices. The average annualized returns in carry trades range between 12.03% to 16.70% with standard deviations between 24% to 44%, giving Sharpe ratios that range between 0.36 to 0.49, whereas the annualized returns on stock markets range between -3.4% to 7.19% with standard deviations between 55.08 to 71.19, giving Sharpe ratios between -0.03 and 0.12. The results also show that the yen-funded carry trade produces both the highest average annualized return and interest differential of 8.6% and 16.70% respectively, whereas the US-dollar-funded carry trade produces the lowest average annualized return and interest differential of 5.21% and 12.03% respectively. However, the percentage of positive returns in the latter is 24% higher than the percentage of positive returns in the former. In addition, carry trade produces the highest Sharpe ratio when the Pak rupee is paired with the US dollar rather than when it is paired with the Japanese yen and Swiss franc, implying that the risk-adjusted return is the highest in the Pak rupee pair with the US dollar.

Key Words: *Uncovered interest parity, exchange rate and open economy*

JEL Classification: F30, F31, F41

1. Introduction

As a consequence of the significant fall in the Japanese and Swiss interest rates the mid-1990s, carry trade has become the most popular investment strategy[1]. It is

[1] Over the period between October 2002 and June 2006, nominal interest rates in Japan were reduced to almost zero, creating a challenge for corporate treasurers to earn a meaningful return on

often viewed as a highly speculative investment strategy, whereby an investor borrows funds in a low-interest (funding) currency and invests the funds borrowed in a high-interest (target) currency to capitalize on the interest differential and possibly on the movement in the exchange rate of the target against the funding currency. If the exchange rate of the target and against the funding currency remains stable between the time funds are borrowed and paid back in the low-interest currency, then the investor earns at least the interest differential. Yet the investor may earn more than the interest differential if the high-interest currency appreciates against the low-interest currency during the life of the investment. On the contrary, a depreciation of the high-interest currency may wipe out much of the gains from the interest differential, and can even put a carry trader out of business if the depreciation of the high-interest currency is much higher than the interest differential[2]. Thus, the profitability of carry trade depends not only on the gains from the interest rate differential but also on the expected change in the exchange rate of the target against the funding currency.

Carry trades have important implications for the exchange rates of funding against target currencies as well as for monetary policies pursued in countries with low- and high-interest currencies. Galati *et al* (2007) argue that carry trades typically tend to have asymmetric impact on exchange rates. In general, the build up of these positions is viewed to result in a persistent strengthening of target currencies and weakening of funding currencies[3]. La Marca (2007) holds the same view by arguing that the relative funds involved in carry trade activities may trigger a cumulative effect on exchange rates, inducing an appreciation of target currencies and a depreciation of funding currencies. According to him, Japanese-yen- and Swiss franc-funded carry trade operations appear to have been responsible for a persistent trend to towards appreciation of high-yielding currencies, such as the Australian dollar, New Zealand dollar, Brazilian real, Turkish lira, South African rand, Korean won and the currencies of some transition economies such as

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excess cash denominated in yen. It also created an opportunity for large financial institutions (such as hedge funds and commodity trading advisors (CTAs)) to borrow funds in yen, convert them into dollars, and then invest the proceeds in U.S. interest-bearing accounts to capitalize on the interest differential (Banyard, 1998; and Galati *et al*, 2007). McGuire and Upper (2007) argue that hedge funds and CTAs have been the main players and beneficiaries of trades in the Japanese yen and Swiss franc as funding currencies.

[2] Zukerman and Pacelle (1999) argue that "much of the time this "yen carry activity" is quite successful, although it can backfire if the yen appreciates sharply as it did in 1998 and 1999.

[3] However, a sudden unwinding of these positions may give rise to a tendency for target currencies to depreciate and funding currencies to appreciate sharply (see, for example, Beranger *et al*, 1999; and Cairns *et al*, 2007).

Hungry, Romania, Bulgaria and the Baltic states. Funding currencies, such as the Japanese yen and Swiss franc, have demonstrated an opposite trend. It is also argued that national monetary policies in these countries have become increasingly affected by the pressures on exchange rates and inflows of short term capital. The fear of a sudden stop of inflows of short term capital, currency depreciation and a consequent inflationary pressure may induce central banks in these countries to maintain high interest differentials and accommodate the increasing appetite of carry traders.

The objective of this paper is to examine whether Japanese-yen, Swiss-franc and US dollar-funded carry trades in the Pak rupee have been profitable over the period 1995m1-2010m6. The motivation lies in the fact that over the sample period nominal interest rates denominated in the Pak rupee have always been, and are still consistently much higher than those denominated in the three major currencies[4]. This might have given rise to an opportunity for currency traders to borrow funds in the major currencies with low interest rates and invest the funds in the Pak rupee with high interest rates and as such make profit by engaging in carry trade activities. The paper also aims to compare the return and risk characteristics of carry trades in the Pak rupee with those of the Standard & Poor 500 (S&P 500), Swiss and Nikkei 225 stock markets over the period under investigation.

The remainder of the paper is structured as follows. Section II describes theories and mechanics underlying carry trades. Section III presents a review of some selected seminal studies to draw major findings about return and risk in carry trades, while Section V discusses data and empirical results. The final section concludes and discusses some policy implications.

2. Theories and Mechanics of Carry Trade

Theoretically, carry trades are closely associated with interest parity conditions, in particular uncovered interest parity (UIP) and covered interest parity (CIP). If the UIP condition is valid, then the carry trade operation is not profitable on average because the high-yielding currency should depreciate against the low-yielding currency by a percentage that wipes out the interest differential. Let i_t^F and i_t^T be the interest rates on funding and target currencies respectively set at time *t*, where $i_t^F < i_t^T$. Also let S_t and S_{t+1} be the current and future spot exchange rates

[4] Only on nine occasions were the Pak rupee interest rates slightly higher than those in the US dollar between the period August 1998 and March 2004.

between funding and target currencies (defined as the target currency price of a unit of the funding currency) prevailing at time t and $t+1$ respectively. The mechanics underlying carry trades is very simple and straight forward. It goes as follows. At time t, an investor borrows K amount of funds in a funding currency at the interest rate i_t^F, and converts these funds at the current spot rate S_t to obtain K/S_t proceeds in a target currency, which are then invested in the target currency yielding the interest rate i_t^T and as such the value of the carry trade at time $t+1$ will be equal to $(K/S_t)(1+i_t^T)$. At time $t+1$ the loan matures and the amount $K(1+i_t^F)$ has to be repaid. Thus if UIP holds, then financing long position in the target currency via short position in the funding currency should not be profitable since the rate of depreciation of the target currency (S_{t+1}/S_t) eventually wipes out the interest differential ($i_t^T - i_t^F$), and as such the net profit (π_t) from carry trades will be equal to zero. The UIP condition is given by

$$\frac{S_{t+1}}{S_t} = \frac{1+i^T}{1+i^F} \tag{1}$$

Equation (1) can be approximated by[5]

$$\dot{S} = i_t^T - i_t^F \tag{2}$$

The carry trade operation will be profitable if the UIP condition implied by equation (1) or (2) is invalidated consistently over time. Thus, the carry will be profitable as long as $i_t^T - i_t^F > \dot{S}$ (that is, as long as the target currency does not depreciate by more than the interest differential) or the target currency appreciates against the funding currency, implying the failure of UIP[6]. It must, however, be noted that the failure of UIP is not the only cause for carry trades. The other cause for carry trades is the failure of CIP, resulting in opportunities for profit that can be made by financing long positions in the currencies selling at a discount via short positions in the ones selling at a premium. Because covered interest parity must hold as an arbitrage or a hedging condition, the two forms of carry trades are equivalent (Moosa, 2010; p.362).

[5] Equation (2) can be obtained by subtracting 1 from both sides of equation (1) and assuming that $\dot{S}i^F$ is equal to zero.

[6] This is why Gyntelberg and Remolona (2007) describe carry as "essentially a bet against UIP".

3. Evidence on Carry Trades

Many studies conducted on carry trades have produced evidence showing that carry trade operations are profitable over long periods. For example, Gyntelberg and Remolona (2007) found evidence that carry trades in 10 currency pairs – involving the Japanese yen and Swiss franc as two funding currencies and the Australian dollar, Indian rupee, Indonesian rupiah, New Zealand dollar and Philippine peso as target currencies – outperformed the major stock markets over the period December 2000-September 2007. The results show that average annualized daily returns on these currency pairs were in the range of 12.9 to 2.40% compared to 2.18 to 5.47% on stock market indices including the S&P 500, Nikkei 225 and FTSE 100. The annualized daily returns on carry trades were much higher when the Japanese yen was used as the funding currency rather than when the Swiss franc was used. For example, the returns on the New Zealand dollar, Australian dollar, and Indonesian rupiah were 14.94%, 12.50% and 10.40% respectively when the Japanese yen was used as the funding currency, whereas of those involving the Swiss franc were 8.38%, 6.08% and 4.13% respectively. Using volatility, value-at-risk and expected shortfall measures of risk, Gyntelberg and Remolona (2007) produced results showing that carry trades appear to be much less riskier than major equity markets. While the VaR and expected shortfall measures of carry trade risk were also below those of equity markets, the difference in the equity market measures was less in relative terms. They also found that return distributions for all the carry trades were negatively skewed ranging from 2% to 4% with positive kurtosis. They interpreted the negative skewness as indicating downside risk as an important feature of carry trades. They also found evidence strengthening the results of earlier studies conducted by Galati *et al* (2007) and Hattori and Shin (2007) who showed that volumes of carry trade involving the yen were high when interest differentials against the yen were high. Based on the carry-to-risk ratio (the interest differential adjusted by the risk of future exchange rate movements), Galati *et al* (2007) found that carry trade positions that were short the Japanese yen, Swiss franc and US dollar and long the Australian dollar, New Zealand dollar and British pound were increasingly promising between the period 2002-2005. Results obtained by studies conducted, *inter alia*, by Burnside *et al* (2007), Dunis and Miao (2007), Jurek (2008), Moosa (2008), Darvas (2009) and Fong (2010) were also supportive of the profitability of carry trade over long periods. Burnside *et al* (2007) find that carry trades applied to two different portfolios – one consisting of the currencies of developed countries and the other currencies of both developed and emerging

markets [7] – yield high average payoffs as well as Sharpe ratios that are substantially higher than those associated with the US stock market. They attribute the high Sharpe ratio associated with the carry trade strategy to the diversification effect that results from combining individual currencies into portfolios. Examining yen-based carry trade over the period 2001-2009, Fong (2010) produced results generating high mean returns and Sharpe ratios prior to the global financial crisis.

Moosa (2008) argue that although carry trades could be profitable over a long period of time, significant losses could arise on a single occasion that may put a carry trader out of business. He used different measures to examine the risk and return profile of six currency combinations involving two funding currencies (the Japanese yen and Swiss franc) and three target currencies (the US dollar, UK pound and Canadian dollar) and quarterly historical data covering the period 1995:4-2006:4. Results show that the yen carry trade with the British pound as a target currency, yielding the highest interest differential, is the most profitable. This combination produces an average annualized return of 9.04% and an average annual compound return of 8.87%. The combination that produces the lowest return is the US dollar with the Swiss franc as the funding currency. Moosa (2008) also uses the performance of the Monte Carlo simulations on the rate of return on carry trade in order to determine whether or not the results obtained are just due to a chance resulting from small sample bias. Based on the fitted distributions of Kolmogorov Smirnov test to pick the most appropriate distribution out of a list of 15 possible continuous contributions, it was found that in no case is the return normally distributed, and in most cases the rate of return follows a distribution that is similar to the distributions followed by the percentage change in the exchange rate, which is the source of risk in carry trade. The probability or the certainty level that a positive return will be produced by any single carry trade operation for the underlying currency pair was shown to be too low for comfort. All measures of distribution (downside risk, value at a risk and Sharpe ratio) used in the study showed that significant risk was associated with carry trade. Moosa (2010) assessed the profitability of carry trade for six currency combination – CAD/USD, JPY/USD, GPB/USD, JPY/CAD, JPY/GBP and CAD/GBP – using monthly data on over the period December 1999-June

[7] Using data used data on spot and forward rates against the US dollar for 63 currencies, Burnside *et al* (2007) found that the inclusion of emerging market currencies in the portfolio substantially increases the Sharpe ration. Some of the emerging market currencies in the portfolio include the currencies of India, Kazakhstan, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore Turkey and Ukraine etc.

2006 and produced results which cast doubt on the profitability of carry trade. These results were interpreted as indicating that there is mostly a fifty-fifty chance that profit can be made from a single carry trade operation. Testing the hypothesis whether carry trade is an exclusively yen-based operation, results were obtained showing the opposite as it was found that the interest rate differential is not the only factor determining the profitability of carry trade operations.

Pilbeam and Olmo (2009) argue that the empirical failure of UIP does necessary imply inefficiency of the foreign exchange market as it is frequently inferred in the existing literature, and that profit can be made by engaging in carry trade operations. Using alternative profitability based tests of UIP for four bilateral pound parities with Euro and yen covering the period March 1978-January 2007, they produced results which could not detect significant excess carry trade profits for the yen, euro and Swiss franc-pound parities. The only parity which produced consistently excess carry trade profit was the dollar-pound parity, evidence which is somewhat surprising as this pair involves the lowest interest differential.

4. Empirical Results

This section presents empirical results on different measures of return and risk in carry trades using monthly historical data covering the period 1995:01-2010:06. Three Pak rupee pairs used in this paper include PKR/JPY, PKR/CHF and PKR/USD. The sample covers data on spot rates of the Pak rupee vis-à-vis three major currencies – the Japanese yen, Swiss franc and US dollar – the money market interest rates and S&P 500, Swiss and Nikkei 225 stock market indices. Data on market interest and exchange rates were obtained from IMF CD-Rom and on stock market indices from Yahoo finance.

This paper uses three measures of returns (average annualized interest differential and average annualized and cumulative return in carry trades) and three measures of risk (standard deviation, its downside semi standard deviation and value at risk, VaR)[8]. The Sharpe ratio is also used to compare the risk-adjusted return in carry trades with those of the three major stock markets, as suggested by Burnside *et al* (2006) and Gyntelberg and Remolona (2007).

[8] For these measures of return and risk, see Moosa (2008; pp8-9).

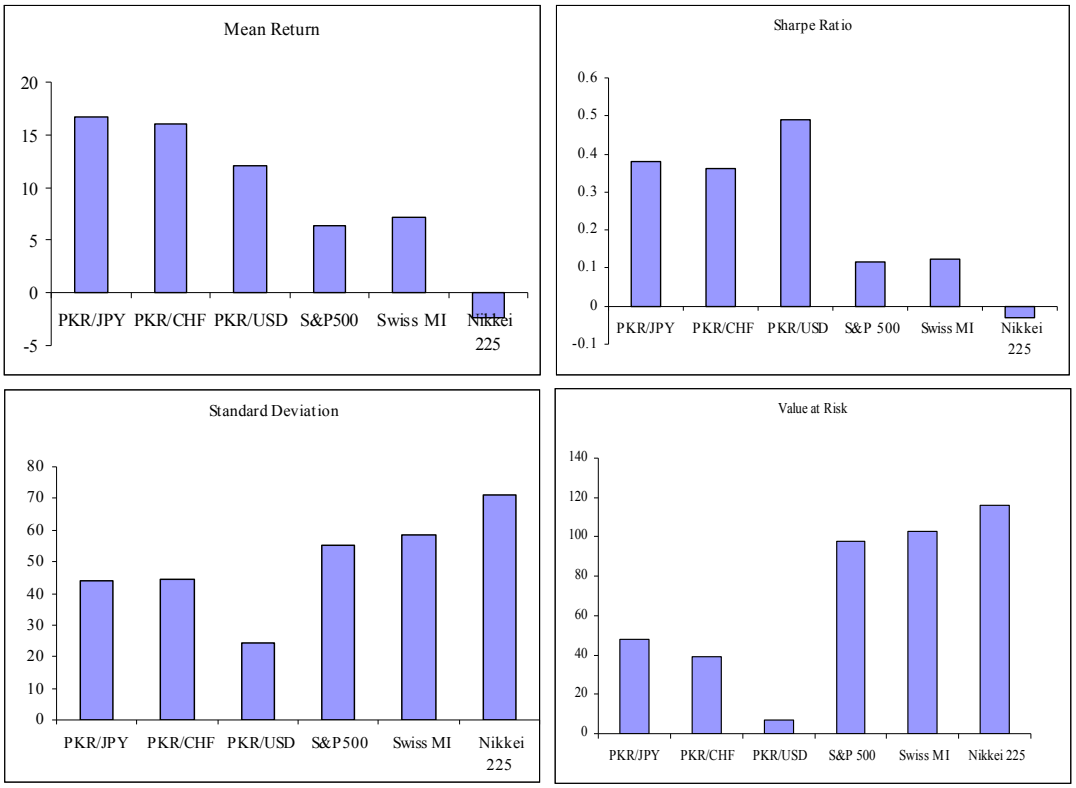
Table 1: Risk and Return on Carry Trades

	PKR/JPY	PKR/SWF	PKR/USD
Mean interest differential	8.6	7.52	5.21
Positive change in exchange rate (%)	55.68	52.43	56.76
Positive return (%)	61.08	62.16	85.41
Mean annualized return	16.7	16.03	12.03
Cumulative return	270.9	265.83	175.17
Standard deviation	44.1	44.31	24.34
Downside semi standard deviation	24.3	25.01	13.42
95% value at risk	47.74	38.95	6.79
Sharpe ratio	0.38	0.33	0.49

Stock markets	Mean annualized return (%)	Standard deviation	Sharpe ratio	95% Value at risk
S&P 500	6.38	55.08	0.116	97
Nikkei 225	-2.31	71.03	-0.03	116
Swiss Market	7.19	58.58	0.123	103

All measures of return and risk in carry trades, as reported in Table 1, show that carry trades in the Pak rupee funded by short positions in the Japanese yen, Swiss franc and US dollar outperform the S&P 500, Nikkei 225 and Swiss stock-market indices. The magnitudes of return and risk of carry trades can be combined by calculating Sharpe ratios and compared with those associated with stock market indices such as the S&P 500, Nikkei 225 and Swiss market indices over the sample period. The average annualized returns in carry trades range between 12.03% to 16.70% with standard deviations between 24% to 44%, giving Sharpe ratios that range between 0.33 to 0.49, whereas average annualized returns on stock markets range between -2.31% to 7.19% with standard deviations between 55.08 to 71.19, giving Sharpe ratios between -0.03 and 0.116. Clearly, as shown in Table 1 and Figure 1, average annualized and risk-adjusted returns in carry trades are much higher than those of the three major stock markets as well as risks associated with carry trades measured in terms of both standard deviation and value at risk are much lower than those associated with the major stock markets. These results are consistent with those obtained by Gyntelberg and Remolona (2007), Burnside *et al* (2006) and Moosa (2008, 2010).

Figure 1: Measures of return and risk



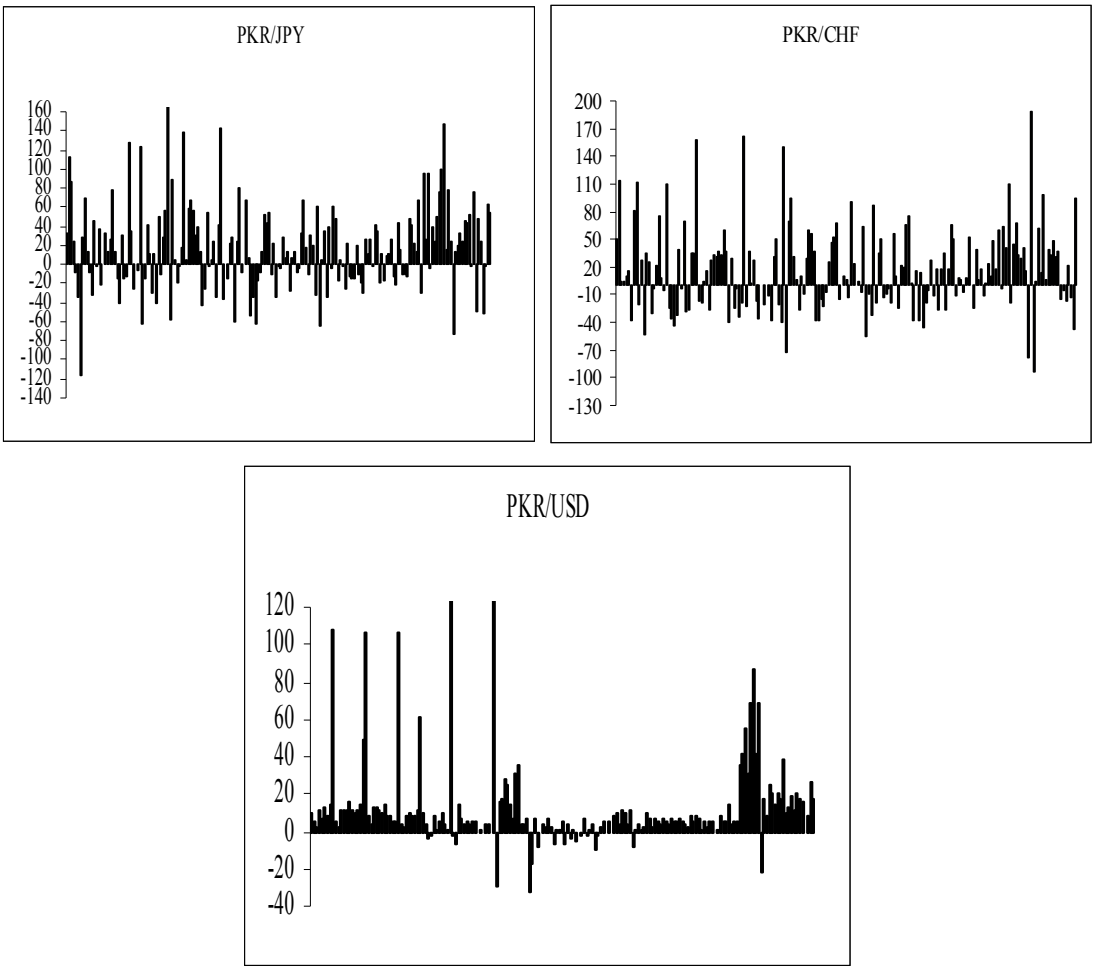
As shown in Table 1 and Figure 1, clearly carry trade in the PKR/JPY pair is the most profitable because it produces the highest values for both average annualized return and the interest differential. Although both average annualized return and interest differential are the lowest in the case of the PKR/USD pair, as compared with those of the other two pairs, the frequency of positive returns is much higher than the frequency of positive changes in the exchange rate in this case than those associated with the other two pairs. For example, in the case of the Pak rupee pair with the US dollar, the frequency of positive returns is 28.65% higher than the frequency of positive changes in the exchange rate. In contrast, the frequency of positive returns is just 9.73% higher than the frequency of positive changes in the exchange rate for the PKR/CHF pair and 5.4% in the case of PKR/JPY pair.

It must be noted that the positive interest differential is a necessary condition for the profitability of carry trade. The sufficient condition for the profitability in carry trade is the percentage of positive changes in the exchange rate. Thus, carry

trade can be profitable even with a negative change in the exchange rate, provided that the absolute change is not greater than the interest differential. Since the percentage of positive return is 28.65% higher than the percentage of positive changes in the exchange rate of the Pak rupee pair with the US dollar, carry trade for this currency pair is less riskier than that of the other two pairs. Moreover, risk-adjusted return for the Pak rupee pair with the US dollar is much higher than that of the Pak rupee pairs with the Japanese yen and Swiss franc.

Although carry trades appear to be highly profitable over a long period of time in all cases, significant losses can be incurred on a single occasion as argued by Moosa (2010). For example, as shown in Figure 2, carry trade operations are not profitable consistently at each and every point during the sample period because month-by-month returns in carry trades are not always positive. On several occasions over the sample period, returns from carry trades appear to be negative, indicating losses. For example, a carry trader tends to incur a loss on 38% of the occasions when the Pak rupee is paired with the Japanese yen and Swiss franc but only on 15% of the occasions when the Pak rupee is paired with the US dollar. Moreover, the magnitude of carry trade losses is relatively more pronounced when the Japanese yen and Swiss franc are used as the funding currency rather than when the US dollar is used. Clearly, this implies that the magnitude of carry trade losses is relatively much lower for the Pak rupee pair with US dollar than with its pairs with the Japanese yen and Swiss franc. One reason for the relative higher profitability of carry trades in the Pak rupee with the US dollar is that the Pak rupee exchange rate vis-à-vis the US dollar is relatively more stable than the Pak rupee exchange rates vis-à-vis the Japanese yen and Swiss franc. For example, the standard deviation of changes in Pak rupee exchange rates vis-à-vis the Japanese yen and Swiss franc is about 44, whereas it is around 24 in the case of the US dollar.

Figure 2: Return on carry trade



6. Conclusion

This paper has investigated the return and risk characteristics of carry trades in the Pak rupee funded by short position in three major currencies – the Japanese yen, Swiss franc and US dollar – and compared with those of the three major equity markets. Results based on all the measures of return and risk employed in this paper show that carry trades outperform the S&P 500, Swiss and Nikkei 225 equity markets. The results produce higher average annualized returns and lower standard deviations for carry trades than for equity markets, giving higher sharp ratios for the former than for the latter. This implies that the risk-adjusted return in carry trades is higher than that of the equity markets. The results also show that the mean of the interest differential and annualized return are the highest when the Pak rupee was paired with the Japanese yen (PKR/JPY) than when the Pak rupee was paired with the Swiss franc and US dollar (PKR/CHF and PKR/USD). However, the frequency of positive return for the PKR/USD pair was much higher than the positive changes in the underlying exchange rate when compared with those of Pak rupee pairs with the Japanese yen and Swiss franc. This leaves the biggest percentage of negative rates of return for the PKR/JPY and PKY/CHF pairs, implying that the highest risk is involved in these two currency pairs. In addition, the PKR/USD pair produces the highest Shape ratio indicating that the risk-adjusted return is the highest for the Pak rupee pair with the US dollar.

Several implications emerge from these results. First, the interest differential is not the only factor determining the return in carry trades; the expected change in the exchange rate of the funding against the target currency over the holding period also affects the return in carry trades. Second, the build up of carry trades in target currencies is likely to strengthen target currencies against funding currencies. Third, a sudden unwinding of carry trades in target currencies may result in an enormous depreciation of target currencies. Finally, the fear of a sudden fall in the inflows of short-term capital, depreciation and a consequent inflationary pressure may induce monetary authorities in high interest countries to preserve high interest differentials and accommodate the increasing appetite of carry traders.

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