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PERFORMANCE OF CURRENCY TRADING STRATEGIES IN DEVELOPED AND EMERGING MARKETS: SOME STRIKING DIFFERENCES

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Abstract. Expanding the currency investment universe makes a lot of sense from a diversification point of view. Nevertheless, 60% of the total foreign exchange turnover is still only traded in three currency pairs (USD/EUR, USD/JPY and USD/GBP). The share of trading in local currencies in emerging markets is only around 5%. This can be explained by the fact that some currency managers fear investing in emerging market currencies. Many believe that political risk is the most dominant driver in these markets and that traditional investment rules do not work. In this paper, I apply four technical trading strategies for the developed market currencies and for the most traded emerging market currencies. The empirical results show some striking differences. They suggest that trend-following rules work better for emerging market currencies, while carry trading strategies perform better across developed market currencies. Nevertheless, it seems that conventional techniques could be successfully applied to both developed and emerging market currencies. I conclude that currency managers should not be afraid to diversify into emerging market currencies. They should, however, adjust their trading style accordingly.

1. Introduction

The importance of diversification has been known for decades: ''Do not put all your eggs in one basket" is a well known saying among investors. However, having many independent bets in a pure currency portfolio is a real challenge due to the limited number of free floating currencies. Globalization has led to an increase in the correlations between different exchange rates, decreasing the diversification effect. After the introduction of the euro, the possibility of diversifying a pure currency portfolio decreased even further. The expansion of the European Union will lead to the disappearance of even more currencies. Unsurprisingly, currency managers are turning towards emerging market currencies in order to expand their currency investment universe.

The case for expanding the currency universe is a strong one. A recent paper by DUNIS and LEVY (2002) shows that the adoption of emerging market (EM) currencies improves risk-adjusted returns compared to an overlay of only developed market (DM) currencies. Nevertheless, some developed market currency managers are hesitant to enter EM currency markets. According to the latest BIS survey of foreign exchange and derivatives market activity, between 2001 and 2004 the share of trading in local currencies in emerging markets has increased only slightly to 5.2%. Many currency managers fear that politics is the major driver for emerging market currency returns and doubt that conventional techniques can also be applied by managing EM currencies.

There is a widespread consensus in academic literature that macroeconomic variables offer little help in exchange rate forecasting. MEESE and ROGOFF (1983) show that random walk forecasts outperform economic models of exchange rates. A survey by FRANKEL and ROSE (1995) on empirical literature on floating exchange rates found that driftless random walk characterizes exchange rates better than standard models based on observable macroeconomic fundamentals. Therefore, it is no surprise that currency managers seldom use econometric models based on macro economic variables, but prefer to focus on technical trading strategies. There are many different styles in currency management[1]. However, regardless of style, two traditional technical trading strategies remain very popular: the trend-following strategy and the carry strategy.

The trend-following strategy relies on the belief that currencies exhibit trends. While the existence of trends is questioned in academic literature, there exist many empirical studies which show the profitability of trend-following rules (for example, LEVICH and THOMAS (1993)). More recently, ACAR and LEQUEUX (2001) show that actively managed currency funds that rely on trend-following strategies could have generated statistically significant out-performance. OKUNEV and WHITE (2003) examine moving average rules across eight currencies and show that the result is not sensitive to the specification of the base currency or the trading rule. The profitability of trading rules implies the existence of inefficiencies in the foreign exchange market over certain periods. There is theoretical support for such inefficiencies in currency markets. The profit motive assumption of the efficient market hypothesis (EMH) does not apply in foreign exchange. In contrast to the bond and the equity markets, there are many non-profit motivated participants in the foreign exchange market. It is not that they do not want to make profit; they are not motivated by profit from currencies. For example, bond and equity investors shifting their portfolios want to profit from the bond or the equity investment respectively, not from the currency transactions. Central banks often intervene in the foreign exchange market to achieve other macroeconomic objectives (for example price stability) and not to generate profit. Empirical research supports this argument. For example, SZAKMARY and MARTUR (1997) found that monthly trading rule returns are correlated with changes in foreign exchange reserves (a proxy for intervention) and LEBARON (1999) shows a remarkably high correlation between daily US official intervention and returns on typical trend-following rules.

The carry strategy is based on the belief that the uncovered interest rate parity (UIP) does not hold, i.e., that the forward rate is a biased predictor of the future change in the spot exchange rate and that it usually points in the wrong direction. The general conclusion from academic literature is that, while covered interest rate parity (CIP) holds, UIP does not[2]. This conclusion is the so called forward premium puzzle. This finding has been confirmed in many studies, e.g., BILSON (1981), FROOT and THALER (1990), ALEXIUS (2001). Under the carry strategy, currency managers buy currencies with high interest rates and sell currencies with low interest rates. For example, during 2001 and 2004, the US Dollar carry trade was a very popular strategy because the US Dollar was a cheap funding currency. However, BANSAL and DAHLQUIST (1999) suggest that the forward parity puzzle might be confined to developed economies. More recently, FRANKEL and POONAWALA (2004) have also shown that the forward parity puzzle is less present among emerging market currencies than among developed country currencies. This implies that carry trades would be more profitable when applied in developed markets than in emerging markets.

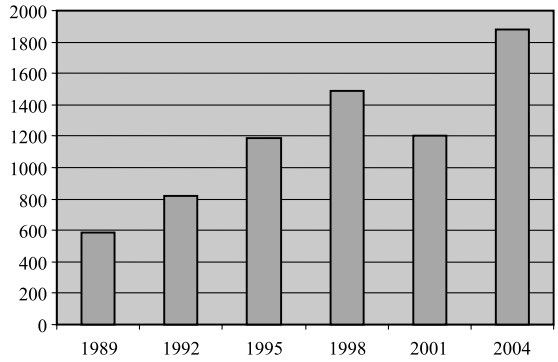
The interest toward expanding the currency universe and investing in EM currencies has motivated me to investigate the question as to whether traditional trading strategies could be successfully applied in emerging markets. I am applying two

trend-following rules and two carry rules for 17 currencies, classified as developed market currencies and emerging market currencies. The data set ranges from January 1, 1999 (the introduction of the euro) to the end of 2004.

My main contribution to the existing literature is that I show that trend-following strategies might work better for emerging market currencies, while carry trading strategies might yield better results across the developed markets. The result could have important implications for currency management since it would suggest that currency managers should allocate more risk toward carry strategies when investing in developed markets and toward trend-following strategies when investing in emerging markets.

The next section describes the data set and the trading rules. Section 3 compares the performance. The last section concludes.

Figure 1: Global Foreign Exchange Market Turnover. Daily averages in April, in billions of US dollars.



Source: BIS, Triennial Central Bank Survey, 2004.

2. Data Set and Trading Rules

2.1 The Data Set

I am using the spot and the one month forward rates of all developed country currencies and the most traded *unrestricted* Emerging market currencies (see Table 1). The data sample is from January 1, 1999 until the end of 2004. It is difficult to obtain larger data sets for the majority of emerging market currencies (especially the forward rates). I am using monthly price data from BLOOMBERG. Since the US Dollar is involved in 90% of all currency transactions (see Table 1), I am using exchange rates against the US Dollar. The currency returns R at period t are calculated as follow:

$$R_t = \ln(S_t) - \ln(F_{t-1}), \quad (1)$$

with S the spot rate and F the forward rate.

2.2 The Trend-Following and the Carry Trading Strategies

Trend-following and carry trades remain among the most popular investment strategies in the currency market. GALATI and MELVIN (2004) show that global FX turnover rises with increases

Table 1: Currency Distribution of Reported Global Foreign Exchange Market Turnover
Period: 2001–2004, Source: BIS, Triennial Central Bank Survey 2004.

	USD	*EUR*	*JPY*	*GBP*	*CHF*	*AUD*	*CAD*	*SEK*	*NOK*	*DKK*	*NZD*	*Sum*
Developed	88.7	37.2	20.3	16.9	6.1	5.5	4.2	2.3	1.4	1.0	0.9	184.5
	SGD	ZAR	MXN	PLN	CZK	THB	HUF					
Emerging	1.1	1	0.9	0.5	0.2	0.2	0.2					4.1

Note:
Because two currencies are involved in each transaction, the percentages of the individual currencies sum to 200% instead of 100%.

in the interest rate differential of major currencies against the US Dollar and with the magnitude of exchange rate changes against the US Dollar. Indeed, the low interest rates in the US in the period 2001–2004 and the persistence of a clear downward US Dollar trend corresponds with the surge of global FX turnover (Figure 1).

2.2.1 A Simple Trend-Following Rule

In a simple trend-following rule, investors are long an exchange rate with a positive return over a given past period, and short an exchange rate with a negative return over a given past period. I am using the following simple trend-following rule:
At the beginning of each month, calculate the return of the past month and stay long if it is positive, otherwise go short. The achieved return with this strategy at period t is:

$$R_t \text{ if } R_{t-1} > 0 \text{ and } -R_t \text{ if } R_{t-1}\ 0 \qquad (2)$$

2.2.2 A Moving Average Trend-Following Rule

A moving average rule generates a buy signal when the current price level is above a pre-specified moving average and a sell signal when it is below this moving average. I am using a simple (1×3) moving average rule, where (1×3) means that the current (monthly) exchange rate is compared with the three months moving average of the past exchange rates[3]. This strategy generates the following return at period t:

$$\begin{aligned} &R_t \text{ if } S_{t-1} > 1/3(S_{t-1} + S_{t-2} + S_{t-3}) \text{ and} \\ &-R_t \text{ if } S_{t-1} < 1/3(S_{t-1} + S_{t-2} + S_{t-3}) \end{aligned} \qquad (3)$$

2.2.3 A Simple Carry Rule

In a carry trade, investors borrow in a low interest rate currency, such as the Yen, and then invest in a higher interest rate currency, such as the New Zealand Dollar. The Fed funds interest rate moved below the ECB refinancing rate in March 2001, and it stayed below it until November 2004. The US Dollar sell-off in the same period is by no means a pure coincidence and underlines the importance of the carry trades.
The carry rule is to sell the forward rate if $F_t > S_t$ and to buy the forward if $F_t < S_t$. The achieved return with this strategy at period t is:

$$\begin{aligned} &R_t \text{ if } F_{t-1} - S_{t-1} > 0 \text{ and} \\ &-R_t \text{ if } F_{t-1} - S_{t-1} < 0 \end{aligned} \qquad (4)$$

For example, under the carry strategy, an investor would have been long the US Dollar against the Euro from January 1999 until March 2001. Then he would have reversed his position by going short the US Dollar against the Euro in April 2001 until November 2004. In December 2004, the Fed funds rate once again moved above the ECB refinancing rate. Therefore, a carry trader would have again switched his position by going long the US Dollar against the Euro. Note, that the carry strategy causes minimal transaction costs since it seldom requires rebalancing. It will be interesting to see whether the US Dollar appreciates against the Euro in 2005 since, according to the carry strategy, it should.

2.2.4 A Threshold Carry Rule

The simple carry rule is based on the forward parity puzzle. It relies on the empirical result that β is negative, where β is estimated from the standard regression to test the UIP:

$$R_{t+1} = \alpha + \beta\left(i^d_{t,} - i^f_{t,}\right) + \varepsilon_{t+1}. \qquad (5)$$

However, equation (5) demonstrates that the future currency return (R_{t+1}) depends on two components: the alpha and the carry. The simple carry rule does not account for the first component

(alpha). It does not take into account the fact that the intercept term α has been found to be different from zero and that it differs across currencies. Therefore, it makes sense to modify the carry rule, i.e., to enter a carry trade only if the carry ($i^d_{t,} - i^f_{t,}$) compensates for the alpha. I am calling this a threshold carry rule because a carry trade is done only if the interest rate differential exceeds a certain "threshold" (alpha). For example, assuming that the actual α for the EUR-USD currency return is 2%, it will make sense to go long the US Dollar against the Euro only if the interest rate differential ($i^d_{t,} - i^f_{t,}$) exceeds 2%.

A recent paper by BILSON (2003) has found that alpha is not a random term, but rather can be explained by the difference in the slope of the yield curve. This relationship makes sense from an economic point of view since this difference could be interpreted as a measure of the future inflation differential. Moreover the purchasing power parity (PPP) theory tells us that currency returns should depend on inflation differentials. As a result, one should try to capture the carry only if the higher interest rate compensates for the expected inflation differential. Therefore, I am proposing to use as a threshold (T) the difference in the slope of the yield curve:

$$T_{t+1} = \left(y10^d_t - i^d_t\right) - \left(y10^f_{t,} - i^f_{t,}\right), \qquad (6)$$

where "y10" stands for the 10 Year Government Bond Yield.

Under the threshold carry (TCarry) rule, an investor should go long a high yield currency only if the carry is larger than the "threshold", and otherwise go short. The modified carry rule would lead to the following return:

$$R_t \text{ if } \left(F_{t-1,} - S_{t-1}\right) > T_{t-1} \text{ and } -R_t \text{ if } \left(F_{t-1,} - S_{t-1}\right) < T_{t-1} \qquad (7)$$

with T computed from equation (6).

3. Performance Evaluation

I have applied the four trading strategies for all 17 currency pairs from January 1999 until December 2000. Transaction costs were taken into account using typical market spreads. Note that transaction costs are larger for the emerging market currencies. For example, the typical market spread on EUR-USD is only 3 pips or approximately 0.02% (using the spot rate from December 2004, 0.0003/1.36 = 0.02%). Transaction costs for the Polish Zloty are about 5 times higher; the typical market spread is 30 pips (or 0.1% = 0.003/3.0).

I am using the following criteria to evaluate the performance of the different trading strategies:

a) annualized excess returns (R)
   The annualized excess returns are defined as the mean currency return (R) from the long or short position multiplied by 12. Note, that a risk free rate is not subtracted from the currency return. This is typical for performance measurement on currencies, since a currency program could be initiated without any investment. Buying and selling currency forward contracts does not require an investment — only the establishment of currency trading lines. The alpha generated by the currency manager can therefore be added on top of that of any other investment return.
b) annualized tracking error (TE)
   The annualized tracking error is defined as the monthly standard deviation multiplied by the square root of 12.
c) annualized modified[4] information ratio (IR)
   The annualized modified information ratio is computed as R/TE.
d) hit rate (H)
   The hit rate is defined as the percentage of the winning months, i.e., months with positive currency returns.
e) average win (W)
   The average win is computed as the average positive return.

f) average loss (L)
The average loss is computed as the average negative return.

3.1 Individual Results

Tables 2 and 3 summarize the results for each individual currency pair. The last column aggregates the results and shows the performance of four equally weighted portfolios for the 10 developed currencies (DM_{st}, DM_{ma}, DM_{sc} and DM_{tc} portfolios) and of four equally weighted portfolios for the 7 emerging market currencies (EM_{st}, EM_{ma}, EM_{sc} and EM_{tc} portfolios). The indices ''st", ''ma", ''sc" and ''tc" stand for the simple trend-following, the moving average, the simple carry and the threshold carry rule, respectively. ''DM" and ''EM" stand for developed markets and emerging markets.

Across the developed markets, the trend-following rules work exceptionally well for the Euro, the Danish Krone and the New Zealand Dollar. The information ratio (IR) for those exchange rates is above 1 for both trend-following rules, and the hit rate is above 60%. Not surprisingly, the IR for the Canadian Dollar is below 0 (−0.02 and −0.17), which is consistent with the perception in the market[5] that the Canadian Dollar does not exhibit clear trends. The highest return (13.32%) is achieved by the moving average rule applied to the New Zealand Dollar. Indeed, the New Zealand Dollar exhibited strong trends during the period 1999–2004. It lost 30% of its value between 1999 and 2001 and gained almost 80% between 2001 and 2004 due to the surge in commodity prices. However, the New Zealand Dollar has been also the ''riskiest" currency to invest into; i.e., it has the highest tracking error (11.32). The lowest return (−1.15%) is achieved by applying the moving average rule to the Canadian Dollar. The simple trend rule yields better performance than the moving average rule. The DM_{st} portfolio has an IR of 1.11 compared with an IR of 0.97 for the DM_{ma} portfolio. Nevertheless, both trend-following rules yield similar results across the different currency pairs, implying that the results are not sensitive to modification of the trading rule.

Applied across the emerging market currencies, the trend-following rules yield best results for the Hungarian Forint. The highest information ratio (1.41) and the highest return (14.88%) is achieved by applying the simple trend rule to the Hungarian Forint. This is not a surprise, since this currency exhibited strong trends between 1999 and 2004. It lost about 30% of its value between 1999 and 2001 and gained more than 40% between 2001 and 2004. The trend-following strategies yield a negative result for the Singapore Dollar, which could be explained by the fact that it is a managed floating currency, not a free-floating currency. The most risky currency to invest into has been the South African Rand. The tracking error for this currency is highest (almost 17%) and the average loss is biggest (−3.1% for the simple trend rule and −3.6% for the moving average rule). Here again, the simple trend rule yields a slightly better performance than the moving average rule. The EM_{st} portfolio has an IR of 1.18 compared with an IR of 1.01 for the EM_{ma} portfolio. Both trend-following rules yield similar results across the different currency pairs, which suggest that the results are not sensitive to modifications of the trading rule.

Among the developed market currencies, the carry rules yield best results for the Euro, the Danish Krone, the New Zealand Dollar and the Swedish Krona. The highest return is achieved in the Swedish Krona (13.19%). It is interesting to note, that the simple carry rule leads to negative results for the Japanese Yen (−1.62%) and the Swiss Franc (−3.56%). This could be explained by the fact that these currencies have been well known for their low interest rates and have been widely used as cheap funding currencies. Borrowing money in Swiss Francs to buy a house in the Euro-zone has been very popular among Euro-zone residents[6]. Therefore, it is not a surprise

Table 2: Performance Results of Trend-Following and Carry Trading Rules: Developed Markets
Period: 01/1999 – 12/2004.

	EUR	*JPY*	*GBP*	*CHF*	*AUD*	*CAD*	*SEK*	*NOK*	*DKK*	*NZD*	*Equally Weighted*
Simple Trend											DM_{st}
Return	11.44	3.24	0.87	5.37	8.00	−0.12	6.70	3.83	11.89	11.61	6.20
Tracking Error	9.55	10.12	7.75	9.81	11.07	6.89	9.98	10.12	9.20	11.32	5.56
IR	1.20	0.32	0.11	0.55	0.72	**−0.02**	0.67	0.38	1.29	1.03	1.11
Hit rate	63	59	46	58	55	46	59	49	65	61	59
Average win	2.6	2.2	2.0	2.4	3.1	1.7	2.5	2.6	2.5	3.1	1.5
Average loss	−1.9	−2.5	−1.6	−2.2	−2.3	−1.5	−2.3	−1.9	−1.8	−2.4	−0.9
Moving Average											DM_{ma}
Return	12.44	−1.04	0.30	5.24	5.60	−1.15	5.71	5.01	11.05	13.32	5.77
Tracking Error	9.31	10.09	7.69	9.71	11.12	6.87	9.84	9.89	9.16	11.14	5.95
IR	1.34	−0.10	0.04	0.54	0.50	**−0.17**	0.58	0.51	1.21	1.20	0.97
Hit rate	62	51	46	48	54	46	54	54	69	61	55
Average win	2.7	2.1	1.9	2.8	3.0	1.6	2.6	2.5	2.3	3.2	1.7
Average loss	−1.3	−2.5	−1.7	−1.8	−2.5	−1.7	2.1	−2.0	−2.1	−2.3	−1.0
Simple Carry											DM_{sc}
Return	10.65	−1.62	4.72	−3.56	6.54	4.34	13.19	4.90	11.05	11.55	6.18
Tracking Error	9.48	10.02	7.48	9.79	10.93	6.70	9.20	9.94	9.16	11.02	5.02
IR	1.12	**−0.16**	0.63	**−0.36**	0.60	0.65	1.43	0.49	1.21	1.05	1.23
Hit rate	68	49	58	51	63	61	68	54	69	65	68
Average win	2.3	2.1	1.9	2.0	2.6	1.6	2.5	2.5	2.3	2.8	1.3
Average loss	−2.2	−2.4	−1.7	−2.9	−2.9	−1.5	−1.9	−2.0	−2.1	−2.4	−1.1
Threshold Carry											DM_{tc}
Return	10.65	5.35	5.79	6.68	7.86	5.36	11.52	4.04	11.71	11.55	8.05
Tracking Error	9.48	9.92	7.42	9.65	10.86	6.64	9.39	9.97	9.09	11.02	5.56
IR	1.12	**0.54**	0.78	**0.69**	0.72	0.81	1.23	0.41	1.29	1.05	1.45
Hit rate	68	63	61	65	65	61	66	54	70	65	72
Average win	2.3	2.1	1.9	2.2	2.6	1.7	2.5	2.4	2.3	2.8	1.4
Average loss	−2.2	−2.5	−1.7	−2.5	−2.9	−1.4	−2.8	−2.1	−2.1	−2.4	−1.2

Table 3: Performance Results of Trend-Following and Carry Trading Rules: Emerging Markets
Period: 01/1999 – 12/2004.

	MXN	*SGD*	*ZAR*	*PLN*	*CZK*	*THB*	*HUF*	*Equally Weighted*
Simple Trend								EM_{st}
Return	3.73	−0.29	13.55	3.16	8.17	1.90	14.88	6.35
Tracking Error	8.27	4.58	16.65	11.4	11.31	7.10	10.53	5.38
IR	0.45	**−0.06**	0.81	0.28	0.72	0.27	1.41	1.18
Hit rate	61	45	56	58	52	52	63	69
Average win	1.8	1.1	4.4	2.5	3.3	1.5	3.0	1.3
Average loss	−2.0	−1.1	−3.1	−2.9	−2.3	−1.3	−2.0	−1.3
Moving Average								EM_{ma}
Return	0.68	−1.90	9.18	4.34	5.92	5.41	11.04	4.95
Tracking Error	7.74	4.46	16.88	11.01	11.10	6.92	10.50	4.91
IR	0.09	**−0.43**	0.54	0.39	0.53	0.78	1.05	1.01
Hit rate	52	42	54	58	49	54	56	56
Average win	1.7	1.0	4.3	2.5	3.2	1.7	3.0	1.4
Average loss	−1.9	−1.1	−3.6	−2.9	−2.3	−1.1	2.0	−0.9
Simple Carry								EM_{sc}
Return	−1.83	−0.18	−0.25	2.31	8.74	4.47	4.80	2.58
Tracking Error	7.43	4.49	16.87	11.10	11.16	6.87	10.41	4.57
IR	**−0.25**	**−0.04**	**−0.02**	0.21	0.78	0.65	0.46	0.56
Hit rate	48	45	52	55	59	55	56	55
Average win	1.6	1.1	3.6	2.5	2.9	1.6	2.5	1.2
Average loss	−1.8	−1.0	−3.9	−2.6	−2.5	−1.2	−2.3	−0.9
Threshold Carry								EM_{tc}
Return	2.97	0.4	2.68	2.31	10.81	4.73	4.8	4.1
Tracking Error	7.40	4.49	16.85	11.1	11.01	6.86	10.41	4.62
IR	**0.4**	**0.09**	**0.16**	0.21	0.98	0.69	0.46	0.89
Hit rate	56	49	55	55	59	55	56	59
Average win	1.7	1.1	3.6	2.5	3.1	1.6	2.5	1.2
Average loss	−1.6	−1.0	−3.9	−2.6	−2.3	−1.2	−2.3	−0.9

that the simple carry rule failed to deliver positive returns over the last six years. When a certain trade becomes ''crowded", it becomes a loosing trade. The basic idea is still valid, but a modification is necessary when the trade is becoming too popular. The threshold carry rule yields much better results for those two currency pairs: 5.35% for the Japanese Yen and 6.68% for the Swiss Franc. The tracking error for the Australian Dollar is the highest (near 11%) and the average loss is the largest (−2.9%). The threshold carry rule yields better results across all developed market currencies. The DM_{sc} portfolio has an IR of 1.23 compared with an IR of 1.45 for the DM_{tc} portfolio.

Among the emerging market currencies, the carry rule yields best results for the Czech Koruna. The highest return (10.81%) is achieved by applying the threshold carry rule for the Czech Koruna; the lowest return (−1.83%) is obtained by applying the simple carry rule for the Mexican Peso. The South African Rand has the highest tracking error (near 17%) and the biggest average loss (−3.9). This is no surprise since the South African Rand exhibits very high volatility; historical volatility has been in the 15–25% range. Among the emerging market currencies, the threshold carry rule again delivers a better performance than the simple carry rule. The EM_{tc} portfolio has an information ratio of 0.89 compared with an information ratio of 0.56 for the EM_{sc} portfolio. It yields a positive IR for all seven currency pairs, while the simple carry rule leads to a negative IR for the Mexican Peso (−0.25), the Singapore Dollar (−0.04) and the South African Rand (−0.02).

3.2 Aggregate Results

For better comparison of the performance between the different trading styles (trend and carry) and the different currency groups (developed and emerging markets), the results are aggregated by defining seven different portfolios as follow:

a) The Developed Markets Trend (DM_{trend}) portfolio invests 50% into the simple trend strategy and 50% into the moving average strategy across the developed market currencies; i.e., it is equally weighted between the DM_{st} and DM_{ma} portfolios.
b) The Emerging Markets Trend (EM_{trend}) portfolio invests 50% into the simple trend strategy and 50% into the moving average strategy across the emerging market currencies; i.e., it is equally weighted between the EM_{st} and EM_{ma} portfolios.
c) The Developed Markets Carry (DM_{carry}) portfolio invests 50% into the simple carry strategy and 50% into the threshold carry strategy across the developed market currencies; i.e., it is equally weighted between the DM_{sc} and DM_{tc} portfolios.
d) The Emerging Markets Carry (EM_{carry}) portfolio invests 50% into the simple carry strategy and 50% into the threshold carry strategy across the emerging market currencies; i.e., it is equally weighted between the EM_{sc} and EM_{tc} portfolios.
e) The Developed Markets Trend and Carry (DM_{t+c}) portfolio invests into all four strategy across the developed markets; i.e., it is equally weighted between the DM_{trend} and DM_{carry} portfolios.
f) The Emerging Markets Trend and Carry (EM_{t+c}) portfolio invests into all four strategy across the emerging markets; i.e., it is equally weighted between the EM_{trend} and EM_{carry} portfolios.
g) The DMEM portfolio invests into all four strategies, with 80% allocated across the developed markets and 20% allocated across the emerging markets; i.e., it invests 80% into the DM_{t+c} portfolio and 20% into the EM_{t+c} portfolio.

I use an equal weighting for the definition of the portfolios because this is the ''fairest" way to

compare the results. For the last portfolio (DMEM) an equal weighting is not appropriate since investments in emerging markets are often restricted by clients or regulators to a maximum of 10–20%. I use the upper restriction limit for a better demonstration of the diversification benefits. Note that the portfolios are rebalanced on a monthly basis and that transaction costs are taken into account (Table 4).

The aggregate results are quite interesting. First, all seven portfolios show a good performance; i.e., the information ratios are in the 1.35 – 2 range. This implies that the described trading strategies would have been working very well in the 1999–2004 period. These results imply the existence of inefficiencies in the foreign exchange market and are very encouraging for currency managers. The results are consistent with economic intuition since, as discussed in the introduction, there exists a theoretical support for inefficiencies in the foreign exchange market. Many of the major participants in the currency market do not trade for profit, leaving greater opportunity for those who seek profits. Second, the results suggest that the trend-following rules work better across emerging market currencies. The information ratio of the EM_{trend} portfolio is higher (1.48) than the information ratio of the DM_{trend} portfolio (1.45). Both trend-following rules yield better results across emerging market currencies (see Tables 2 and 3). This suggests that the result is not sensitive to the specification of the trend-following rule. Furthermore, statistical inference shows that the out-performance of the EM_{trend} portfolio (the difference in the mean three-year rolling information ratios) is statistically significant. A t-test[7] rejects the null hypothesis of equal means at a 95% confidence level. This suggests that emerging market currencies exhibit clearer trends than developed market currencies, which is consistent with the expectation that developed markets are more efficient and hence developed market currency returns are closer to random walks. Figure 2 shows three-year rolling information ratios for the DM_{trend} and EM_{trend} portfolios from January 2002 until December 2004. The DM_{trend} portfolio outperforms only in a very short time period. It is interesting to note that the EM_{trend} portfolio has a lower tracking error (3.71%) and a lower return

Figure 2: Three-Year Rolling Information Ratios for a Trend-Following Trading Rule. From January 2002 until December 2004.

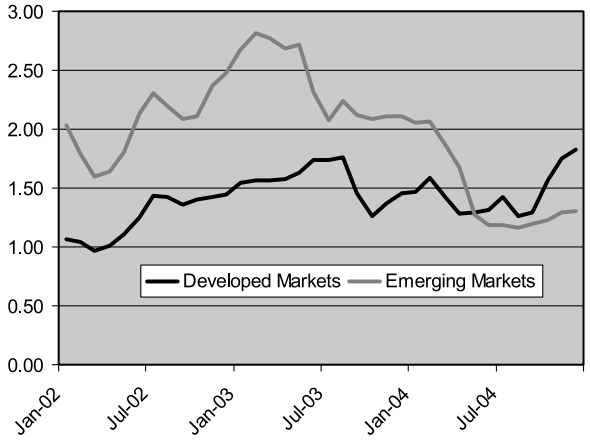


Table 4: Performance Results of Trend-following and Carry Trading Rules
Period: 01/1999 – 12/2004.

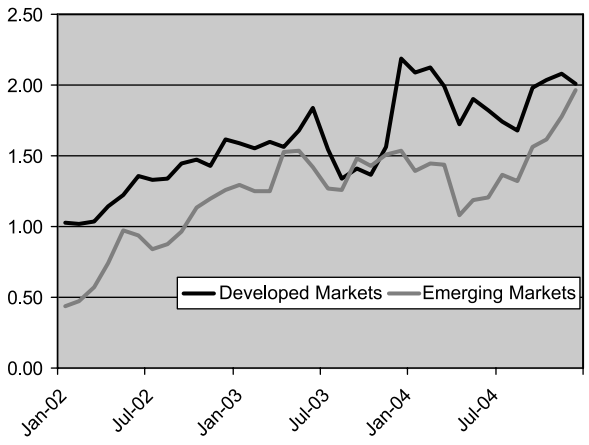
	DM_{trend}	EM_{trend}	DM_{carry}	EM_{carry}	DM_{t+c}	EM_{t+c}	DMEM
Return	5.96	5.49	8.10	6.01	7.03	5.75	6.77
Tracking Error	4.12	3.71	5.22	4.44	3.75	3.11	3.39
IR	1.45	1.48	1.55	1.35	1.88	1.85	2.00
Hit rate	59	69	70	62	68	70	68
Average win	1.2	1.0	1.4	1.3	1.1	0.9	1.0
Average loss	−0.6	−0.6	−1.1	−0.7	−0.5	−0.5	−0.4

(5.49%). There is the presumption in the market that emerging market currencies are riskier and, as such, offer a higher return than the developed market currencies. However, this presumption is not supported by the results.

A remarkable result is that the DM_{carry} portfolio would have achieved a much higher IR than the EM_{carry} portfolio. It also has a higher return (8.10% instead of 6.01%) and a higher hit rate (70% instead 62%). Its tracking error is also higher, which again contradicts the presumption that emerging market currencies are riskier. Again, the result is not sensitive to the specification of the trading rule, since both carry rules perform better across developed markets. Statistical inference shows that the out-performance of the DM_{carry} portfolio (the difference in the mean three-year rolling information ratios) is statistically significant. A t-test [7] rejects the null hypothesis of equal means. This is consistent with previous findings (BANSAL and DAHLQUIST (2000) and FRANKEL AND POONAWALA (2004)) that the forward parity puzzle is less present in emerging markets. This result is quite important. The presumption in the market is that carry trades should be more profitable in emerging market currencies since those currencies usually offer higher interest rates. However, the empirical results suggest that this presumption might be wrong. Figure 3 plots a three year rolling information ratio for the DM_{carry} portfolio and for the EM_{carry} portfolio. It shows that the carry rules would have worked better for the developed market currencies than for the emerging market currencies between 1999 and 2004.

Note that the average loss for the portfolios which invest into the trend-following rules (DM_{trend} and EM_{trend} portfolios) is lower (−0.6%) than the average loss for the portfolios which invest into the carry-capturing rules (DM_{carry} and EM_{carry} portfolios) This is not a surprise since trend-following rules change the positions when the trade turns against them, while carry rules will hold the position regardless of the performance.

Figure 3: Three-Year Rolling Information Ratios for a Simple Carry Trading Rule. From January 2002 until December 2004.



The DM_{carry} portfolio has the highest tracking error (5.22%) and the biggest average loss (−1.1%). However, it yields also the highest return (8.10%). This is quite a surprise since one could have expected the highest return to be captured by a trend-following strategy. This result highlights the importance of the forward parity puzzle for active currency management.

Third, the aggregate results also show that the performance could be enhanced by diversifying across trading styles and into more currency pairs. Both the DM_{t+c} portfolio and the EM_{t+c} portfolio exhibit remarkably high IRs and hit rates above 65%. This demonstrates the diversification benefit from applying different trading strategies. The result implies that currency managers should diversify across different trading styles. The DMEM portfolio has the highest information ratio (2.00) and demonstrates the benefit from expanding the currency investment universe into emerging markets. The DMEM portfolio also exhibits the lowest tracking error (3.39) and the lowest average loss (−0.4). The results point into a clear direction: currency managers should diversify across different currencies and across different styles.

The described strategies could be applied for the construction of a pure currency portfolio which invests in all seventeen currency pairs. The full diversification benefit could not be achieved within a currency overlay since the currency overlay manager can only place and lift hedges on those currencies in which the underlying portfolio is invested. This does not mean that the discussed strategies could not be applied within a currency overlay framework. The currency overlay manager could for example use the trend-following and the carry rules to decide when to hedge the US Dollar exposure for a Euro-based investor and when to leave it un-hedged.

4. Conclusion

This paper evaluates the performance of trend-following and carry strategies in the foreign exchange market. It examines the performance differences for emerging market currencies and developed market currencies and whether the expansion of the currency investment universe can improve the performance. Several results stand out from the analysis.

First, they show that currency trading strategies would have generated a positive return in the 1999–2004 period. This implies the existence of inefficiencies in the foreign exchange market over given periods. There exists a theoretical support for this finding, since the profit motive assumption of the efficient market hypothesis does not apply in the currency market. This is an encouraging result for currency managers since it suggests that alpha generation from currency management should be possible.

Second, the results of the paper show some striking differences between emerging and developed market currency performance with respect to the trading rules applied in this paper. It seems that trend-following rules work better across emerging markets. This is consistent with economic intuition since these markets are expected to be less efficient. An interesting result, however, is that trading strategies based on the forward parity puzzle yield better results across developed market currencies despite the larger yield offered from emerging market currencies. This confirms previous research that the forward bias is not as present in emerging markets as in developed markets. These results might have important implications for currency management. They suggest that traders investing in emerging market currencies should rely more on trend-following rules, while investors trading developed market currencies should allocate more risk to carry trading strategies.

Third, the paper demonstrates the diversification benefits of applying different trading strategies and of expanding the currency investment universe. The portfolio which invests into the developed and emerging market currencies, and uses all four investigated strategies, yields the best performance. This implies that currency managers should try to expand their investment universe into emerging market currencies and that style diversification is also important. Therefore, plan sponsors should seek to employ currency managers with different investment styles.

The results point toward the following advice for currency managers:

a) Expand the currency universe and apply different styles.
b) Allocate more risk toward trend-following style when investing in emerging market currencies and toward carry style when investing in developed market currencies.

Unfortunately the forward rates for most of the emerging currencies are available only starting in late 1997–1998. Therefore, it was not possible to apply the trading strategies for a much longer time period. Thus, the data history is too short to generalize the results, and future research (when more data are available) should show whether the results persist.

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ENDNOTES

[1] Investment styles in currency management can be broadly classified into four groups according to the importance of quantitative models and rules in the decision making process:
   a) Purely qualitative (discretionary): The investment process is based on qualitative factors, which cannot be expressed numerically. Therefore, no quantitative models are used in the decision making
   b) Flexible decision support: The use of models is limited to giving the decision makers an additional input.
   c) Systematic (model based): The investment decision is 70% model based. Normally, an investment committee verifies the validity of the model's assumption on a regular basis. The model's signals can be overruled.
   d) Purely quantitative (black-box): The investment decision is 100% model based. There is no qualitative overlay.

[2] The CIP follows from the assumption of arbitrage between spot and forward exchange rates. Algebraically, it is expressed as follows:

$$F_t/S_t = I_t^d \Big/ I_t^f, \tag{1}$$

where F is the forward rate, S is the spot rate at time t, I^d is the domestic interest and I^f is the foreign interest rate.
Taking logarithms of both sides (indicated by lowercase letters) leads to

$$f_t - s_t = i_t^d - i_t^f. \tag{2}$$

The uncovered interest rate parity states that the forward rate is an unbiased predictor for the future spot rate, i.e.,

$$E(R_{t+1}) = i_t^d - i_t^f. \tag{3}$$

A standard test of the UIP hypothesis is performed by regressing the actual change in

the exchange rate on the interest rate differential, as in:

$$R_{t+1} = \alpha + \beta\left(i^{d}_{t,} - i^{f}_{t,}\right) + \varepsilon_{t+1}. \quad (4)$$

The null hypothesis of the weak form of UIP is that $\beta = 1$, so that if the foreign interest rate is higher than the domestic interest rate, the currency appreciates in line with the differential. However, many studies have found that β is less than zero and even negative. The survey by FROOT and THALER (1990) found an average estimate of -0.88.

[3] Sometimes the moving average does not include the month that is used to make the investment decision. In this case the described moving average rule should change to

$$\begin{aligned} &R_t \text{ if } S_{t-1} > 1/3(S_{t-2} + S_{t-3} + S_{t-4}) \text{ und} \\ &-R_t \text{ if } S_{t-1} < 1/3(S_{t-2} + S_{t-3} + S_{t-4}) \end{aligned} \quad (5)$$

Nevertheless, the variant where the current month is included seems to be preferred by currency managers (private conversations with many market participants). Note, that adjusting the moving average rule is not likely to change the results significantly.

[4] The information ratio is widely used in the equity and bond markets. Since the generated alpha in the currency markets (and in the paper) is defined in a different way (i.e. the risk free rate is not included), I call the measure "modified information ratio" instead of information ratio.

[5] Jessica James from Citigroup made this point at the FX Week 2004 Congress in London.

[6] For example, Oesterreichische Nationalbank points out the rising importance of foreign currency loans since the middle of the 1990s, and estimates the percentage of foreign currency loans to households in Austria at approximately 25% of total loans to households, with loans in Swiss Francs and Yen dominating (see http://www.oenb.at).

[7] The t-test assesses whether the means of two groups are statistically different from each other

a) Data : x_1 : The three − year rolling information ratios of the DM_{trend} portfolio
y_1 : The three − year rolling information ratios of the DM_{trend} portfolio

Then the t-test yields a t = −6.02 for df = (48.0) degrees of freedom, and the p-value = 0 tells us that the difference in information ratios is significant.
The 95% confidence interval is (−0.72 −0.36).

b) Data : x_1 : The three − year rolling information ratios of the DM_{carry} portfolio
y_1 : The three − year rolling information ratios of the DM_{carry} portfolio

Then the t-test yields a t = 4.65 for df = (69.82) degrees of freedom, and the p-value = 0 tells us that the difference in information ratios is significant.
The 95% confidence interval is (0.21 0.52). (Note that we use a two-sided alternative hypothesis: the true difference in means is different from zero)

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