Currency Risk Management and International Bond Diversification

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Abstract

We analyze alternative currency risk management strategies for a sample of international bond portfolios. In all cases, fully hedged or dynamically hedged portfolios dominate their unhedged counterparts under a mean-variance criterion. In addition, we present strong evidence that common foreign exchange technical trading rules do not enhance the performance of currency risk management strategies. To summarize, simple passive risk management techniques appear to be more efficient in improving the performance of international bond portfolios than complex strategies that depend upon the forecasting of foreign exchange. Given the poor showing of common currency risk management methods, the main benefits of international bond investment comes from the simple diversification of bond risk.

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1 Introduction

The emergence of new currency risk management techniques over the past twenty years has radically altered institutional investment practices. Currency risk management can be split into two approaches: passive strategies (such as 'never hedge' or 'always hedge' methods), which take a position irrespective of market movements or conditions, and active strategies (such as tactical currency hedges or currency overlay hedges), which predict foreign currency movements and hedge according to forecasted changes in the exchange rate.

Levich and Thomas (1993) investigate the use of simple mechanical trading rules for actively managing currency risk. Their research provided clear evidence that technical analysis not only benefits international bond investment strategies in terms of more efficient risk diversification but also that its application leads to significantly higher returns (compared to a domestic bond portfolio).

While the findings are no doubt important, they also implicitly suggest that either the currency markets are inefficient or that purchasing power parity does not hold in the longer term. There is a body of research that suggests this may be the case.

Arnott and Pham (1993) argue that technical trading in the currency markets may be successful due to the very fact that central bank intervention is common. If foreign currency markets are to be efficient, then profit taking investors are a necessary component. From the perspective of currency markets, corporations and central banks do not perform that role. In fact, in certain circumstances central banks may actually hinder the removal

of such inefficiencies.[1]

The presence and activities of central banks in the foreign currency markets is analysed by Silber (1994) who finds that the success of technical trading is highly correlated with the price smoothing activities of central banks. Szakmary and Mathur (1997) examine the link between monthly technical trading rule returns and monthly changes in the foreign exchange reserves (which can be used as an estimate for intervention) of five central banks. Again, their results present evidence of an association between intervention activity and trading rule returns.

It could also be argued that the findings of Levich and Thomas (1993) are no longer valid in the current international financial environment. Currency markets in the early twenty-first century are no doubt very different venues for investment than they were in the late eighties. Moreover, financial markets have become increasingly sophisticated and integrated in recent years. As such, we believe that the question of whether active currency risk management in international bond investment can still be successful deserves a fresh and careful reconsideration.

In the present study, we update and improve upon past evidence on technical trading in the currency markets. Firstly, we extend the Levich and Thomas (1993) analysis by examining approximately twenty years of the most recent international floating exchange rate data. This is a time period that has not been studied by earlier work and is a more relevant period for study to practitioners and academics.

[1]The Bank of Japan's active presence in the foreign currency market in recent times is one such example of price manipulation. The British government's unsuccesful support of sterling in 1992 is another example.

Secondly, we improve upon previous empirical methodologies by utilising a more realistic algorithm than earlier work for calculating trading profits. Previous research calculates the same day investment return on the implementation of trading rules, under the assumption that market participants react immediately to new information. If a sensible lag to investor reaction is incorporated into the analysis, the superior performance of currency trading rules rapidly disappears.

Thirdly, we examine the role of international diversification in improving the performance of bond portfolio investments. The international bond markets have become more closely linked in recent years. As such, an understanding of whether there are continued benefits to international bond investment over domestic bond portfolios is necessary.

Finally, in light of the empirical results presented here, we jointly examine the role of international diversification and active currency risk management of bond portfolios. In sum, we investigate the relative benefits of each concept and provide some insights into current international bond investment performance.

In this paper, we find that the method of calculating trading profits is crucial to the determination of whether active currency risk management is effective. Utilising an identical methodology to Levich and Thomas (1993), our findings mimic that of the earlier paper and show that for the past twenty years, not only do trading rules improve international bond portfolio returns but also their risk, through the benefits of diversification. In effect, international bond investors have a 'free lunch'.

However, when a more realistic implementation of the Levich and Thomas

(1993) trading rules are carried out and the trading profit is calculated with a realistic investor response lag, the apparent excess returns disappear. Furthermore, our findings clearly show that mechanical trading rules of the kind proposed by Levich and Thomas (1993) are ineffective in predicting future currency movements.

We present evidence that a passive approach to managing currency risk in international bond portfolios is more effective than active risk management strategies. Although all techniques led to more efficient international bond portfolios in terms of the mean-variance criterion, the fully hedged international bond portfolio performed better for most individual country bond portfolios. Only with a fully diversified international bond portfolio investment, did more active currency risk management strategies perform better.

Finally, we show that holding an equally weighted international bond portfolio over the past twenty years would have led to significant benefits in the form of both higher returns and higher Sharpe ratios (compared to a domestic dollar portfolio). This finding shows that even with the integrated capital markets that exist today, international diversification of bond portfolios still has its advantages in the presence of volatile exchange rates.

In Section Two, we present a brief discussion of the relevant literature and Section Three, we describe our data. The performance of common currency technical trading rules is examined in Section Four and in Section Five, we introduce and compare the performance of four currency risk management strategies for international bond investment. Section Six concludes the paper.

2 Relevant Literature

Our paper is part of a small but growing literature that examines the effectiveness of currency risk management and international bond investments. The merits of international diversification was first put forward in a number of classic papers such as Grubel (1968); Levy and Sarnat (1970) and Solnik (1974). However, much of this research took place during a fixed exchange rate regime.

In more recent research, Levi and Zvi (1988) reported that U.S. investors would have made significant gains from international investments without hedging their currency risk. Perold and Schuman (1988) showed that a passive currency hedging strategy could improve the returns that an international investor received relative to both a domestic portfolio and an unhedged international portfolio. They also report that hedging costs are small enough not to impact upon the performance of the international bond portfolio. This finding has also been observed by Jorion (1989), Thomas (1989), and Odier and Solnik (1993).

Hazuka and Huberts (1994) focus on how exchange rate predictability impacts upon international diversification. As a means of hedging exchange rate risk, they create a trading rule whereby an investor would hedge if the domestic interest rate was greater than or equal to the foreign interest rate (Real Interest Rate Rule). They report that this conditional hedging rule outperformed basic hedging strategies for portfolios of currencies. Although the paper analyses currency portfolios, the rationale underlying the study could also be applied to international bond portfolios.

A more recent paper by Vander Linden, Jiang and Hu (2002) implemented

a conditional hedging rule that is a synthesis of the 'real interest rate rule' of Hazuka and Huberts (1994) and a 'forward hedge rule' (creating the 'real forward hedge rule'). Their results show that the new rule was beneficial to international investors (US) and that it, in general, outperformed all other methods of hedging.

Levich and Thomas (1993) examined the use of simple trading rules to hedge the currency risk exposure of international bond portfolios. They showed that the implementation of simple technical trading rules improved the Sharpe ratio more than ten-fold over that of a counterpart unhedged portfolio.

The success of technical trading in the short run has been recorded in a number of papers. Pruitt and White (1999) find that technical trading rules can be successful in beating the market. There is also much support for the ability of trend-following strategies in beating foreign exchange markets, (for example, Dunis (1989), Taylor (1994), and Mills (1997)).

The only research that presents conflicting evidence are Curcio, Goodhart, Guillaume and Payne (1997) and Sullivan, Timmerman and White (1999). Both studies report that trend following strategies do not lead to profitable trading, when tested from an out of sample perspective.

3 Data

The data consist of several databases. Currency data for the United Kingdom, Germany, Japan, Canada, and Australia, are obtained from Global Treasury Information Services. The sample period ranges from January 1^{st}

1986 and June 30^{th} 2004.

Given that the euro was introduced in 1999, which is half way through our sample period, an issue arises with the analysis of German currency returns. In order to circumvent this problem, we reconstruct the Deutsche Mark currency series using the implicit Deutsche Mark - euro exchange rate of DM1.95583/euro as set by the European Central Bank in 1999. This rate has been irrevocably fixed and is the official rate used for all Deutsche Mark - euro currency conversions.

International bond returns are generated from JP Morgan Liquid Government Bond Indexes and all other data are collected from *DataStream*.

4 Currency Technical Analysis

Our basic tests assess the success and profitability of technical trading rules in the currency futures markets. Following Levich and Thomas (1993), we use two types of mechanical rules to generate buy and sell signals: filter rules and moving average rules. To enable the tests to be carried out, a synthetic currency futures contract was constructed.

The synthetic contract is generated by the cost of carry model and is given as follows:

$$F_0 = S_0 e^{(r_d - r_f)T} \tag{1}$$

where F_0 is the futures price at time zero, S_0 is the spot currency price at time zero, r_d is the domestic currency risk-free rate of interest and r_f is the foreign currency risk-free rate of interest.

Futures prices are preferred to spot currency prices because they more

accurately reflect the return investors earn on foreign currency investments. The cost of carry model incorporates not only the return earned on the foreign currency but also the cost of funding the investment, in terms of domestic currency return. Changes in futures prices thus represent the total excess return on a foreign currency position, interest rate differential plus capital gain (or loss).

Filter rules are defined by the parameter, f, the filter size. Exchange rates are expressed in US$ per unit of foreign currency. The filter rule is implemented whereby the foreign currency is purchased (sold) whenever it rises (falls) by $f\%$ above the most recent trough in the past 20 days. Seven filter rules are implemented where f has values of 0.5%, 1.0%, 2.0%, 3.0%, 4.0%, 5.0% and 10.0%.

The moving average crossover rules require two parameters, the length (L) in trading days of the longer moving average, MA_L, and the length in trading days of the shorter moving average, MA_S. The rule specifies that if MA_S is greater (less) than MA_L then buy (sell) the foreign currency, otherwise take no position. Three different moving average crossover rules are analysed with an L/S value of 5/1, 20/5 and 200/1.

The significance of any observed profits could be tested using a conventional t-test if the observed exchange rate volatility over the sample period was constant. However, tests of the distribution of returns showed the data to be non-stationary thereby invalidating conventional t-tests. Consequently a non-parametric test is applied – the Signed Wilcoxon Rank Test.

We also create a currency portfolio that combines the ten trading strategies (seven filter rules and three moving average rules) into one composite

strategy. This was done by equally weighting the returns from each strategy to generate an overall portfolio currency return.

Finally, an international bond portfolio is constructed by equally weighting the individual country portfolios, to provide the overall mean return of the technical trading rules.

The results from applying the seven different filter rules and the three moving average crossover rules are presented in Table One. In nearly all of our simulations there are no statistically or economically significant profits.[2] Indeed, for the British Pound (BP), the German Mark (DM), the Australian Dollar (AUD) and the Swiss Franc (CHF), all of the trading profits[3] lack statistical or economical significance for any trading rule. The most successful currency was the Japanese Yen (JY) which earned significantly positive profits from only two strategies out of ten we tested.

An examination of Table One shows that the number of trades involved in the technical trading rule strategies can be very high. For the 0.5% filter rule, over one thousand trades are required for each currency. If one was to construct and manage an internationally diversified currency portfolio using only the 0.5% filter rule, over six thousand transactions would have been required over the sample period. Clearly, this strategy would incur major transaction costs over time and such costs would further erode the profits, if any, made from utilising the rules.

[2]Our algorithm assumes that investors trade the day *after* a signal is created. When profits are calculated assuming that investors trade on the same day as the signal (as in Levich and Thomas (1993)), trading profits are highly statistically and economically significant. Because we believe that the methodology is flawed, we do not report the results in detail. They are available from the authors on request.

[3]Profits are presented as gross returns but are in excess of the risk free rate since margin accounts can be held in Treasury Bills that earn the risk free return for the investor.

Table Two (Panel A) reports the returns from buying and holding each of the currencies individually, as well as the returns from holding an equally weighted basket of currencies. As with each of the mechanical trading rules, the returns do not take into account transaction costs, such as commissions, but are in excess of the 90-day treasury bill rate.

The performance of strategies that enter into individual foreign currency positions is mixed. Over the period, annualized returns on the currencies ranged from, -0.10% for the Australian Dollar to 3.3% for the Japanese Yen. The level of volatility for each of the currencies is broadly similar across countries starting from 0.33% for the Canadian Dollar to 0.75% for the Swiss Franc.

For the equally weighted currency basket, the excess annual return is 1.61% and the volatility is lower than all of the individual currencies with only one exception, the Canadian Dollar.

In general, foreign currencies earned positive returns against the dollar over the sample period. Most of the currencies had Sharpe ratios above 1.5, with only the Australian and Canadian Dollars performing poorly. It can also be seen that the equally weighted basket of currencies had a relatively high Sharpe ratio of 3.62. Moreover, this figure would have improved significantly if the Australian dollar, which depreciated greatly over the period, was omitted from the analysis.

Panel B of Table 2 shows the returns from applying the composite trading rule to the six currencies individually, in addition to an equally weighted portfolio of all the currencies in our sample. In each case, the returns earned by the composite trading rule (Panel B) are less than the returns from buying

and holding the currencies (Panel A) over the sample period.

Although the returns for the composite trading rule are in all cases lower, it may be that the composite portfolios are more efficient than buy and hold portfolios if volatility falls by a greater level. An examination of Panel B shows that this is indeed the case for some currencies but not all. As a result of the lower volatility, the Sharpe ratios for the composite trading portfolio are superior to the Sharpe ratios observed from the buy and hold strategy for the German Mark and Japanese Yen only. However, for other currencies as well as the equally weighted international currency portfolio, the buy and hold strategy was superior.

In both panels of Table 2 the impact of diversification can be seen. The level of volatility for both the equally weighted basket of currencies is considerably lower than the levels of volatility observed for almost all of the individual currencies. The only currency that has a lower volatility than the portfolios in both cases is the Canadian Dollar. However, the excess return on the Canadian Dollar was also significantly lower than other currencies, offsetting any perceived benefit from its low volatility.

5 Analysis of International Bond Portfolios

We simulate (a) two passive strategies - 'always hedge' and 'never hedge' and (b) two active strategies – 'tactical currency hedge' and 'currency overlay hedge'. Each risk management strategy is founded upon a number of assumptions.

Taking the two passive strategies first, these can be viewed as the most ba-

sic approaches to controlling currency risk. An institution that never hedges against currency risk fundamentally accepts the volatility inherent in foreign exchange. In addition, if the transaction costs involved in undertaking any form of hedge are expensive and the volatility of foreign currencies are low, there is little benefit to undertaking currency risk management. When an international bond portfolio is unhedged, investors are exposed to both interest rate risk and currency risk.

The other extreme is a portfolio that is always hedged against currency risk. This strategy is optimal when the transaction costs of entering into hedges are very low. As a result, maintaining a continuous currency hedge would have minimal impact on investment returns. Alternatively, a continuous hedge is sensible if the forward price and the future spot price differential tends to be small.

Active strategies are predicated on the notion that investors can predict future currency movements.[4] If this is the case, dynamic hedging strategies can be constructed such that foreign currencies are hedged when they are expected to move against the dollar and left exposed when they are expected to move in favour of the dollar.

In this paper, we examine two active currency risk management strategies in the context of international bond investment. First, we investigate the performance of the tactical currency hedging strategy. This is a composite approach to currency risk management based upon the 10 technical rules considered in Section Three.

[4] A good example of an active currency hedge strategy was when BMW announced in the summer 2004 that they were no longer going to be net short in dollars as a result of their prediction that the dollar would strengthen against the euro in the latter half of 2004.

Specifically, the percentage of currency futures to go short (for currency i), $P_{T,i}$, is given by:

$$\begin{aligned} P_{T,i} &= 0.1[10 - (N_{L,i} - N_{S,i})] \quad for N_{L,i} \geq 5 \\ &= 100\% \qquad\qquad\qquad\qquad for\ N_{L,i} \leq 4 \end{aligned} \tag{2}$$

where, $N_{L,i}$ and $N_{S,i}$ are the number of technical rules which indicate long and short currency positions, respectively. The return on a tactical hedge, R_T , is therefore:

$$R_T = R_U(1 - P_T) + R_H(P_T) \tag{3}$$

where $R_U(R_H)$ is the return on the unhedged (currency hedged) bond.

The second active strategy, the currency overlay strategy, is more aggressive than the tactical hedge strategy and has two investment components. First, a foreign bond position that is always fully hedged against currency risk, and second, a currency position that follows the technical trading rule:

$$P = 0.1(N_L - N_S) \tag{4}$$

As was the case with the tactical hedge strategy, if all the rules advocate a long position the portfolio will be 100% hedged. However, if all the trading rules recommend a short position then, the currency overlay will implement a 100% short position in the foreign currency (unlike the tactical hedge that would advocate a 100% hedge.)

Consequently, the currency overlay strategy is more risky than the tactical allocation strategy and leads to more aggressive currency positions. The

return on the currency overlay strategy can be calculated by:

$$R_{CO} = R_H + R_A \tag{5}$$

where, R_A is the return generated by the active trading rule or,

$$RA = \sum_t P_t \times \ln(\frac{F_{t+1}}{F_t}) \tag{6}$$

where P_t (the percentage of future contracts to go long) lies in the range:

$$-1.0 \leq P_t \leq +1.0$$

5.1 Passive Risk Management Strategies

Table 3 reports the outcome for the two passive Bond strategies. Panel A of Table 3 presents the unhedged returns for each individual country bond investment as well as the unhedged equally weighted global bond portfolio. The return from holding a purely domestic dollar bond portfolio is also presented.

The mean return from investing in US Government bonds (the dollar portfolio) is 7.6% per annum, with a standard deviation of 1.41%. The excess return, which is the mean return on the bond portfolio less the return on 90-day treasury bills, is 2.5% giving a Sharpe Ratio of 1.77.

From Panel A it can be seen that all of the international government bond indexes had a higher annual mean return than the domestic dollar bond portfolio. However, the volatilities associated with the returns generated from

holding the foreign bond positions are much higher than the volatility of the domestic dollar portfolio. This is clearly a result of the additional volatility arising from the unhedged currency risk. As a consequence, the measure of risk to return for the individual country bond returns are considerably lower than those of the domestic portfolio.

The benefit of international bond diversification can again be seen in the returns generated from holding an equally weighted unhedged global bond portfolio. The portfolio has an annual return that is 3.31% greater than the domestic portfolio. It is also clear how international diversification has reduced the volatility of foreign bond invesmtents.

When compared with a domestic bond investment, a 'never hedge' risk management strategy in international bonds was inferior under a mean-variance performance criterion.

In Panel B of Table 3, the returns that are generated from the 'Always Hedge' passive strategy, are presented. To calculate the returns for this strategy it is necesarry to roll over currency hedges at the expiry date of the futures contracts. Since the maturity of currency futures contracts (usually every month) is significantly lower than the maturity of long-term bonds, there will be some basis risk at each rollover date. As a result, the currency hedge will not be a perfect hedge.

It can be seen that the mean annualized returns for all of the indexes are greater than the mean returns from holding a domestic dollar portfolio. This is a similar finding to that of unhedged international bond portfolios. Although the volatility of fully hedged international bond portfolio returns is significantly lower than unhedged bond portfolio volatilities, they are still

higher than the levels of volatility for the domestic portfolio. With currency risk significantly reduced, this finding is indicative of the greater risk of investing in foreign bonds over domestic US bonds..

With the 'Always Hedge' strategy, the Sharpe Ratio for the domestic bond portfolio outperforms all of the individual fully hedged foreign bond investments.

Interestingly, the equally weighted fully hedged global bond portfolio outperforms the domestic portfolio as it has a higher annual mean return as well as a higher Sharpe Ratio. The main reason for such a result derives from the benefits of international diversification. Because currency risk has been managed, the diversified international bond portfolio is a more efficient investment than the single US domestic bond portfolio.

5.2 Active Risk Management Strategies

The passive strategies that are presented in the previous section should be taken as extreme cases in the approach to managing international bond investments. A more accurate reflection of current investment practice is the utilisation of strategic or dynamic hedges. Basically, funds hedge their investments when the market is moving against them and expose themselves when the market is moving for them.

Table 4 Panel A shows the results of applying the tactical currency hedge strategy, while Panel B contains the results from implementing the currency overlay strategy. All tables display the mean return, excess mean return, annualized volatility and Sharpe ratio.

The results in Panel A suggest no real improvement from undertaking

the tactical currency hedge for individual foreign country bond investments. Mean returns and volatilities are of a similar scale to that of the passive 'Always Hedge' strategy. Consequently, no strategy dominates the other.

An examination of the equally weighted international bond portfolio shows that the tactical currency hedge provided some benefits over the passive strategies. Although, the volatility of the tactical hedge international bond portfolio is higher than that of the always hedged portfolio, the technical trading rules appear to have improved the returns on the actively managed portfolio enough to offset its increase in risk.

Panel B of Table 4 presents the results from applying an active currency overlay, the most aggressive active currency risk management strategy we analyse. The mean return for the UK, Germany, Japan and Australia are higher than the mean return from holding a fully hedged position in each of these indexes. The volatility associated with each position is also slightly higher, which is a natural consequence of the nature of the approach.

All in all, there is very little to separate the performance of the active currency risk management approaches. Although the currency overlay approach led to improved risk-return ratios for most country bond investments, the inherently risky nature of the strategy is displayed from the very poor performance of Japanese bond portfolios. For Japanese bonds, tactical overlay hedging methods led to a significant decrease in investment performance.

Similar to the tactical currency hedge, the currency overlay strategy led to an improved sharpe ratio for the international bond portfolio. However, this was more likely a combination of international diversification and currency forecasting than a result of the strategy itself.

5.3 Discussion

Table 5 reports a summary of Sharpe Ratios across all strategies. The evidence suggests that there are considerable benefits to be attained from international bond diversification. Although the unhedged strategy has a lower Sharpe Ratio than the domestic portfolio (= 1.77), the unhedged position does offer the highest returns and there are no hedging costs associated with this strategy, unlike all of the other global strategies which are considered.

For the remaining three strategies that are considered, each of their international portfolios outperforms the domestic portfolio.

Figure 1 further presents the efficient frontiers from combining the domestic portfolio with the fully hedged and unhedged global portfolios. The chart shows that both the fully hedged and unhedged global portfolios outperform the domestic portfolio. The process of diversification between the domestic and global portfolios reduces the level of return for only modest gains in risk reduction.

The fully hedged and unhedged international bond portfolios also outperform the dollar bond portfolio in terms of mean return and risk/return trade off. The chart also plots international bond portfolios constructed using the tactical currency and currency overlay risk management strategies.

The currency overlay outperforms the international portfolio and offers a modest increase in return for a small increase in risk. In contrast, for a much larger increase in risk the tactical currency hedge offers a smaller increase in return. However, there are trading costs associated with active risk management techniques and so the net mean return will be smaller and the risk-return trade off will therefore not be as appealing.

6 Conclusions

This paper investigates whether active currency risk management enhances the performance of international bond investments. Using a sample of international bond portfolios over a period spanning January 1^{st} 1986 and June 30^{th} 2004, we find that currency risk management can result in performance increases. However, most of the improvement comes from passive risk management approaches, such as continually rolling over currency hedges.

Our analysis indicates that more complex, active risk management techniques do not improve significantly upon passive approaches to currency risk management. In addition, most of the benefits from international bond investments comes from the diversified properties of portfolios rather than risk management.

Implicitly, our findings suggest that the currency markets may be (weak form) efficient in that no gains can be made from applying rules that try to predict future movements. A caveat to this statement should be made. In this paper, we examined the most common approaches to forecasting currency movements: filter and moving average rules. If more successful methods were found to predict future currency price changes, it may be that the active risk management strategies perform significantly better.

Given our general findings we believe that the case for active currency risk management in the current environment is questionable, especially given the costs associated with these strategies. Our results suggest that investors who wish to diversify should consider international diversification as: (a) offering a return that is greater than the return from a purely domestic bond portfolio; (b) offering a better risk/return payoff than the domestic portfolio;

and (c) offering a return that is attainable and does not require the ability to actively manage currency risk.

Future research in this area would be well advised to examine other active risk management strategies to determine whether they can significantly improve upon the performance of the techniques we use in this study. It would also be of interest to see whether the same results would apply in an emerging market context. Given the potential lack of efficiency in developing world currency markets, active risk management in that environment may result in significant performance gains to international bond investors.

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Table 1 – Profits of Technical Trading Rules in Currency Futures Applying a One-Day Lag

This table reports the annual US dollar percentage return from following each of the mechanical trading rules over the sample period January 1986 - June 2004. The annual returns are the first row of figures listed against each strategy. Directly below each of the annual returns is the number of trades generated by each of the mechanical rules over the sample period. The annual returns are gross returns as the cost of trading has not been included. Returns that are significant at the 95% confidence level are marked with *.

	Currency					
Strategy	**BP**	**DM**	**JY**	**CD**	**AUD**	**CHF**
Filter						
f = 0.5	1.40	1.44	4.91*	1.12	-1.38	1.56
No. Of Trades	1197	1253	1193	1021	1252	1241
f = 1.0	1.24	1.59	4.72	-0.06	-0.42	-0.03
No. Of Trades	816	1093	1119	884	1126	1201
f = 2.0	-0.45	0.80	1.65	-1.65*	0.65	0.20
No. Of Trades	884	941	875	486	857	991
f = 3.0	-0.45	1.52	2.21	-0.72	-1.51	0.72
No. Of Trades	304	673	673	146	620	757
f = 4.0	0.39	0.13	1.00	-0.45	-1.25	0.54
No. Of Trades	328	489	456	46	390	515
f = 5.0	-0.13	-0.24	0.68	-0.26	-0.57	-0.79
No. Of Trades	244	308	310	16	208	344
f = 10.0	0.26	-0.35	2.78	0.00	-0.24	-0.18
No. Of Trades	8	12	30	4	6	22
Moving Average						
L/S = 5/1	1.52	1.58	2.78	1.51	-1.95	-0.27
No. Of Trades	1084	1112	1079	1060	1133	1136
L/S = 20/5	1.92	2.22	5.88*	0.40	2.03	0.70
No. Of Trades	304	298	296	277	284	301
L/S = 200/1	-0.06	4.71	2.69	-0.27	1.70	3.40
No. Of Trades	178	269	143	176	140	142

Table 2 – Profits Using a Buy-and-Hold Trading Rule in Currency Futures Markets

This table shows the US dollar returns for two trading rules in currency markets: Panel A – from buying and holding and Panel B – from a composite trading rule. Results are reported over the sample period January 1986 – June 2004 for an equally weighted currency portfolio as well as the for individual currencies. The volatilities of the currencies and the Sharpe ratios are also presented. All returns are in excess of the risk free rate.

	UK	**DM**	**YEN**	**CD**	**AUD**	**CHF**	**Portfolio**
Panel A: Buy-an-hold Trading Rule							
Mean Excess Return	1.16	2.36	3.30	0.24	-0.10	2.75	1.61
Volatility	0.63	0.69	0.71	0.33	0.65	0.75	0.44
Sharpe Ratio	1.84	3.42	4.65	0.73	-0.15	3.67	3.62
Panel B: Composite Trading Rule							
Mean Excess Return	0.57	1.33	2.58	-0.05	-0.29	0.33	0.75
Volatility	0.33	0.37	0.40	0.14	0.34	0.41	0.21
Sharpe Ratio	1.70	3.60	6.50	-0.35	-0.86	0.80	3.47

Table 3 – Returns from Passive Bond Strategies

This table shows the US dollar returns for two passive bond strategies: Panel A – from being unhedged against currency exposure and Panel B – from being fully hedged against currency exposure. The bond returns are taken from JP Morgan Liquid Bond Indexes. The Excess return is the mean return minus the risk free rate. The international portfolio is an equally weighted portfolio of the non-dollar bonds. Results are reported over the sample period January 1986 – June 2004. The volatilities of the currencies and the Sharpe ratios are also presented.

	UK	**Germany**	**Japan**	**Canada**	**Australia**	**International Portfolio**	**US**
Panel A: Unhedged Bonds							
Mean Return	11.68	10.99	11.60	9.38	10.94	10.91	7.60
Excess Return	6.58	5.89	6.50	4.28	5.84	5.82	2.50
Volatility	6.26	6.60	7.33	3.72	6.34	4.16	1.41
Sharpe Ratio	1.05	0.89	0.89	1.15	0.92	1.40	1.77
Panel B: Fully Hedged Bonds							
Mean Return	10.44	8.73	8.28	9.12	10.76	9.46	7.60
Excess Return	5.34	3.63	3.18	4.02	5.66	4.37	2.50
Volatility	3.57	3.48	3.91	2.49	3.64	2.36	1.41
Sharpe Ratio	1.50	1.04	0.81	1.61	1.55	1.85	1.77

Table 4 – Returns from Active Bond Strategies

This table shows the US dollar returns for two active bond strategies: Panel A – from implementing a tactical currency strategy and Panel B – from implementing a currency overlay strategy. The bond returns are taken from JP Morgan Liquid Bond Indexes. The Excess return is the mean return minus the risk free rate. The international portfolio is an equally weighted portfolio of the non-dollar bonds. Results are reported over the sample period January 1986 – June 2004. The volatilities of the currencies and the Sharpe ratios are also presented.

	UK	**Germany**	**Japan**	**Canada**	**Australia**	**International Portfolio**	**US**
Panel A: Tactical Currency Strategy							
Mean Return	10.34	9.94	9.76	8.74	11.00	9.95	7.60
Excess Return	5.24	4.84	4.66	3.64	5.90	4.86	2.50
Volatility	3.87	3.99	4.44	2.48	3.85	2.50	1.41
Sharpe Ratio	1.35	1.21	1.05	1.47	1.53	1.94	1.77
Panel B: Currency Overlay Strategy							
Mean Return	11.20	10.44	8.55	8.95	11.46	10.12	7.60
Excess Return	6.10	5.34	3.45	3.85	6.36	5.02	2.50
Volatility	4.20	4.32	4.59	2.60	3.85	2.70	1.41
Sharpe Ratio	1.45	1.24	0.75	1.48	1.65	1.86	1.77

Table 5 – Summary Sharpe Ratios for International Portfolios with Alternative Currency Hedging Strategies

This table presents the Sharpe ratios generated by each of the different hedging strategies over the sample period January 1986 – June 2004. The Sharpe ratio for the domestic dollar portfolio over the sample period was 1.77.

Strategy	**UK**	**Germany**	**Japan**	**Canada**	**Australia**	**International Portfolio**
No Hedge	1.05	0.89	0.89	1.15	0.92	1.40
Fully Hedge	1.50	1.04	0.81	1.61	1.55	1.85
Tactical Hedge	1.35	1.21	1.05	1.47	1.53	1.94
Currency Overlay	1.45	1.24	0.75	1.48	1.65	1.86

Figure 1 – International Portfolio Frontiers with Active and Passive Hedges

This figure presents the frontiers from diversification between the passive management strategies for international asset allocation and holding a domestic dollar portfolio. The chart also presents where the active strategies of the tactical currency hedge (TCH) and the currency overlay (CO) are in relation to the two passive strategies.