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FORECASTING-BASED CARRY TRADE USING PEGGED CURRENCY: A CASE OF OMANI RIAL

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ABSTRACT

This paper examines the profitability of using an emerging country, currency that is pegged to the U.S. dollar in carry trade against floating currencies. It also examines the effect of embedding forecasting techniques in its profitability and risk-adjusted returns. While carry trade is performed largely with currencies that adapt a floating exchange rate system, conducting such a strategy using pegged currency has proven to be very rewarding, especially when the strategy is enhanced with forecasting methods. Carry trade is a speculative strategy where carry traders take advantage of interest rate differential between two currencies. It is conducted by borrowing a low interest rate currency and investing in a high interest rate currency. According to uncovered interest parity (UIP), carry trade should not yield any profit. If investors are both rational and risk-neutral, then exchange rate changes will eliminate any gains arising from the differential in interest rate. But literature has shown that UIP does not hold. This failure has led to unprecedented returns for that strategy matching the returns of the S&P 500 and outperforming it in terms of Sharpe ratio.

Keywords: Carry trade, Random walk, Uncovered interest parity (UIP), Omani rial (OMR), Monetary Model, Sharpe Ratio.

Contribution/ Originality

This study contributes to the existing literature on carry trade by examining the feasibility of using pegged currencies in such strategy. This study is one of the few studies which has investigated the effect of embedding forecasting methods in the selection process and its effect on return, risk and risk-adjusted returns.

1. INTRODUCTION

Carry trade is a lucrative strategy that is so popular among all levels of investors from housewives to global hedge funds due to its simplicity and return that is similar to the S&P 500 according to Burnside *et al.* (2006), Duni and Miao (2007), Moosa (2008), Darvas (2009), Menkhoff *et al.* (2012), and Jurek (2014). Adding to its attractive returns it is seen as less risky than the equity stocks producing a better Sharpe ratio according to Gyntelberg and Remolona (2007). Brunnermeier and Pedersen (2009) found that carry trade returns are much less variable than stock returns, with an annualized standard deviation of about 5 percent (compared to about 15 percent for stocks); as a result, the Sharpe ratio of the carry trade is double that of stock. A study conducted by Burnside *et al.* (2007) for the period spanning 1997-2006 using the U.S. dollar as the funding currency in carry trade. They reported that carry trade is a profitable strategy producing an annualized Sharpe ratio of 1.32 compared to 0.23 for the U.S. stock market. Neely and Weller (2013) stated that there is a growing body of literature indicating that the carry trade has statistically and economically significant positive excess returns and a Sharpe ratio about double that of equity markets.

UIP is an arbitrage condition indicating there should be no profit opportunity from the differences in interest rates between two currencies. According to UIP, high interest rate currency should depreciate against the low

interest rate currency by the interest rate differential. But, literature shows that UIP does not hold especially at time horizon less than 5 years as concluded by Engle (1996), Flood and Rose (2002), Chinn and Meredith (2004), Szilagyi and Batten (2006), Gyntelberg and Remolona (2007) and many others. Flood and Rose (2002) state that "a strong consensus has developed in the literature that UIP works poorly". Chinn and Meredith (2004) argue that "Few propositions are more widely accepted in international finance than that uncovered interest parity (UIP) is at best useless – or at worst perverse – as a predictor of future exchange rate movement". The success of carry trade is a result of UIP failure. That is why Carry trade is described by Gyntelberg and Remolona (2007) as nothing more than a bet against UIP. While Baillie and Chang (2011) agreed when they described carry trade as a speculation against UIP. However, it has been noticed that currencies with higher interest rates tend to appreciate against low interest rate currencies, contradicting UIP. Many researchers such as Gyntelberg and Remolona (2007), Baillie and Chang (2011), and others tend to imply a link between the failures of UIP and profitability, Moosa and Burns (2012) state that, although the failure of UIP is a necessary condition for a profitable carry trade, it is not a sufficient enough condition. They argue that big movements in the foreign exchange markets, which satisfy the failure of UIP might offset the interest rate differential and might even produce a losing position.

Carry trades is a leveraged strategy that tend to thrive during high interest rate differential and low exchange rate volatility periods. Gyntelberg and Remolona (2007) concluded that carry trade tends to be pursued only when the interest differential is wide enough to compensate for foreign exchange risk. On the other hand Moosa and Halteh (2012) argue that interest rate differential is not a good indicator for carry trade return. Liu *et al.* (2012) state that the use of leverage is an essential feature of carry trade, that is why Hattori and Shin (2009) described it as a double-sided sword as it can boost losses as well as gains. Mitchell *et al.* (2007) observed that capital arrives slowly such a currency appreciates gradually, occasionally disrupted by a sudden depreciations as speculative capital is withdrawn. That's why The Economist (2007) described carry trade as "picking up nickels in front of steamrollers: you have a long run of small gains but eventually get squashed". Predicting currency crashes is essential for carry traders. Embedding a forecasting element in the carry trade decision-making process could reduce the exchange rate risk, enhance profitability and improve risk-adjusted returns, as concluded by Jorda and Taylor (2009), Moosa (2010), Schmidbauer *et al.* (2010), Li (2011), Moosa and Halteh (2012) and others. For example, Della *et al.* (2009) found there is significant economic benefit to an investor who exploits deviations from UIP by forecasting currency returns. In addition, Li (2011) evaluated the effectiveness of economic fundamentals in enhancing carry trade and found the profitability of carry trade and risk-return measures can be enhanced by using forecasts. Further, Bhatti (2012) found that 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.

The Magnitude of error was used by Meese and Rogoff (1983) to evaluate the goodness of the forecasting models. The use of these measures led to the conclusion among researchers and practitioners that a naïve forecasting model would work just as well as professional forecasts. The inability to beat the random walk caused a pessimistic effect on the field of exchange rate modelling. Frankel and Rose (1995) stating that the negative results of the forecasting models have had a "pessimistic effect of the field of empirical exchange rate modelling in particular and international finance in general". Engel *et al.* (2007) describe the current position of forecasting models by stating the "explanatory power of these models is essentially zero". Fair (2008) describes exchange rate equations as "not the pride of open economy macroeconomics" and argues that the "general view still seems pessimistic". However, Chow and Tan (2007) questions the validity of such measures to evaluate the forecasting model by stating, "It seems irrational for profit-maximizing firms to 'waste' millions of dollars generating and buying professional forecasts". Considering their findings, they suggested it might not be appropriate to use forecast error measures to judge the quality of professional forecasts and profit should be included as a judging criterion. Cheung *et al.* (2005) noted using criteria other than the mean square error (MSE) is not "changing the rules of the game" and minimizing the mean square error may not be important from an economic standpoint,

implying that relying on mean square error may result in overlooking other important aspects of prediction, such as profitability, particularly at the long horizon.

After failing to beat the random walk in terms of error measures, researchers started exploring new measures to evaluate the forecasting models. Leitch and Tanner (1991) found a strong relation between direction accuracy and profitability, but not between error measures and profitability. They argued the direction of change may be more relevant for profitability and economic concerns than the error measures and that measuring the forecasting accuracy based on the magnitude of the error has no predictable relation to profitability. Engel and Hamilton (1990) supported the use of direction accuracy, by describing it as "not a bad proxy for a utility-based measure of forecasting performance". West et al. (1993) suggested a utility-based evaluation of exchange rate predictability. Moosa and Burns (2012) agreed by stating that profitability is consistently related to direction accuracy while the random walk does not predict the direction. Moosa (2013) suggested that profitability is the ultimate test of forecasting accuracy.

2. METHODOLOGY

This paper examines two strategies, the first one is based on interest rate differential and nothing else when taking the decision the conduct carry trade. While the second strategy takes into account both interest rate differential and the expected percentage change in the exchange rate.

Let i_x and i_y be the interest rates for currencies x and y, respectively. In addition, let S be the spot rate between the two currencies measured as one unit of y against x, so appreciation of y against x would result in a higher S, and vice versa. Under conventional carry trade, carry traders would go long currency y and short currency x if $i_y > i_x$ and vice versa. In this case the return on carry trade is given by;

$$\pi = \frac{S_{t+1}}{S_t}\left(1 + i_y\right) - (1 + i_x), \tag{1}$$

Which can be rewritten as

$$\pi = \left(i_y - i_x\right) + \dot{S}_{t+1}, \tag{2}$$

Where $\dot{S}_{t+1}$ is the percentage change in the exchange rate between t and $t+1$. The carry trade operation is implicitly based on the assumption of random walk without drift (Moosa, 2004) which means that $\dot{S}_{t+1} = 0$. Thus, carry trade is profitable as long as $\left(i_y - i_x\right) > -\dot{S}_{t+1}$. (That is, as long as the interest rate differential is larger than the depreciation of currency y against currency x.)

Because of the changes in interest rates differential, it is necessary to switch the role of the currencies, so the general formula for calculating the rate of return on the carry trade will be as follow:

$$\pi = \begin{cases} \left(i_y - i_x\right) + \dot{S}_{t+1} \\ \left(i_x - i_y\right) - \dot{S}_{t+1} \end{cases} \quad if \quad \begin{matrix} i_y > i_x \\ i_y < i_x \end{matrix} \tag{3}$$

The forecasting-based strategy involves calculating the expected rate of return and conducting the position accordingly. The expected return is calculated as follows:

$$\pi^e = \left(i_y - i_x\right) + \dot{S}^e_{t+1}, \tag{4}$$

Where $\dot{S}^e_{t+1}$ is the calculated percentage change in exchange rate based on the forecasting model. Thus, we go long y and short x if $\pi^e > 0$ and vice versa. In that case, the profitability of the forecasting-based strategy is as follows:

$$\pi = \begin{cases} \left(i_y - i_x\right) + \dot{S}_{t+1} \\ \left(i_x - i_y\right) - \dot{S}_{t+1} \end{cases} \quad if \quad \begin{matrix} \pi^e > 0 \\ \pi^e < 0 \end{matrix} \tag{5}$$

Since the Omani rial is pegged to the U.S. dollar at 0.385 rial per dollar, with a very narrow fluctuation band, the exchange rate of the rial will reflect the economic conditions of the U.S. dollar. Thus, when calculating for $\dot{S}^e_{t+1}$ using the flexible price monetary model of exchange rates, we will be doing so for the U.S. dollar.

$$s_t = \alpha_0 + \alpha_1\left(m_{a,t} - m_{b,t}\right) + \alpha_2\left(y_{a,t} - y_{b,t}\right) + \alpha_3\left(i_{a,t} - i_{b,t}\right) + \varepsilon_t, \tag{6}$$

where s is the natural log of the exchange rate, m is the natural log of the money supply, y is the natural log of the industrial production, i is the nominal interest rate, ε is the error factor, and a and b refer to the countries whose currencies are involved. Here, country b will have its currency as the base currency in the exchange rate pair. The forecasted exchange rate will be as follows:

$$\hat{s}_{t+1} = \hat{a}_0 + \hat{a}_1\left(m_{a,t+1} - m_{b,t+1}\right) + \hat{a}_2\left(y_{a,t+1} - y_{b,t+1}\right) + \hat{a}_3\left(i_{a,t+1} - i_{b,t+1}\right), \tag{7}$$

Where $\hat{a}_0$ is the estimated value of α_0 and so on. To convert the natural log forecasted exchange rate to estimated exchange rate, the following is applied:

$$S_{t+1}^e = \exp(\hat{s}_{t+1}) \tag{8}$$

$\dot{S}_{t+1}^e$ is calculated from S_{t+1}^e and S_t, which can be used to calculate the expected return in equation (4).

3. DATA AND EMPIRICAL RESULTS

The empirical results presented in this paper are based on six currency combinations involving the Omani rial (OMR) against the Japanese yen (JPY), the British pound (GBP), the Korean won (KRW), the Singaporean dollar (SGD), the Canadian dollar (CAD), and the Swiss franc (CHF). Monthly data were used for the period of January 2001 to December 2011. Data were obtained from the International Financial Statistics (CD-ROM) and DataStream terminal.

The magnitude of error measurements were used by Meese and Rogoff (1983) to evaluate the forecasting model against the random walk. In terms of error measurements, table 1 clearly shows the monetary model was unable to outperform the random walk in any pair. The error measuring criteria for the average of the six pairs are shown in table 2. Looking at the mean absolute error (MAE) for both strategies it was 1.79 for the carry trade compared to 7.25 for the forecasting-based model. While the mean square error (MSE) was 6.91 for the carry trade it was 90.94 for the forecasting-based model. In terms of RMSE, the results were 2.51 and 9.33 for the random walk and forecasting-based models, respectively. The Theil inequality coefficient (U) summarizes the findings in one number, confirming the superiority of random walk over forecasting models by showing no result below 1. The same results can be seen at the individual pairs, where none of the individual pairs out-performed the random walk in all error measures.

Table-1. Results for Individual Pairs

	SGD/OMR		GBP/OMR		JPY/OMR		OMR/KRW		CAD/OMR		CHF/OMR	
	CT	FC	CT	FC	CT	FC	CT	FC	CT	FC	CT	FC
MAE	1.11	4.50	1.64	6.11	1.98	7.75	2.11	8.39	1.41	6.88	2.51	9.84
MSE	2.21	40.15	4.75	59.61	6.45	86.35	14.11	111.93	3.66	90.67	10.25	156.94
RMSE	1.49	6.34	2.18	7.72	2.54	9.29	3.76	10.58	1.91	9.52	3.20	12.53
U	4.26		3.54		3.66		2.82		4.98		3.91	
Ave Interest Diff	3.53		0.60		4.37		1.28		3.18		3.74	
Direction Accuracy %		55.87		50.28		49.72		60.45		48.60		46.37
Confusion Rate %		44.13		49.72		50.28		39.55		51.40		53.63
Mean Return	3.12	2.12	1.16	3.59	2.01	4.23	-0.41	10.55	1.54	1.31	1.60	1.06
Cumulative Return	55.95	34.43	13.98	63.70	27.25	77.53	-18.25	329.35	21.70	17.63	15.73	6.89
Standard Deviation	18.1	18	26.4	26.04	30.72	30.48	45.24	43.92	22.92	22.80	38.76	38.64
Sharpe Ratio	0.17	0.12	0.04	0.14	0.07	0.14	-0.01	0.24	0.07	0.06	0.04	0.03
VaR 99%	3.35	4.05	5.44	5.28	5.94	4.67	11.68	5.37	4.87	4.14	6.27	6.35
VaR 95%	1.65	2.07	2.99	2.77	4.34	3.48	4.44	2.91	2.77	2.71	4.91	4.72

CT is carry trade and FC is the forecasting based strategy.

In terms of mean return, carry trade produced positive returns in five of the six pairs; on the other hand, the forecasting-based strategy had positive mean return for all six pairs. While SGD/OMR produced the highest mean return of 3.12% in the carry trade, OMR/KRW showed the biggest return of 10.55% in the forecasting-based strategy. The OMR/KRW was the only pair in carry trade that showed negative return and on the other hand showed the highest return in the forecasting-based strategy. The reason for such big deviation in return for OMR/KRW was due to the high volatility on the exchange rate of the KRW during the Asian crisis in 1997, indicating that the monetary model was able to capture most of the time. The overall mean return for the six pairs was 1.50% for the carry trade, compared to 3.81% for the forecasting-based strategy. When embedding the forecasting model into the selection process three out of the six pairs showed improvement in mean return, except for SGD/OMR, CAD/OMR and CHF/OMR, where the mean return of carry trade exceeded the mean return of the forecasting-based strategy. On the cumulative return side, the forecasting-based strategy outperformed the carry trade on the average of the six pairs producing 88.26% compared to 19.39%.

Table-2. Cumulative Results

	CT	FC
MAE	1.79	7.25
MSE	6.91	90.94
RMSE	2.51	9.33
U	3.86	
Ave Interest Diff	2.78	
Direction Accuracy %		51.88%
Confusion Rate %		48.12%
Mean Return	1.50	3.81
Cumulative Return	19.39	88.26
Standard Deviation	30.36	29.98
Sharpe Ratio	0.06	0.12
VaR 99%	6.26	4.98
VaR 95%	3.52	3.11

CT is carrying trade and FC is the forecasting based strategy.

When it comes to volatility, the carry trade showed, on average, a higher standard deviation of 30.36 compared to 29.98 for the forecasting-based strategy. OMR/KRW showed the highest standard deviation in both the carry trade and the forecasting-based strategy, with 45.24 and 43.92, respectively. With the Sharpe ratio being the most common risk-adjusted ratio investors consider, the forecasting-based strategy improved that ratio in three out of the six pairs, with OMR/KRW as the most improved among the pairs. The average Sharpe ratio for the six pairs under the carry trade was 0.06 while that average improved to 0.12 under the forecasting-based strategy.

As concluded by Moosa (2008); Bhatti (2012) and Moosa and Halteh (2012), a higher interest rate differential does not necessarily mean a higher return. It can be seen that, despite JPY/OMR having the largest interest rate differential, it did not produce the highest mean return. Moreover, the OMR/KRW interest rate differential of 1.28% produced a negative mean annual return of -0.41% as seen in figure 1.

The coefficient () on the interest rate differential are positive and statically significant. According to the UIP the coefficients should be zero and insignificant. (Hoffmann, 2012)
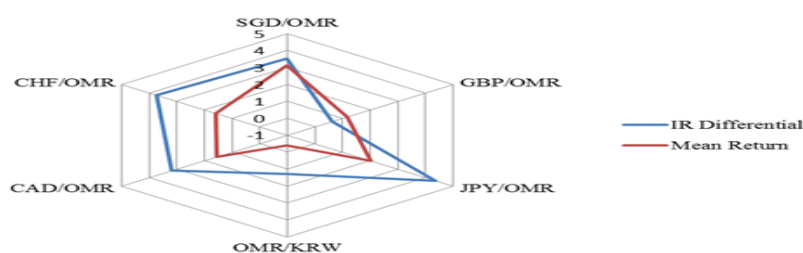

Figure-1. Interest Rate Differential vs. Mean Return

Concerning direction accuracy, the forecasting-based model provided three pairs with an accuracy level of more than 50% and three pair with an accuracy level of less than 50%. Comparing these results to the mean returns, two of the three pairs with accuracy rates above 50% improved their mean returns; the only one that did not was SGD/OMR. On the other side, only pairs out of the three that had direction accuracy less than 50% showed an improvement in mean return as seen in figure 2.

Number of researchers such as Galati *et al.* (2007); Hattori and Shin (2007); Brunnermeier *et al.* (2008); Tosborvorn (2010) and Jylhä and Suominen (2011) documented a strong relation between interest rate differential and exchange rate volatility. The results on an individual currency pair level is illustrated in table 3. Based on the literature interest rate affects the volatility of the exchange rate, for that we used the exchange rate volatility as the dependent variable and the interest rate differential as the independent variable. The regression model can be seen in equation (9).

$$vol = a + b\ ir \tag{9}$$

Where vol is the exchange rate volatility and ir is the interest rate differential. The results show that there is a statistically significant relation between interest rate volatility and interest rate differential in the six pairs. But, we could not determine the direction of the relation if it is direct or inverse since four pairs showed a negative relation and two showing a direct relation. The relation between the average interest rate differential for the six pairs against the average volatility can also be seen in figure 5.

Table-3. The Relation between Interest rate differential vs. Exchange rate volatility

	SGD/AED	AED/GBP	JPY/AED	AED/KRW	CAD/AED	CHF/AED
ir	-0.86***	-0.973***	0.631***	1.972***	-0.660*	-0.515**
	(-3.55)	(-5.96)	(4.67)	(9.06)	(-2.02)	(-3.03)
a	1.59***	2.06***	1.90***	1.70***	1.81***	2.41***
	(25.79)	(94.23)	(44.01)	(31.70)	(27.31)	(53.76)
R square	0.070	0.174	0.115	0.328	0.024	0.052
N	170	170	170	170	170	170

* P < 0.05, ** P < 0.01, *** P < 0.001
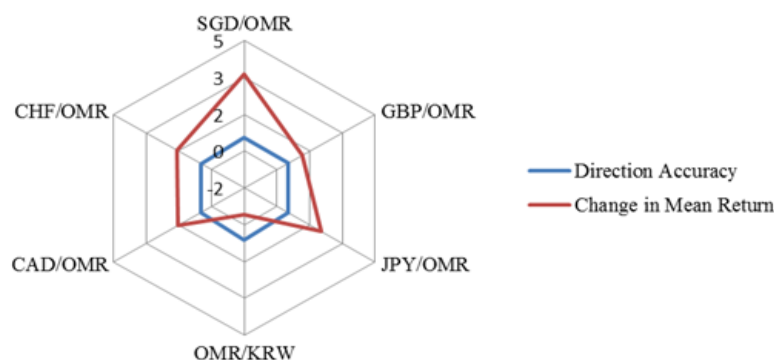
ir = Interest Rate Differential

Figure-2. Direction Accuracy vs. Change in Mean Return

Concerning value-at-risk (VaR) at the 99% confidence level, the forecasting-based strategy improved it in four pairs of the six pairs under consideration. OMR/KRW showed the most improvement, from 11.68% to 5.37%. At the 95% confidence level, VaR improved in five of the six pairs while SGD/OMR was the only pairs with a higher expected loss in the forecasting-based model than in the carry trade model. In all, the forecasting-based strategy improved the average VaR at both the 99% confidence level, for which the average for the six pairs declined from 6.26% to 4.98%, and at the 95% confidence level, for which the average declined from 3.52% to 3.11%.

When it comes to comparing carry trade to the S&P 500 as seen in table 4, it can be seen from the results that the mean return on carry trade was slightly lower than the return on the S&P 500. For the sample period carry trade produced an average mean return for the six pairs of 1.79% compared to 1.875% for the S&P 500. On the

other hand, carry trade demonstrated lower volatility than the stock market, which is consistent with Brunnermeier and Pedersen (2009) findings. When it comes to the Sharpe ratio, it can be seen that carry trade produced a better rate of 0.06 compared to 0.034 for the S&P 500. This finding is consistent with Burnside *et al.* (2007) findings that carry trade produces better Sharpe ratio than the S&P 500.

Table-4. Comparative Results between Carry Trade and S&P 500

	CT	S&P 500
Mean Return	1.79	1.87
Standard Deviation	30.36	54.72
Sharpe Ratio	0.06	0.034
VaR 99%	6.26	10.1
VaR 95%	3.52	6.99

4. CONCLUSION

The results presented in this paper showed that using Omani Rial in a carry trade in its simplest form produced positive returns which are in line with AlAli and AlKulaib (2015) findings that the use of pegged currencies in carry trade would yield positive returns. In addition, using forecasting techniques improved both profitability and the risk-adjusted return. By using six currency combinations, with the Omani Rial in each one of the pairs, profit was made in five of the six pairs when the interest rate differential alone was the selection criterion, and the number of profitable pairs went to six pairs out of six when a forecasting technique was introduced. We also conclude that the interest rate differential is not associated with profit, confirming Moosa (2008) and Moosa and Halteh (2012) findings. The results of this research were also consistent with Burnside (2007) and Neely and Weller (2013) that carry trade produces better Sharpe ratio than the S&P 500.

The findings of this paper also support Meese and Rogoff (1983) in that no forecasting model can outperforms the naïve random walk in terms of magnitude of error measurements such as root mean square error. On the other hand, in terms of profitability, the monetary model showed that it performs well in generating better returns than random walk. This result answers the question of Chow and Tan (2007) concerning why profit-maximizing firms pay huge amounts of money to purchase forecasting models. However, despite the success and popularity of carry trade among traders and investors, "the reasons for the success of the carry trade remain a bit of a mystery" (The Economist, 2007).

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