INFORMATION TO USERS

VOLATILITY SWAPS
AND THEIR USE IN CURRENCY RISK MANAGEMENT

Tamara Gray Close

A Thesis
in
The Faculty
of
Commerce and Administration

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Administration at
Concordia University
Montreal, Quebec, Canada

November 2000

0-612-59278-2

Canada

ABSTRACT

Volatility Swaps and Their Use in Currency Risk Management

Tamara Gray Close

The paradox of international investing is that, although foreign investments deliver diversification benefits that help to decrease the asset risk of a portfolio, they also introduce foreign exchange risk. Classic hedging instruments used to hedge this risk have the drawback of hedging not only the risk but the foreign exchange returns as well. Volatility swaps are financial instruments that allow the user pure exposure to the volatility of an asset. While most of the published works on volatility swaps have focused on their use as a speculative instrument, this thesis will attempt to show how portfolio managers can use foreign exchange volatility swaps to manage the currency risk from international equity investments.

CONTENTS

2.1 Description

2.2 Example of a Volatility Swap

2.3 Risk of a Volatility Swap

2.4 Valuation

2.5 Uses of a Volatility Swap

2.6 Use as a Foreign Currency Risk Management Tool

3.1 Methodology

3.2 Data

3.3 Existence of Foreign Exchange Risk
         (i) Purchasing Power Parity
         (ii) Impact of Foreign Exchange Risk

3.4 Currency Risk Management Strategies
         (i) One Month Strategies
         (ii) Six Month Strategies

TABLES

FIGURES

.

.

INTRODUCTION

There exists a paradox in international investment: including foreign asset investments in an investment portfolio produces diversification benefits that act to reduce asset risk, however it also introduces another type of risk, that of foreign exchange risk.[1] What to do about this additional risk has sparked an on-going debate among both practitioners and academics. Some advocate the full hedging of foreign exchange exposure while others believe that the gains from unhedged foreign exchange positions outweigh any increase in risk. Still others believe in some form of dynamic or tactical hedging. While this thesis does not attempt to settle this debate, it does examine the problem of foreign exchange risk from the portfolio manager's point of view.

Portfolio managers are evaluated not simply on the portfolio returns that they produce but on the risk-adjusted returns. Leaving foreign exchange returns unhedged has the potential for greater returns from favorable currency movements, but it also carries with it, an increase in risk. The main problem with classic hedging instruments[2] is though they can be used to hedge foreign exchange risk, they end up hedging the returns as well. Until very recently these were the only instruments readily available. This thesis examines a relatively new financial instrument, the "volatility swap." It allows one pure exposure to the volatility of an asset. What I attempt to show, is how this instrument can

---

[1] Lundin (97) p. 17

[2] In this paper we will be examining over-the-counter (OTC) forwards and options.

be used to manage the foreign exchange volatility from an international investment. To accomplish this, I first compute the foreign exchange risk produced from an international equity investment. I then compare the risk-adjusted returns from passive currency hedging strategies, to that of a currency management strategy involving volatility swaps.

This thesis is divided into five sections. The first section discusses in more detail the paradox of international investing. The second section is devoted to the understanding and valuing of volatility swaps as a currency risk management tool. The third section covers the empirical research of this thesis. It proves the existence of foreign exchange risk for a US investor when investing in the foreign equity markets of Canada, Germany, the United Kingdom and Japan. This section then compares the risk-adjusted returns of a volatility swap strategy to three foreign exchange hedging strategies. Section four presents and analyzes the results of the study. The final section summarizes the thesis and presents the conclusions. It also offers topics for further study.

SECTION 1

THE PARADOX OF INTERNATIONAL EQUITY INVESTING

Since the early 1970s, market participants have known about the diversification

benefits to an investment portfolio from the addition of international investments.[3] The

main reason cited for these benefits is the low return correlation between local and

foreign markets, which in turn act to reduce the risk of the total portfolio. Yet, while

exposure to a foreign market may help to reduce the asset risk of the portfolio, it also

exposes the portfolio to exchange rate risk.[4] While this additional risk can prove to be

quite substantial, according to DeSantis and Gerard (98) "relatively little attention has

been paid to the role of foreign exchange rate risk,"[5] and in fact, "the premium for bearing

currency risk often represents a significant fraction of the total (foreign market plus

foreign exchange) risk premium."[6] Dumas and Solnik (95) find that the price of currency

risk is also significantly different from zero. According to Lee (89) some investors argue

that "currencies are a small and unsystematic source of long-run return" and that they can

be "ignored over the long term."[7] But as Lee points out, this argument ignores the impact

of currencies on investment risk. He also explains that while "currencies may be a small

---

[3] For a good overview see French and Poterba (91).
[4] Foreign exchange risk exists when the Purchasing Power Parity (PPP) between two countries' currencies is violated.
[5] p. 376
[6] p.375
[7] p. 14-15

and unsystematic source of long run return, however they are definitely a systematic and significant source of investment risk."[8]

Lundin (97) finds that, although the effect that foreign exchange risk has on returns depends on the time period studied, "volatilities of returns increase on average, more that 30% when adjusted for fx risk."[9] Layard-Liesching (97) points out that a foreign currency is "an exposure, not an investment, because no capital is invested to create the currency exposure - it is simply a side-effect of the international investment decision."[10] The author believes that if foreign currency moves were small, or averaged out over time, then active currency management would not be needed. However, he points out that currency movements can indeed be very large.

Zerolis (97) mentions that much confusion surrounds the issue of currencies and their impact on international investments. Schimko (97) states that fund managers have to look at "not only how much return the portfolio will achieve, but also how much risk the portfolio is assuming."[11] Davidson (95) rebuts those that believe foreign exchange risk is not a significant source of portfolio risk. He describes how the foreign exchange market has dramatically changed. The breakdown of fixed exchange rates in the early 1970s has "produced opportunities for enormous profit."[12] Accordingly, the "market has

---

[8] Lee illustrates his point by showing that currency risk is a substantial fraction of the local market risk. For instance, in the Japanese equity market, the currency risk is nearly 80% of local market risk. Over all non-US markets, currency risk is approximately 80-90% of local market risk.
[9] p. 17
[10] p. 50
[11] p. 67
[12] ibid.

perhaps never been more risky."[13] He continues to explain how the increasing average deal size and the high speed of change of foreign exchange prices, has contributed to "conditions of extreme volatility."[14]

As mentioned above, adding low or negatively correlated assets to an investment portfolio produces diversification benefits. These benefits have been recognized for decades.[15] Since foreign assets tend to not be highly correlated with domestic assets, they are often included in investment portfolios. Recently however, a number of researchers have started to question these diversification benefits. The basis for their argument is the existence of a strong "home bias"[16] in investment portfolios.[17]

There have been various explanations put forth for this bias. While barriers to international investment (such as high transaction costs, withholding taxes, information asymmetry, as well as government controls and regulations on cross-border capital flows) used to lend some credibility to the existence of this bias, Tesar and Werner (94) state that these barriers have gradually declined, and yet the bias has remained.[18] Errunza, Hogan and Hung (99) believe that there exists sufficient domestically traded securities which allow investors exposure to foreign assets. They conclude that the "economic

---

[13] ibid.

[14] p. 2

[15] French and Poterba (91) p. 222

[16] This is the tendency for investors to invest only (or a very large percentage) in domestic or 'home' assets only.

[17] French and Poterba (91) show proof of this bias in equity portfolios.

[18] p. 185

gains from international diversification that cannot be obtained with domestically traded securities are, with few exceptions, minimal."[19]

Other researchers believe that this "home bias" is not so significant. Bohn and Tesar (96) report that "while the US portfolio still exhibits home bias, the bias has clearly eroded with time."[20] French and Poterba (91) explain that the home bias is not due to institutional restraints but rather from investor choices. The authors cite investors' tendency to believe that domestic equity market returns will be greater than foreign equity market returns. Some believe that investment in multinational companies allow for exposure to foreign markets. Rowland and Tesar (98) however, refute this argument. They found only "weak evidence" that US multinationals provided global diversification benefits. They also found that adding foreign market indices to a domestic portfolio inclusive of multinationals, provided diversification benefits.

In this thesis, I examine the management of foreign exchange risk associated with international investments undertaken for their diversification benefits. Due to conflicting data on such benefits, I performed my own correlation study. I used monthly data from the US S&P 500 equity index and four foreign equity indexes,[21] from February 1971 to December 1999.[22] I calculated simple correlations between the US equity index returns

---

[19] p. 2091
[20] p. 77
[21] These were the FTSE (United Kingdom), the DAX (Germany), the NIKKEI (Japan), and the TSE 300 (Canada).
[22] Data for the NIKKEI index were only available from February 1973; data for the FTSE index were only available from February 1984.

and each foreign equity index return over the entire period, as well as three sub-periods: January 1971 to December 1979, January 1980 to December 1989, and January 1990 to December 1999. Two methods were used to calculate these correlations. The first method used returns calculated in unhedged US dollars (therefore returns viewed from the perspective of a US investor). The second method used returns measured in the home or local currency of each index. If international equity index returns offer US investors diversification benefits, then the correlations between foreign and US equity index returns should be low or negative.

The results can be found in tables 1 and 2. While the United Kingdom and Canada did exhibit relatively high correlations with the US equity market, Japan and Germany had quite low results. The correlations varied slightly between the 1980s and the 1990s, although correlations in the 1970s tended to be much lower for all markets studied. There were similar results when the returns were measured in local or US dollars, although with the exception of Germany in the 1970s, I found that the correlations were all higher when measured in local currencies. Therefore when taking the unhedged foreign currency return into account, for a US investor, the correlation of the international equity index is lower, thereby offering higher diversification benefits.

Similar to French and Poterba (91), I then calculated the average pairwise correlation between monthly returns on the equity markets in the United States, Japan, the

United Kingdom, Germany and Canada.[23] In accordance with the above authors, the result of 0.50 for the entire period from the perspective of a U.S. investor, "suggests nontrivial risk reduction is available from cross-border holdings."[24]

Table 1: Correlations between US and foreign equity indexes.
(returns measured in US dollars)

	1970-1999	1970-1979	1980-1989	1990-1999
USA	1.00	1.00	1.00	1.00
Canada	0.69	0.58	0.76	0.71
UK	0.62	na	0.61	0.63
Germany	0.39	0.30	0.37	0.51
Japan	0.29	0.23	0.31	0.36
Average corr'n	0.50	0.37	0.51	0.55

Table 2: Correlations between US and foreign equity indexes.
(returns measured in local currencies)

	1970-1999	1970-1999	1980-1989	1990-1999
USA	1.00	1.00	1.00	1.00
Canada	0.70	0.58	0.78	0.72
UK	0.73	na	0.79	0.67
Germany	0.42	0.28	0.43	0.53
Japan	0.35	0.27	0.48	0.38
Average corr'n	0.55	0.38	0.62	0.58

Therefore, diversification benefits do seem to exist for a US investor from international equity investing. Since we have seen the importance of identifying and managing the foreign exchange risk from foreign investments, the next rational step is to decide what to do about it. This is where my thesis comes in. Practitioners and researchers have debated for many years on what is the best way to deal with foreign

---

[23] Note that French and Poterba (91) used quarterly returns, included three-month forward contracts and

exchange exposure. While some say hedging is optimal, others believe that increased returns from an unhedged foreign exchange exposure outweighs the risk minimization and costs incurred from hedging.

Literature covering this debate is plentiful. Those practitioners that do not hedge currency exposure often cite such theories as: "currencies are a zero-sum game"; "we're so big it doesn't matter"; and "investors expect currency exposure." In Miyamoto (99) however, these issues are addressed and the author concludes that foreign exchange hedging does make financial sense. Black (89) believed that all portfolios should be hedged following a universal hedging rule. Glen and Jorion (93) conclude statistically significant improvements in the performance of hedged international portfolios. Rhodes (89) draws the following conclusions about currency hedging over the long term:[25]

(i) Currency hedging can reduce foreign equity risk by 20-25%.

(ii) Currency hedging reduces foreign bond risk by 50-60%.

However, as Solnik (97) points out, the big problem is that the long run is "extremely long for a portfolio manager, even for a pension fund."[26]

---

also used data from France.
[24] French and Poterba (91) p. 223
[25] p. 4
[26] p. 64

Levich and Thomas (93) believe that by being pro-active in the currency management of international investments, one can "improve substantially upon the risk-return profiles of passive currency strategies."[27] Other academics and practitioners believe in partial hedging. While still others are of the view that hedging depends on other factors, such as the type of international assets that are being hedged, or macroeconomic indicators, such as inflation.[28]

In a survey done of closed country funds and international equity funds, only "17% of the funds used any form of currency hedging."[29] Fund managers gave the following reasons for such a low percentage of currency risk hedging in international markets:

(i) International equity funds are well diversified by region and therefore do not require hedging.

(ii) Unhedged portfolios will outperform hedged portfolios in the long run.

When deciding whether hedging is beneficial or not, participants are faced with the fact that most classic hedging instruments hedge not only the risk or volatility of the foreign exchange returns but also the direction of the returns as well. This represents a major drawback of classic hedging instruments. Appendix 1 describes in more detail, the

---

[27] p. 63
[28] see Adler and Prasad (92)

problems inherent in the use of available currency hedging instruments. However, if one decided to leave the foreign exchange risk unhedged, one must then assume what could amount to be a great deal of risk. In this thesis, I examine a relatively new financial instrument, the volatility swap, and determine it's use as a tool in currency risk management. Volatility swaps are further discussed in Section 2.

---

[29] Chen (99)

SECTION 2

VOLATILITY SWAPS

(2.1)   Description

Volatility swaps are relatively new financial instruments. They can be viewed as "forward contracts on future realized volatility,"[30] since they allow investors to "gain exposure to the future level of volatility."[31] Unlike classic hedging instruments, whose volatility exposure is "contaminated" by it's price dependence, a volatility swap can "provide pure exposure to volatility alone."[32] Appendix 2 provides a discussion on the importance of volatility as an asset.

The most comprehensive work I found on volatility swaps is Demeterfi, Derman, Kamal and Zou (99). Hill (97) also offers a descriptive work. In a volatility swap "a dealer pays the investor a return based on the extent to which actual market volatility is below a 'strike level' for the swap." The strike level is "typically close to the implied volatility in options with the same term as the swap."[33]

Therefore if one believed the volatility of an asset was going to increase over a certain time period, they would buy a volatility swap. If the volatility did increase over that time

---

[30] Demeterfi, Derman, Kamal and Zou (99) p. 1
[31] Ibid.
[32] Ibid.

period, then the buyer would receive a cash payment. An important point must be made here. A volatility swap is indeed a swap and not an option. While buying an option is similar to purchasing insurance on the returns of an asset, a long volatility swap position has a different payoff. If the buyer's expectations turned out to be wrong, and the realized volatility decreased over the time period of the volatility swap, then the buyer would have to make a cash payment to the seller.

The payout on a volatility swap is calculated by the following equation:

$$P_{vswap} = N\left(\sigma_R - K_{vol}\right) \tag{1}$$

where N = notional amount (expressed in dollars per annualized volatility point)

σ_R = the annualized realized volatility, over the life of the swap contract

K_{vol} = the annualized implied volatility, or strike price of the swap

The "holder of a volatility swap at expiration receives N dollars for every point by which the (asset's) realized volatility σ_R has exceeded K_{vol} ."[34] One counterparty is in fact swapping a fixed volatility level for a floating volatility level, with the other counterparty. The fixed volatility level represents the implied volatility rate at the

---

[33] Hill (97) p. 23
[34] Demeterfi et al (99) p. 1

beginning of the swap. The floating volatility level represents the actual or realized historical volatility over the life of the contract. Demeterfi et al (99) mention that "as with all contracts or swaps, the fair value of volatility at any time is the delivery price that makes the swap currently have zero value."[35] Therefore if the strike price for the swap is the implied volatility level of an option over the same period as the swap (or very close to it), there is no premium to be paid at the start date of the swap. If however, the strike price used was not the 'fair value of volatility' then the counterparties would have to exchange a premium at the beginning of the swap. This would constitute an 'off-market' swap.

There can be variations on the method to calculate the realized volatility (σ_R). Whatever method is used, it must first be agreed upon by each of the swap counterparties. Other variables which need to be agreed upon include the source and observation frequency of prices used for the underlying asset, as well as the annualization factor. For the annualization factor, both the multiplicative factor and the method for calculating the standard deviation of returns must be agreed upon. The standard deviation of returns can be calculated by either "subtracting the sample mean from each return, or by assuming a zero mean."[36] According to Demeterfi et al (99), the zero mean method is theoretically preferable. This is because it "corresponds most closely to the contract that can be

replicated by options portfolios. For frequently observed prices, the difference is usually negligible."[37] Two methods are shown below.

The first method, which assumes a zero mean, is from Chris and Morokoff (99).

$$\sigma_R = \sqrt{\frac{250}{T - t_0} \sum_{i=1}^{M} \left(\frac{F_i - F_{i-1}}{F_{i-1}} \right)^2}$$

(2)

where M = the number of observations

F_i = the closing price of the asset on the ith day

the swap is traded at time t_0 and matures at time T

The second method, shown below, subtracts the sample mean from each return, and uses the natural log to calculate returns. I have used 250 days as the multiplicative factor for annualizing the variances in both formulas. As will be seen in the following example, the two methods reach similar conclusions.

$$\sigma_R = \sqrt{\frac{250}{M - 1} \sum_{i=1}^{M} (x_i - \bar{x}_i)^2}$$

(3)

$$\text{where: } x_i = \ln\left(\frac{F_i}{F_{i-1}} \right)^2$$

$$\bar{x} = \frac{1}{M - 1} \sum_{i=1}^{M} x_i$$

---

[37] Ibid.

(2.2)   Example of a Volatility Swap

The best way to visualize a volatility swap is through a concrete numerical example. The following example is for a ten day volatility swap on the Canadian dollar (CAD) exchange rate[38]. We assume that the ten day annualized implied volatility for an at-the-money(ATM) CAD/USD option is 6.0%. If one believed that this volatility would increase over the next ten days, then they could try to profit from this belief by 'buying' a volatility swap.[39] The following variables must be agreed upon before entering into the swap.

(i)   currency pair: in this example, I am using the CAD/USD exchange rate

(ii) frequency of observations: in this case, I am looking at daily closing prices

(iii) counterparties: buyer and seller

(iv) start date/transaction date: the first day of the life of the swap

(v)   expiry date: in this case, ten days after the transaction date

(vi) notional amount: here $100,000 USD per volatility point

---

[38] Expressed in European terms (i.e. number of Canadian dollars per one US dollar).
[39] Similarly, if one believed that the volatility would decrease over the next ten days, then they would want to sell a volatility swap.

(vii) reference volatility rate (strike rate): here, 6% annualized[40]

Once the above terms of the swap are agreed upon by both counterparties, the payout then depends on how the CAD/USD currency prices move over the next ten days. Assume the following closing daily price data for the exchange rate[41]:

Day 1 1.3000
Day 2 1.3010
Day 3 1.3011
Day 4 1.3100
Day 5 1.3105
Day 6 1.3200
Day 7 1.3050
Day 8 1.3000
Day 9 1.2950
Day 10 1.2965

The zero means method of calculating the realized historical volatility, produces a result of 8.49%. Subtracting the sample mean from the returns, one obtains a realized historical volatility of 8.50%. The payout on the volatility swap is thus equal to:

$$P_{vswap} = 100,000 \text{ (\$ per volatility point)} \times (8.49\% - 6.0\%)$$

or $249,000 to the buyer[42]

---

[40] As already noted, the strike volatility is close to the implied option volatility for the period of the swap. In practice, the reference volatility rate differs just slightly from the implied rate. For simplicity's sake, I will not include any premium on the implied strike rates. The premium is however, usually negligible. To give one an idea of the size of this premium, Societe Generale SA, which is a market maker in volatility swaps charges approximately 0.2%, depending on the size and terms of the swap. It must be noted that there is no upfront premium for a volatility swap, hence the 0.2% constitutes in effect a transaction charge.

[41] We will be using two methods to calculate σ_R for the purpose of comparison. However, in a standard swap contract, only one method is used.

[42] Or $250,000 to the buyer, using the second method.

Assuming a different set of closing daily price data for the CAD/USD exchange rate:

Day 1 1.3000
Day 2 1.3010
Day 3 1.3011
Day 4 1.3050
Day 5 1.3105
Day 6 1.3200
Day 7 1.3100
Day 8 1.3025
Day 9 1.3000
Day 10 1.2965

The zero means method calculates a realized historical volatility of 5.20%.

When I subtract the sample mean from the returns, I obtain a realized historical volatility

of 5.18%. The payout on the volatility swap in this instance, is equal to:

P_{vswap} = 100,000 ($ per volatility point) X (5.20% - 6.0%)

or $80,000 payment to the seller

As you can see from the above example, the payout on the volatility swap depends

on how the currency prices move over the life of the swap. The first set of prices had a

realized historical volatility that was less than the implied CAD/USD ten day. Hence the

buyer received a cash payment. The second set of prices however, had a realized

historical volatility that was lower than the implied volatility. In this instance the buyer

had to make a cash payment to the seller.

(2.3)   Risk of a Volatility Swap

For an end-user of a financial instrument, there naturally arises certain risks. Some of these risks are common to all financial instruments, such as counterparty risk, while others are specific to each contract. This section describes some of the risks to end users of volatility swaps.[43] For an end user, the greatest source of risk comes from the mark-to-market risk of their volatility swap position.

It is mentioned in the following section, that it is possible to replicate a variance swap, and thus a new variance swap can be used to hedge one that is partially matured. This is because the mark-to-market value of a variance swap is equal to the "time weighted average of the realized payout on the variance swap and the change in the fair value of variance, i.e. the variance strike."[44] However, this thesis deals with volatility swaps and unfortunately it is not possible to hedge a volatility swap, with an offsetting volatility swap. This is due to the fact that the new swap will not hedge the change in the fair value of volatility. Although, as pointed out in Chris and Morokoff (99), one can "bound the mark-to-market value of a volatility swap."[45]

There are four main sources of mark-to-market risk. These are covered below.

---

[43] Hedging risks arise when the replicating portfolio captures variance differently from the true realized variance. For a good discussion on risks for hedgers of volatility swaps, see Demeterfi et al (99) in *Risk* p. 56.

[44] Chris and Morokoff (99) p. 1

[45] They show on page 4, that "bounds can be obtained from an arbitrary argument involving an optimal hedge in a new volatility or variance swap."

1. *Strike Risk:* This type of risk arises from movements in the fair value of volatility. Such movements are determined by those movements in the implied volatilities of the underlying asset. Hence, this risk can also be termed the vega risk of the volatility swap. This is because it represents the change in the value of the volatility swap for a change in the value of the implied volatility.

2. *Delta Risk:* This type of risk arises from continuous underlying price movements.

3. *Jump Risk:* This type of risk arises from the fact that the underlying asset's price can 'jump'. Pricing and hedging models discussed in this thesis assume the continuous movement of the underlying asset's price. A jump in this price can cause errors in the pricing of a volatility swap. Jumps will also tend to cause dealers to revise (usually upwards) their views of the implied volatility of an asset.

4. *Liquidity Risk:* The theoretical value of a swap depends on the implied volatilities of options of all strikes. However, since in practice, only a certain range of option prices are available, this causes volatility swap prices to differ.

(2.4) Valuation

The proper use of any financial security requires a thorough understanding of how such a security is priced. Determining the value of a volatility swap requires the determination of the cost of the fair value of variance[46]. A replication strategy is one which replicates the payout of a contract, over the life of the contract. From Demeterfi et al. (99), we obtain the equation for continuously sampled variance, from time 0 to T,[47] presented below. The only assumption that must be made here is that the underlying currency moves continuously[48].

$$V \equiv \frac{1}{T}\int_0^T \sigma^2 dt = \frac{2}{T}\left[\int_0^T \frac{dF_T}{F_t} - \log\frac{F_T}{F_0}\right] \tag{4}$$

where: T = time to maturity
F_0 = foreign currency spot rate at time t=0
F_T = foreign currency spot rate at time t=T
F_t = foreign currency spot rate at time t

This mathematical identity "dictates the replication strategy for variance."[49]

---

[46] Demeterfi et al. (99) p. 11 point out that although market participants are more interested in volatility, it is variance (volatility squared) that has "more fundamental significance." The correct way to value a swap is to value the portfolio that replicates it. The swap that can be replicated the most reliably is a variance swap. In this section I will replicate a variance swap and show how it relates to the implied volatility. On p. 31 of Demeterfi et al, the authors demonstrate that it is possible to "pick the strike and notional size of a variance contract to match the payoff of a volatility contract".

[47] In this replication strategy, I will be replicating a volatility swap that offers a one US dollar exposure to each volatility point squared, of the underlying foreign currency.

[48] Demeterfi et al p. 19

[49] Ibid.

The first term $\left(\int_{0}^{T}\frac{dF_T}{F_t}\right)$ represents the outcome of a continuously rebalanced currency position that is always long $1/F_t$ of foreign currency, worth \$1. The second term $\left(-\log\frac{F_T}{F_0}\right)$ represents a short position in a contract that "at expiration, pays the logarithm of the total return."[50] Such a log contract was first discussed in Neuberger (94).

To obtain the cost of this replication strategy, one needs only to take the expected risk-neutral value of the right-hand side of equation (4). This results in the following equation:

$$K_{VAR} = \frac{2}{T}E\left[\int_{0}^{T}\frac{dF_T}{F_t} - \log\frac{F_T}{F_0}\right] \tag{5}$$

The expected value of the first term in equation (5) is the cost of rebalancing the position in the underlying currency. Since the position is constantly rebalanced to be worth \$1, in a risk-neutral world with a risk-free rate of interest r, the financing cost of this rebalancing, grows at the risk-free rate.

Therefore, $\quad E\left[\int_{0}^{T}\frac{dF_T}{F_t}\right] = rT \tag{6}$

---

[50] Ibid. p. 17

The second term, as we have seen is supposed to have a payoff equal to the logarithm of the total return. However, there are no actively traded log contracts. Therefore we need to duplicate the log payoff. This can be done using forward contracts and standard options. The shape of the log payoff is split into the linear and curved components. The linear component is duplicated with a forward contract on the underlying currency. The curved component is duplicated using a combination of European-style calls and puts on the foreign currency. The strikes (K) range from at-the-money to deep out-of-the-money. The second term can be re-written as:

$$\log \frac{F_T}{F_0} = \log \frac{F_T}{F^*} + \log \frac{F^*}{F_0} \tag{7}$$

where F* = some reference price marking the boundary between calls and puts

Since the term $\left(\log \frac{F^*}{F_0} \right)$, is constant and independent of the final currency price, it does not have to be replicated.[51] The log payoff can then be decomposed as follows:

$$-\log \frac{F_T}{F^*} = -\frac{F_T - F^*}{F^*} + \int_0^{F^*} \frac{1}{K^2} Max(K - F_T, 0) dK + \int_{F^*}^{\infty} \frac{1}{K^2} Max(F_T - K, 0) dK \tag{8}$$

---

[51] Demeterfi et al (99) p. 18

Equation (8) represents the decomposition of the log payoff into a portfolio consisting of:[52]

- A short position in (1/F*) forward contracts struck at F*.

- A long position in (1/K^2) US dollar put options (or foreign currency calls) struck at K, for a continuum of strikes from 0 to F*.

- A long position in (1/K^2) US dollar call options (or foreign currency puts) struck at K, for a continuum of strikes from F* to ∞.

All contracts expire at time T.

The fair value of future variance can then be calculated as the following:

$$K_{VAR} = \frac{2}{T}\left[rT - \left(\frac{F_0}{F*}e^{rT} - 1\right) - \log\frac{F*}{F_0} + e^{rT}\int_0^{F*}\frac{1}{K^2}P(K)dK + e^{rT}\int_{F*}^{\infty}\frac{1}{K^2}C(K)dK \right] \quad (9)$$

Here P(K) and C(K) represent the prices for the put and call options. This equation can be used even when there is a volatility skew since the prices of the options used would take this skew into account.

In equation (9) I have included all option strikes from 0 to ∞. Realistically this is not possible. Since there are only a limited number of strikes available in the market, the following approximation has been suggested by Demeterfi et al (99):[53]

$$K_{VAR} \equiv \frac{2}{T}E\left[\int_0^T\frac{dF_t}{F_t} - \frac{F_T - F*}{F*} - \log\frac{F*}{F_0} + \frac{F_T - F*}{F*} - \log\frac{F_T}{F*} \right] \quad (10)$$

---

[52] ibid.
[53] p. 19

Taking expectations,

$$K_{VAR} = \frac{2}{T}\left[rT - \left(\frac{F_0}{F*}e^{rT} - 1\right) - \log\frac{F*}{F_0} \right] + e^{rT}\Pi_{CP} \tag{11}$$

where Π_{CP} is the present value of the portfolio of options with payoff at expiration given by:

$$f(F_T) = \frac{2}{T}\left(\frac{F_T - F*}{F*} - \log\frac{F_T}{F*} \right) \tag{12}$$

where F* = some reference price marking the boundary between calls and puts

To determine the log payoff replication, one must first determine the number of options for each strike. It is assumed that one can trade US dollar call options (foreign currency puts) with strikes $K_0 = F* < K_{1c} < K_{2c} < K_{3c} < K_{4c} <...$ and US dollar put options (foreign currency calls) with strikes $K_0 = F* > K_{1p} > K_{2p} > K_{3p} > K_{4p} >....$ We can approximate $f(F_T)$ with a piecewise linear function. See Figure 1. The first segment to the right of F* is equivalent to the payoff of a call option with strike K_0. The number of options is determined by the slope of this segment. [54]

$$w_c(K_0) = \frac{f(K_{1c}) - f(K_0)}{K_{1c} - K_0}$$

The next segment is a combination of calls with strikes K_0 and K_{1c}. The number of options with strike K_{1c} is given by the following equation:

$$w_c(K_1) = \frac{f(K_{2c}) - f(K_{1c})}{K_{2c} - K_{1c}} - w_c(K_0)$$

---

[54] Ibid. p. 28

Figure 1: Log Payoff and Options Portfolio at Maturity

Log Payoff and Options Portfolio at Maturity
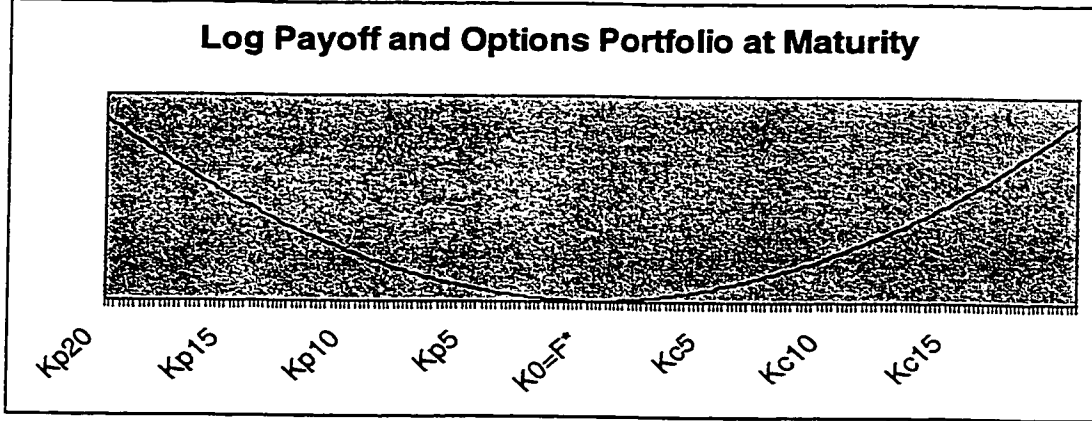
The right hand side of the curve is gradually built this way. The number of call options is equivalent to:

$$w_c(K_{n,c}) = \frac{f(K_{n+1,c}) - f(K_{n,c})}{K_{n+1,c} - K_{n,c}} - \sum_{i=0}^{n-1} w_c(K_{i,c}) \tag{13}$$

The other side of the curve is built with put options. The number of put options is equivalent to:

$$w_p(K_{n,p}) = \frac{f(K_{n+1,p}) - f(K_{n,p})}{K_{n,p} - K_{n+1,p}} - \sum_{i=0}^{n-1} w_p(K_{i,p}) \tag{14}$$

Once these weights are calculated, we can obtain Π_{CP} from the following equation:

$$\Pi_{CP} = \sum_i w(K_{ip}) P(F, K_{ip}) + \sum_i w(K_{ic}) C(F, K_{ic}) \tag{15}$$

This procedure can be illustrated using a concrete numerical example.

Example:

Assume that the spot rate on the Canadian dollar at time t_0 is 1.4955. If the three month forward premium is -35 points, then the three month at-the-money forward rate is 1.4920. Assume the risk-free rate of interest is 6.70% and you wish to replicate the value of a three month variance swap. Suppose you can buy European-style Canadian dollar options with strikes ranging from 1.4820 to 1.5020, spaced every 5 points. The at-the-money implied volatility for the Canadian Dollar is 5.6%. Since the range of the option prices are relatively close to the three month at-the-money forward rate[55], the implied volatility used to calculate each option price is assumed to be the same (therefore no volatility skew). However, this method could just as easily be used if a volatility skew did exist because the options prices would include this skew. Table 3 shows a list of the option strikes, their weights, as calculated from equation (13) and (14), and their prices.[56] The total cost of these options represents the solution to Π_{CP}. The cost of capturing variance can now be calculated using equation (11). Therefore K_{VAR} = 30.80 which is equivalent to $(5.55)^2$. This is very similar to our three month implied volatility rate of 5.6%.

---

[55] The furthest out-of-the-money option strikes represent only a 40 delta option.
[56] Option prices are quoted as percent of 1 US dollar.

Table 3: Portfolio of Options to Capture Realized Variance

	Strike	Weight	Value per Option	Contribution to Cost
Puts	1.4825	0.038690	0.830	0.0003211
	1.4830	0.033256	0.850	0.0002820
	1.4835	0.031438	0.860	0.0002700
	1.4840	0.029622	0.875	0.0002590
	1.4845	0.025098	0.890	0.0002230
	1.4850	0.026173	0.905	0.0002360
	1.4855	0.026706	0.920	0.0002460
	1.4860	0.022367	0.930	0.0002080
	1.4865	0.020556	0.950	0.0001950
	1.4870	0.016945	0.960	0.0001630
	1.4875	0.017119	0.980	0.0001680
	1.4880	0.016753	0.993	0.0001660
	1.4885	0.013325	1.010	0.0001350
	1.4890	0.011521	1.025	0.0001180
	1.4895	0.008818	1.040	0.0000917
	1.4900	0.008096	1.060	0.0000858
	1.4905	0.006834	1.075	0.0000735
	1.4910	0.004314	1.090	0.0000470
	1.4915	0.002336	1.105	0.0000258
	1.4920	0.000898	1.120	0.0000101
Calls	1.4920	0.001490	1.120	0.0000167
	1.4925	0.012850	1.110	0.0001420
	1.4930	0.020900	1.090	0.0002280
	1.4935	0.022900	1.075	0.0002460
	1.4940	0.024420	1.060	0.0002590
	1.4945	0.023516	1.040	0.0002450
	1.4950	0.027821	1.030	0.0002860
	1.4955	0.032661	1.010	0.0003290
	1.4960	0.031578	1.000	0.0003160
	1.4965	0.033365	0.980	0.0003270
	1.4970	0.035152	0.970	0.0003400
	1.4975	0.036930	0.950	0.0003510
	1.4985	0.040503	0.920	0.0003720
	1.4990	0.042284	0.910	0.0003840
	1.4995	0.044065	0.895	0.0003940
	1.5000	0.045840	0.880	0.0004030
	1.5005	0.047621	0.870	0.0004140
	1.5010	0.049390	0.854	0.0004220
	1.5015	0.051174	0.840	0.0004290
			Total Cost:	**0.0095990**

(2.5) Uses of Volatility Swaps

Most of the published works have focused on speculative uses for volatility swaps. Volatility exhibits certain tendencies which makes it an attractive asset to trade.[57] These include the fact that:

1. When uncertainty increases, so does volatility.

2. Volatilities appear to be mean reverting.

3. Volatility is often negatively correlated with standard deviation or index level and tends to stay high after large downward moves in the market.

Volatility swaps can be used to "speculate on future volatility levels, and to trade the spread between realized and implied volatility."[58] In particular they are a valuable tool for traders who might have "insight into the level of future volatility."[59] Volatility swaps can also be used for different types of hedging. Though the authors focus on equity volatility swaps, Demeterfi et al (99) give a good overview and some examples of hedging volatility exposure for businesses implicitly short volatility. This thesis examines another possible use for volatility swaps: that of managing the foreign exchange risk arising from international equity investments. This is outlined in Section 2.6.

---

[57] Ibid.
[58] Demeterfi et al (99) p. 2
[59] Ibid p. 10

(2.6)   Use as a Foreign Currency Risk Management Tool

Portfolio managers are evaluated on their risk-adjusted returns. Since international investments produce foreign exchange risk and classic hedging instruments hedge not only the risk, but also the returns of an asset, this thesis examines whether portfolio managers could use volatility swaps in their currency risk management decisions. I attempt to determine if an unhedged position in the foreign currency, coupled with a volatility swap on the foreign currency, can result in higher risk-adjusted returns than a fully hedged foreign currency position.

Classic foreign currency hedging instruments hedge the risk, effectively bringing it to zero. The foreign currency returns are known at the time the hedge is put on (in the case of forwards) or limited (in the case of options). For an unhedged currency position, the returns are not known or limited, but the risk is also not known. For an unhedged position with a long volatility swap, the returns are not known, however the volatility of the underlying currency is known. This is because the volatility swap effectively locks-in the volatility of the exchange rate.

This can be illustrated by the example in Section 2.2. The buyer of a volatility swap expects the realized volatility over the life of the swap to be greater than the implied, or strike volatility, at the start of the contract. If it does, the buyer receives a payment. If realized volatility decreases over the life of the swap, the buyer must make a

payment. Therefore the buyer has effectively locked-in the volatility of the exchange rate. What this thesis attempts to do is determine whether volatility swaps can be useful in the management of this foreign exchange volatility risk. The following example outlines my thinking.

Example:

A US investor invests in the TSE 300 equity index for six months. This investor then has foreign exchange risk based on the CAD/USD exchange rate. For the US investor, the risk is that the US dollar increases in value relative to the Canadian dollar by the end of six months (i.e. the Canadian dollar depreciates). Possible strategies to manage this foreign exchange exposure are:

(i) *Do not hedge*: The investor assumes the foreign exchange risk and hopes that the returns outweigh the risk.

(ii) *Fully hedge*: The investor uses classic hedging instruments to hedge the risk and direction of the foreign currency exposure.

(iii) *Hedge only the volatility*: Buying volatility swaps on the foreign currency will lock-in the volatility of the currency. The direction of the returns remains unhedged.

If choosing the third possibility and entering into a volatility swap, the investor would receive a cash payment when the CAD/USD exchange rate was very volatile over the course of the investment. Therefore the overall return on the equity investment strategy would increase. However the risk of the equity investment would also be higher because the foreign exchange risk would be higher. If the CAD/USD exchange rate's volatility decreased over the course of the investment period, the risk of the investment would be lower, however the payment which must be made to the seller of the volatility swap decreases the overall return on the equity investment strategy.

This thesis compares a strategy that leaves the foreign exchange returns unhedged and buys volatility swaps, to fully-hedged strategies that use classic hedging instruments. These strategies are compared on a risk-adjusted return basis.

SECTION 3

EMPIRICAL RESEARCH

This section provides a description of the data I use as well as a detailed explanation of the research methodology followed throughout. The results and analysis of all the empirical research is contained in Section 4. Section 5 contains the summary and conclusions.

(3.1)   Methodology

Theory tells us that foreign exchange risk is an important parameter to consider when investing in foreign assets. I study a time period from October 1994, to March 2000. I first prove the existence of foreign exchange risk over this time period, for a US investor investing in the foreign markets of Canada, Germany, the United Kingdom and Japan. I then determine whether a foreign currency volatility swap can successfully manage this foreign exchange risk so as to increase the investor's risk-adjusted returns, as compared to classic foreign exchange hedging instruments. Throughout the empirical study I take the view point of a US investor.

My empirical approach will consist of the following steps. First, to ensure that foreign exchange risk does exist for a US investor, investing in Canada, Germany, the

United Kingdom and Japan. I perform some simple linear regressions to test the relative

PPP conditions between the US dollar and the currencies of the above four countries.[60]

Next, to determine a volatility swap's ability to manage foreign currency risk from

an equity investment in the previously mentioned four countries, I construct a strategy

consisting of unhedged foreign currency returns coupled with a long position in a

volatility swap on the underlying currency. This strategy is compared to three passive

foreign exchange hedging strategies that employ over-the-counter (OTC) foreign

exchange forward contracts as well as currency options. The investment period is from

October 1994, to March 2000. Therefore sixty-six monthly returns are calculated for

each strategy, per currency. Sharpe ratios are then calculated for the entire period, as well

as for seven annual sub-periods.

(3.2) Data

Data from the United States, the United Kingdom, Germany, Japan and Canada,

were studied. The countries were selected in accordance with DeSantis and Gerard (98),

due to their large market capitalization. Monthly price data were obtained from

Bloomberg Financial Data for each country's equity index: the US S&P 500, the British

FTSE, the German DAX , the Japanese NIKKEI, and the Canadian TSE 300. Price data

included all dividends reinvested.

---

[60] These are the Canadian dollar, the German deutschemark, the British pound and the Japanese yen.

Foreign currency exchange rate data for each of the countries studied was also obtained from Bloomberg Financial Data. The German deutschemark, the Japanese yen and the Canadian dollar were all quoted per unit of one US dollar (i.e. European terms).[61] The British pound exchange rate however, was quoted as the number of US dollars per one British pound (i.e. North American terms).[62] Monthly and daily data from February 1971, to April 2000, were used to calculate both monthly and daily foreign currency returns.

The PPP study used the change in the Consumer Price Index[63] in each country as a proxy for the inflation rate used to test relative PPP conditions between the United States and each of the four other countries studied. Again data was obtained from Bloomberg Financial Data. The time period covered for the PPP study was October 1994, to March 2000. This time period was used since it is the same period over which the currency risk management strategies are compared.

Monthly implied volatility data were required to calculate all the option prices as well as the volatility swap prices used in the currency risk management strategies. These data were obtained from the Federal Reserve Bank of New York. Since these data were only available on a monthly basis, for the time period of October 1994, to March 2000, this is the time period over which the currency risk management strategies were compared. Risk-free interest rates were also needed to calculate the option prices as well

---

[61] DEM/USD, JPY/USD, and CAD/USD
[62] USD/GBP

as the risk-adjusted returns, as measured by Sharpe ratios. Eurocurrency deposit rates offered in the interbank market in London (LIBOR) for one month deposits in US dollars and British pounds were used as a proxy for the risk-free interest rates. They were obtained once again from Bloomberg Financial Data. The model used to calculate all option prices was the binomial option pricing model.[64]

All of the monthly price data gathered used the closing mid-market price on the last business day of that month, except for the volatility data where both bid and ask data were collected. Daily price data for all of the above financial instruments also used closing mid-market data for the close of that day. Only open business days, adjusted for US holidays, were used. It was assumed that there were 250 business days per year.

---

[63] Except for the United Kingdom which uses the RPI, or Retail Price Index.
[64] An in-house option pricing system from Societe Generale SA, called CONCERTO, which uses the binomial model was used to calculate the option prices.

(3.3) Existence of Foreign Exchange Risk

(i) Purchasing Power Study

A violation of Purchasing Power Parity (PPP) between two countries means that investing in one of the countries' markets entails exposure to exchange rate risk for a local investor in the other country's market.[65] To determine if foreign exchange risk exists from international investments for a US investor, we test the relative PPP conditions between the United States and four other countries.[66]

PPP implies that "a domestic country's exchange rate should decline if its rate of inflation increases at a faster rate than the rate of inflation in the foreign country, or if it's rate of inflation decreases at a slower rate."[67]

$$\text{Final Exchange Rate} = \text{Initial Exchange Rate} \ \frac{1 + \Pi_d t}{1 + \Pi_f t}$$

where: $\Pi_d t$ = initial domestic inflation rate

$\Pi_f t$ = initial foreign inflation rate

To test if PPP is violated over the period from October 1994, to March 2000, I ran some simple linear regressions. The test was done from the point of view of a US

---

[65] For a good discussion on the theory and evidence, see Salehizadeh and Taylor (99).
[66] Canada, Germany, the United Kingdom and Japan
[67] Clarke and Kritzman (95) p. 117

investor. Inflation rate data used were the return on the Consumer Price Index for each of the countries. The regression equation used was the following:

$$\ln \text{(final exchange rate)} - \ln \text{(initial exchange rate)} = \alpha + \beta[\ln(1+\Pi_{dt}) - \ln(1+\Pi_{ft})](16)$$

The following table reveals the regression results.

Table 4: Test of Purchasing Power Parity for October 1994, to March 2000.

Currency	Alpha	Beta	t-statistic	Adjusted R²
Canadian dollar	0.0010	0.2667	0.3202	-0.0141
Deutschemark	0.0050	-1.1348	-0.7974	0.0056
British pound	-0.0007	0.4562	0.6718	-0.0085
Japanese yen	0.0026	-0.3109	-0.2588	-0.0146

The R^2 results in table 4 are all quite low. The slope coefficient statistics show that there is no reasonable degree of confidence one should have to conclude that the relationship between the difference in the final and the initial exchange rates and the inflation rate differentials, are different from zero. Therefore the results in table 4 reveal essentially no relationship between the change in a country's relative inflation rate and the exchange rate of that country's currency. This implies that the purchasing power parity condition did appear to be violated over the time period of October 1994, to March 2000. Foreign exchange risk then does exist for a US investor when investing in either Canada, Germany, the United Kingdom, or Japan.

(ii) Impact of Foreign Exchange Risk

We have seen from the correlation study in Section 1, that diversification benefits do exist for a US investor in foreign equity markets. However while these benefits may act to reduce asset risk in a US investor's investment portfolio, international investment also introduces foreign exchange risk. The above PPP study confirms the existence of such risks. An example of the effect of foreign exchange risk can be seen in Table 5. It compares the return and volatility of the S&P 500 equity index when measured in five different currencies. Section (a) covers monthly returns between February 1971 and April 2000. Section (b) covers those returns between October 1994, to March 2000.

Table 5: Foreign Exchange Adjusted Returns and Volatilities
(a)　　For the time period, February 1971, to April 2000.

	Average Monthly Return (%)	Annualized Monthly Return (%)	Volatility (%)	Added volatility	Annualized Sharpe Ratio	Change in Sharpe Ratio
S&P$_{500}$	1.81	24.02	15.48	0.00	1.51	0.00
Fx-adjust:						
Cad/Usd	1.77	23.43	15.81	0.33	1.44	-4.73
Dem/Usd	1.28	16.49	19.13	3.65	0.81	-46.12
Gbp/Usd	1.79	23.73	22.50	7.02	0.98	-37.98
Jpy/Usd	1.57	20.56	27.02	11.54	0.70	-53.42

*The average added volatility from foreign exchange adjusted returns was 5.64%.
*The average decrease in Sharpe ratios for foreign exchange returns was 39%.

---

[68] Volatility of returns was calculated using the same method found in Chris and Morokoff (99). This is an annualized rate and calculated as follows:

$$\text{annualized volatility} = \sqrt{\frac{12}{N-1}\sum_{i=1}^{N}\left(\frac{R_i - R_{i-1}}{R_{i-1}}\right)^2}$$

where　R_i = return observation for month$_i$
　　　　N = number of monthly return observations

[69] Sharpe ratios are equal to the average monthly return divided by the standard deviation of these returns, and then annualized. This is the method used by Lundin (97) p. 26.

(b)   For the time period, October 1994, to March 2000.

S&P$_{500}$	0.87	10.95	15.52	0.00	0.69	0.00
Fx-adjust:						
Cad/Usd	0.98	12.41	15.16	-0.36	0.79	14.49
Dem/Usd	0.89	11.22	19.06	3.54	0.56	-18.84
Gbp/Usd	1.13	14.44	25.55	10.03	0.54	-21.74
Jpy/Usd	0.96	12.15	32.48	16.96	0.35	-49.28

*The average added volatility from foreign exchange adjusted returns was 7.54%.
*The average decrease in Sharpe ratios for foreign exchange returns was 19%.

To illustrate the impact of foreign exchange risk we will look at an example. For instance, in part (a) of table 5, the S&P 500 average monthly returns in Deutschemarks was 1.28% rather than 1.81% in US dollar terms. This is equivalent to a 53 basis point difference on a monthly basis. Note that while all the foreign exchange adjusted returns are below the returns of the S&P 500 index in US dollar terms in part (a), they are all above in part (b). This reflects the fact that returns are dependent upon the time period measured.

Over the first time period, when we examine the volatilities of returns, we find that they increase on average by approximately 30% when adjusted for foreign exchange risk. When we examine the October 1994, to March 2000 time period, we see an average increase of nearly 50% in the volatility of returns, except for the Canadian dollar which

showed a decrease of 0.02%. All risk-adjusted returns, as measured by the Sharpe ratio, decreased when adjusted for foreign exchange exposure, except for the Canadian dollar in the second time period. These results are similar to the findings in Lundin (97).

Sharpe ratios do vary for the time period studied.[70] Therefore one must not generalize the results. Table 6 shows the foreign exchange volatilities for daily returns over the October 1994, to March 2000 time period. Studying these volatilities gives us a better view on whether the Sharpe ratios calculated in table 5 part (b) are conservative or over-stated. Since the volatility levels in table 6 appear a bit high, especially for the Japanese yen and the German deutschemark, this may make our Sharpe ratios for the October 1994, to March 2000 period seem a little low, since it was a very volatile time period. Nevertheless, when analyzing a specific time period, Sharpe ratios do aid in determining the impact of foreign exchange risk over that period.

Table 6: Daily Returns for October 1994, to March 2000

Foreign Exchange Rate	Volatility
CAD/USD	4.94
DEM/USD	9.26
USD/GBP	7.25
JPY/USD	12.94

(3.4) Currency Risk Management Strategies

One and six month strategies are developed and applied over the time period of October 1994, to March 2000. It is assumed for each of the strategies described below,

that a US investor has invested one million (MM) US dollars at the beginning of each investment period in a foreign equity index. The foreign currency needed for such an investment is assumed purchased in the spot market at the time of the investment. At the end of each period the investor sells his foreign equity investment and converts his foreign exchange holdings into US dollars.

(i) One Month Strategies

All of the strategies covered are considered 'passive' foreign exchange hedging strategies, since the hedge is put on at the beginning of the investment period and then never changed or altered during the course of the investment. The first three strategies employ classic foreign exchange hedging tools. They all use a matched hedge, meaning that the hedge "uses the same currency to construct a hedge as the currency to which the investor is exposed."[71] The fourth strategy uses volatility swaps. The volatility swap strategy is compared on a risk-adjusted return, to the three other strategies, to determine whether in hedging only the volatility of foreign exchange returns, can volatility swaps offer more attractive risk-adjusted returns?

---

[70] Lundin (97) p. 17

[71] Clarke and Kritzman (95), p. 53

Foreign Exchange Forwards Strategy

In the first strategy, the foreign currency hedge consists of a rolling hedge. It shorts one month OTC foreign exchange forward contracts at the end of every month over the time period studied: October 1994, to March 2000. Selling foreign exchange forwards essentially "eliminates currency risk, leaving the investor with the risk of the local asset position only."[72] Since we are only interested in the foreign exchange risk of the investment, we will not hedge the local asset risk. When comparing the different strategies, this local asset risk would be the same for each strategy and therefore would not affect the results. The end date of the international equity investment and the forward contract match, therefore there is no basis risk, or tracking error, in terms of time to maturity of the investment and the hedge.

There is a cost to each strategy.[73] For the forwards strategy, the cost of the hedge is "embodied" in the forward premium. Since the US investor is selling a foreign currency forward one month, the cost to the US investor lies in the forward premium (quoted in European terms as either positive or negative). If the premium is positive, this represents a negative return to the US investor since they would be paying more foreign currency per US dollar at settlement of the forward contract, than they would have

---

[72] ibid.

[73] It must be noted that in every hedging strategy there is the possibility of 'opportunity loss'. For instance if one did enter into a forward hedge and the foreign currency rate appreciated, then an unhedged foreign exchange exposure may have turned out to be more profitable. This possibility exists for every hedging strategy. I will not include opportunity losses in the calculations in this thesis but it does remain a 'cost' inherent in any hedging strategy.

received at the beginning of the contract. Forward points quoted at a discount would thus

produce a positive currency return.[74]

Calculation of Monthly Returns to the Forwards Strategy[75]:

$$R_i = \left\{ \left(\frac{(F_0 \times N)(1 + R_{li}) - (FWD_i \times N)}{F_1} \right) \right\} \div N \times 100$$

(17)

where: R_i = return on strategy in month i

FWD$_i$ = forward rate in month i

N = notional (1MM Usd)

F_0 = initial spot exchange rate

F_1 = spot exchange rate at maturity

R_{li} = return to foreign currency index in local currency

Example:

At time t_0 , a US investor purchases one million US dollars worth of Canadian

---

[74] The reverse is true for the British pound forward premium, since it is quoted in North American terms.
[75] Note that this is the return equation for currencies quoted in European terms. For our USD/GBP strategy the returns would see the notional amount divided by the spot exchange rates when determining the foreign currency amount and multiplying when determining the USD amount. These rules apply to all of the currency strategies.

stocks on the TSE 300 equity index. He buys the Canadian dollars in the spot market at

t_0 (1.4050). Also at t_0, the investor sells forward one million US dollars for one month, at

the forward rate (1.4055). Since the equity investment return is assumed to be 5% , the

investor receives 1,475,250 CAD at time t_1. He then settles his forward contract and sells

the difference in foreign currency, namely 1,475,250 CAD minus 1,405,500 CAD, in the

spot market at the prevailing spot rate. Table 7 shows the returns to this strategy with two

different scenarios for the final spot rate. In the first scenario, the CAD/USD spot rate

has appreciated. In the second scenario, it has depreciated.

Table 7

			Exchange Rate CAD/USD	Portfolio Value (CAD)	Return (USD)
Time	t_0:		1.4050	1,405,000.00	na
	t_1:	first scenario:	1.3950	1,475,250.00	5.00%
		second scenario:	1.4250	1,475,250.00	4.89%

From table 7, we see that depending on where the spot rate is at the maturity date,

the return on the strategy can vary slightly. In theory, the sale of the forward contract on

the foreign currency was supposed to have eliminated all foreign exchange risk of the

foreign equity investment. Our strategy ensures that there is no tracking error in terms of

mismatched maturities for the equity investment and the forward contract, however, a

source of basis risk or tracking error does arise in terms of mismatched final foreign

currency amounts for the international equity investment and the hedge. This error arises

from the fact that the US investor does not know in advance (at the time they put on the foreign exchange hedge) what their return will be on the foreign equity investment, and hence what their final foreign currency amount will be. The currency risk of the principal foreign equity investment amount (namely one MM USD) can be hedged, but the currency risk from the equity return amount cannot be hedged (in this example, it was 5% of the initial foreign currency amount).

Since we cannot determine the size of the tracking error beforehand, I calculated two separate series of returns for each strategy. The first series includes the true returns for each foreign equity index, and hence includes tracking error. The second set of returns assumes a zero return for each foreign equity investment each month, and hence assumes zero tracking error.[76] The strategy can then be compared when tracking error exists and when it does not. The one month returns from the forwards strategy, for each currency, can be found in Appendix 3A.

---

[76] In fact, for the tracking error to be truly zero, the return on the equity index would have to be exactly the same as the return on the forward sale. In this case, 0.05%. However, to do this for each monthly investment period would prove to be too cumbersome, and would not prove to be materially different from using a zero percent return.

Protective Puts Strategy

The second strategy is similar in theory to the first. Again it involves a one month rolling hedge to protect against the foreign exchange exposure of a one month foreign equity index investment by a US investor. Although, instead of selling a one month foreign currency forward, the US investor buys a one million US dollar notional one month European[77] foreign currency put option (US dollar call), with the strike set at the one month forward rate. If at maturity, the foreign currency has depreciated against the US dollar, then the put option is exercised and the holder sells foreign currency at the specified price (strike). If at maturity, the foreign exchange rate has appreciated greater than the strike, then the option expires worthless. The US investor then sells the foreign currency proceeds from the equity investment at the prevailing spot price.

This hedging strategy is asymmetrical (as opposed to symmetrical for the forwards strategy) since put options protect the holder from negative currency returns but still allow the holder any upside potential (minus the amount paid for the premium). The cost of this strategy is the amount of the option premium[78] which is paid upfront. We assume for the purposes of this thesis, that this premium amount is financed at the one month LIBOR rate. As with the forwards strategy, tracking error occurs because the return on the foreign equity investments is not known at the time the hedge is put into place.

---

[77] i.e. can only be exercised at maturity
[78] One could reduce the amount of premium by buying further out-of-the-money puts, but this would also reduce upside potential.

Calculation of the Monthly Returns to the Protective Put Strategy:

If $K_{pi} < F_1$, the put option is exercised[79] and the return to the strategy is:

$$R_i = \left[-P_i + \frac{(F_0 \times N)(1 + R_{Ii}) - (K_{Pi} \times N)}{F_1} \right] \div N \times 100 \tag{18}$$

If $K_{pi} > F_1$, the put option is *not* exercised, and the return to the strategy is:

$$R_i = \left[-P_i + \left(\frac{(F_0 \times N)(1 + R_{Ii})}{F_1} - N \right) \right] \div N \times 100 \tag{19}$$

where: R_i = return on put strategy for month i

F_1 = spot foreign exchange rate at expiry

F_0 = initial spot foreign exchange rate

N = notional (1MM USD)

P_i = premium for put in month i times (1 + the one month LIBOR rate in month i)

R_{Ii} = return on foreign currency index

K_{pi} = strike on put in month i

---

[79] Except for GBP/USD options, where the GBP put is exercised if the GBP/USD spot rate at maturity is less than the strike of the put. The put is not exercised if the GBP/USD spot rate at maturity is greater than the strike.

Example:

At time t_0, a US investor purchases one million US dollars worth of Canadian stocks on the TSE 300 equity index. They buy the Canadian dollars for this investment in the spot market at t_0 (1.4050). Also at t_0, the investor buys a 1MM US dollar notional CAD put at a strike of 1.4055. The cost of this put is 0.91% of USD, or $9,100.00. This amount is assumed to be borrowed at a 1 month US LIBOR rate of 0.5%. Since the equity investment returned 5%, the investor receives 1,475,250.00 Cad at time t_1. Depending on the spot rate at time t_1, the investor either exercises his put option or not. Any difference in foreign currency is sold/bought in the spot market. Table 8 shows the return to this strategy under two different scenarios.

Table 8

			Exchange Rate CAD/USD	Portfolio Value (CAD)	Return (USD)
Time	t_0:		1.4050	1,405,000.00	na
	t_1:	first scenario:	1.3950	1,475,250.00	4.84%
		second scenario:	1.4250	1,475,250.00	3.98%

In the first scenario, since the expiry spot rate is less than the strike rate on the put option (1.4055), the option expires worthless. Note that the return in this scenario is not equivalent to that of an unhedged foreign exchange position[80] because of the upfront premium paid for the put option. It can also be said that there is no tracking error in this scenario. Since the option expired worthless there is no mismatch between the final

foreign exchange amount of the hedge and that of the foreign equity investment. In the second scenario the expiry spot rate is greater than the strike and the put option finishes in-the-money. In this case, the option contributes to the value of the portfolio and the return of the strategy.

The one month returns over the October 1994, to March 2000 time period for this strategy for each of the currencies studied, can be found in Appendix 3B. Again two series are calculated: one with the true equity returns, and another that assumes zero monthly equity returns.

---

[80] The return to an unhedged foreign exchange position would be 5.75%.

Covered Calls Strategy

This strategy involves selling a European-style one month at-the-money (ATM) forward foreign currency call option (USD put) each month. While you receive the premium from the option upfront, this strategy has limited upside because any final foreign exchange rate lower than the strike of the call would cause the option holder to exercise the option. Therefore even if the exchange rate moved in a favorable direction for the US investor, they could not take full advantage of it. Their gains on the foreign exchange rate movement would be limited to the level of the strike of the short call option. This strategy is not as risky as selling an uncovered call however, since the writer will be receiving foreign currency from the proceeds of the foreign equity investment. Although, they will have to either sell that foreign currency at the prevailing spot rate at maturity or at the strike rate of the call option.

Since the premium is received upfront, and invested at the one month LIBOR rate, there is no cost, per se, to this strategy. Yet, the upside potential is limited. The return to the short call option strategy can be seen below:

Calculation of the Monthly Returns to the Covered Call Option Strategy:

If $K_{ci} > F_1$ then the call option is exercised,[81] and the return to the strategy is:

$$R_i = \left[C_i + \frac{(F_0 \times N)(1 + R_{li}) - (K_{ci} \times N)}{F_1} \right] \div N \times 100 \qquad (20)$$

If $K_{ci} < F_1$ then the call option is *not* exercised, and the return to the strategy is:

$$R_i = \left[C_i + \frac{(F_0 \times N)(1 + R_{li})}{F_1} - N \right] \div N \times 100 \qquad (21)$$

where: R_i = return on strategy for month i

$\quad$ F_1 = spot foreign exchange rate at expiry

$\quad$ F_0 = initial spot foreign exchange rate

$\quad$ N = notional (1MM USD)

$\quad$ C_i = premium for call in month i, invested at the 1 month LIBOR rate in month i

$\quad$ R_{li} = return on foreign currency index in local currency terms

$\quad$ K_{ci} = strike on call in month i

---

[81] Except for USD/GBP options, where the GBP call is exercised if the GBP/USD spot rate at maturity is greater than the strike of the call. The call is not exercised if the GBP/USD spot rate at maturity is less than the strike.

Example:

At time t_0 , a US investor purchases one million US dollars worth of Canadian stocks on the TSE 300 equity index. He buys the Canadian dollars in the spot market at t_0 (1.4050). Also at t_0 the investor sells a 1MM US dollar notional Canadian dollar call at a strike of 1.4055. The cost of this call is 0.88% of USD, or $8,800.00. This amount is assumed to be invested at a 1 month US LIBOR rate of 0.5%. Since the equity investment returned 5% , the investor receives 1,475,250.00 CAD at time t_1. Depending on the spot rate at time t_1 , the call is either exercised or not. Any difference in foreign currency is sold/bought in the spot market. The return to this strategy under two different scenarios, can be seen in the last column of table 9.

Table 9

			Exchange Rate CAD/USD	Portfolio Value (CAD)	Return (USD)
Time	t_0:		1.4050	1,405,000.00	na
	t_1:	first scenario:	1.3950	1,475,250.00	5.88%
		second scenario:	1.4250	1,475,250.00	4.41%

In the second scenario, since the expiry spot rate is greater than the strike on the short call option (1.4055), the option expires worthless. Note that the return for this scenario is greater than an unhedged foreign exchange position because of the upfront

premium received for the call option.[82] Again, since the option was not exercised, there

is no tracking error in this scenario. In the first scenario, the spot expiry rate is less than

the strike and the call option finishes in-the-money. The writer of the call must therefore

sell foreign currency at the strike rate for the equivalent of 1 MM US dollars. There is

tracking error present in this scenario since the foreign currency amount from the equity

investment is not the same as the call option settlement amount. Results for this strategy,

both with true equity returns and zero equity returns, can be found in Appendix 3C.

---

[82] The return to an unhedged foreign currency position would have been 3.34%.

Volatility Swap Strategy

In this final strategy, I do not employ a matched hedge. In fact I do not hedge the foreign exchange returns at all. The volatility of these returns, however, is hedged by rolling a one month volatility swap contract on the underlying foreign currency. The first three strategies all hedged the foreign exchange risk of the foreign equity investment, but also the direction of the foreign exchange returns. Each of the first three strategies also had some amount of tracking error associated with the final foreign currency amounts. This strategy offers a different approach. It leaves the principal component of the foreign equity investment unhedged. This allows for zero tracking error, and, should the foreign currency appreciate during the course of the foreign equity investment, positive foreign currency returns.

The volatility swap strategy leaves the US investor's portfolio open to a large amount of foreign exchange risk. The first three strategies do not have this type of risk since they hedge the principal component of the foreign equity investment. However, the volatility swap strategy deals with this concern by buying a series of one month volatility swap positions. The strike rate used is the current one month implied volatility level for the underlying foreign currency. If the annualized realized historical volatility of the foreign currency over a certain month is greater than the implied volatility at the beginning of that month (the strike), then the holder receives a cash payment at maturity. If however the realized volatility decreases over the month, the holder makes a payment.

One may question why enter into volatility swaps at all? They do produce a cash payment if the volatility increases, but the buyer must pay if the volatility decreases. Investors and portfolio managers are concerned not only about returns, but about the volatility of those returns. High volatility in an underlying foreign currency means that there is a higher chance of profit but also a higher chance of loss. Since a volatility swap can be thought of as a forward contract on realized volatility, the holder of a foreign currency volatility swap on the underlying foreign exchange exposure in their portfolio, will know the maximum amount of foreign exchange volatility that portfolio will sustain. This amount is equivalent to the strike on the volatility swap.

Calculation of Monthly Returns to the Volatility Swap Strategy:

$$R_i = \left[R_{vi} + \left(\frac{(F_0 \times N)(1 + R_{ii})}{F_1} \right) - N \right] \div N \times 100 \qquad (22)$$

$$R_{vi} = n(RHV_i - IV_{t0})$$

$$RHV_i = \sqrt{\frac{250}{m-1} \sum_{j=1}^{m} \left(\frac{(r_{j+1} - r_j)}{r_j} \right)^2}$$

where: RHV_i = realized historical volatility for month i

r_j = daily return on foreign exchange rate for day j in month i

m = number of daily observations in month i

R_i = return on volatility swap strategy for month i

R_{vi} = return on volatility swap for month i

N = notional (1 MM USD)

IV_{t0} = implied one month volatility for the foreign currency at time t_0

n = the notional amount for the volatility swap, which is equivalent to the vega for

a 1 MM USD one month ATM forward option on the currency

The notional amount that is used in this strategy for the purchase of the monthly volatility swap contracts is not 1 MM US dollars as for the options and forwards. Instead it is the vega of a 1 MM USD one month ATM forward option on the foreign currency. Vega represents the change in an option's premium for a 1% change in volatility. Therefore for every vega of say 1500 USD, each 1% move in volatility (or difference between the realized and implied volatilities), would change a position of 1 MM USD, by 1500 USD. The vegas were calculated at the beginning of each one month foreign equity investment period.

Example:

At time t_0, a US investor purchases one million US dollars worth of Canadian stocks on the TSE 300 equity index. He buys Canadian dollars to finance this equity

purchase, in the spot market at t_0 (1.4050). Also at t_0, the investor buys a volatility swap with a strike of 5% (the one month implied volatility rate). The notional amount of the volatility swap contract is equivalent to the vega of a 1 MM USD one month at-the-money forward option ($1,500.00). At time t_1, since the equity investment returned 5% , the investor receives 1,475,250.00 CAD. The investor sells this amount of foreign currency in the spot market at time t_1. Depending on how the daily foreign exchange rate has moved over the month, the investor either makes or receives a cash payment from the volatility swap purchase. Table 10 shows the return to this strategy from two different scenarios for the final spot exchange rate. Each of these scenarios also has the return to the strategy when the realized volatility of the CAD/USD exchange rate is greater than and less than, the implied volatility rate.

Table 10

			Exchange Rate CAD/USD	Volatility	Portfolio Value (CAD)	Return (USD)
Time	t_0:		1.4050	5% (implied)	1,405,000.00	na
	t_1:	first scenario:	1.3950	4%(realized)	1,475,250.00	5.60%
			1.3950	6%(realized)	1,475,250.00	5.90%
		second scenario	1.4250	4%(realized)	1,475,250.00	3.38%
			1.4250	6%(realized)	1,475,250.00	3.68%

Since this strategy does not hedge the principal amount of the foreign equity investment, there is no tracking error in terms of final foreign currency amounts. There is however, tracking error due to the notional amount of the volatility swap and the fact that

we do not know the final equity investment return at the beginning of the strategy. The volatility swap notional is chosen on the basis of the vega of a one month at-the-money forward option with a notional amount of 1 MM USD. Therefore the volatility swap is supposed to hedge the volatility of returns from a 1 MM USD investment in the foreign exchange rate over the course of one month. If however the return on the equity investment is greater than zero, the final USD amount will be greater than 1 MM USD. Therefore, the volatility swap notional should have been based on the vega of an option with a notional amount greater than 1 MM USD. The reverse is true when the return on the equity investment is less than zero. This tracking error however, would prove to be quite small given the size of the vegas used in the strategies.

As can be seen from table 10, the volatility swap strategy does best when compared to the three other strategies, when the foreign currency appreciates and the realized volatility of this currency is greater than the implied rate. Again, I calculated two series of returns for each currency for this strategy. One series assumes zero equity returns, while the other shows the correct historical returns. These results can be found in Appendix 3D. Appendix 3D also contains returns from an unhedged foreign currency position. This allows us to determine the extent which the foreign currency return had on the volatility swap strategy results.

(ii)   Six Month Strategies

All of the above one month strategies are also applied over six month investment periods. This was done to see if the volatility swap strategy ranked differently, in terms of risk-adjusted returns, when compared to the hedging strategies over a longer time horizon. Another reason for employing six month strategies was to determine if the relationship between realized and implied volatilities, was the same as for the one month strategies. Volatility swap payouts depend on the relationship between an asset's realized and implied volatilities. As can be seen from our data in Appendix 3D, especially for the Canadian dollar, the one month volatility swaps position did not pay out very often. This was because the realized volatility over the month was usually lower than the implied volatility at the beginning of the month. By examining the payout on six month volatility swap positions instead of one month positions, it will show us if the same relationship between historic and implied volatilities holds over a longer term. As well, implied volatility rates represent dealers expectations of the future levels of volatility. From the data in Appendix 3D, obviously dealers had over-estimated the one month volatility rates for the currencies studied.[83]

Data for the six month strategies were obtained from the same sources as for the one month strategies. Data were collected for the time period from January 1995 to

---

[83] It must be noted that implied volatility rates also include 'jump risk'. This is the risk that a currency may 'jump'. This tends to revise upwards the rate of the currency's implied volatility.

December 1999.[84] The strategies were performed both with the true equity returns and zero equity returns. All the six month results can be found in Appendix 4.

---

[84] I could not use the exact time period as the one month strategies because it didn't divide into even six month periods.

(3.5)   How Currency Trends Affect the Currency Risk Management Strategies

We have already discussed the existence of foreign currency risk inherent in a foreign equity investment. When applying these strategies, this risk can in turn develop into a positive or negative currency return depending on the underlying foreign currency rate at the maturity of the foreign equity investment. How the foreign currency moves during the life of the foreign equity investment (i.e. how volatile it is) also has great impact on the volatility swap strategy and how it ranks in comparison to the other strategies. This discussion describes how each of the currency risk management strategies will perform in different currency exchange rate environments. Figures 2 and 3 illustrate the profit/loss diagrams for each strategy.[85]

Figure 2 illustrates the payoff to each classic hedging strategy. The forward strategy hedges 100% of the foreign currency exposure on the principal amount of the international equity investment. When forward points are at a discount (quoted in European terms) then the forward strategy has a positive currency return. However, when forward points are at a negative, the forward strategy locks-in a negative currency return.

---

[85] At this point in the discussion, for the profit-loss diagrams, I am assuming a 0% equity return and an initial spot rate of 1.4050 Canadian Dollars to 1 US Dollar. Tracking error when equity returns do not equal 0% is covered later in this discussion.

Figure 2: All Classic Hedging Strategies

Payoff to Hedging Strategies

Legend:
- Fwd Premium
- Fwd Discount
- Protective Put
- Covered Call
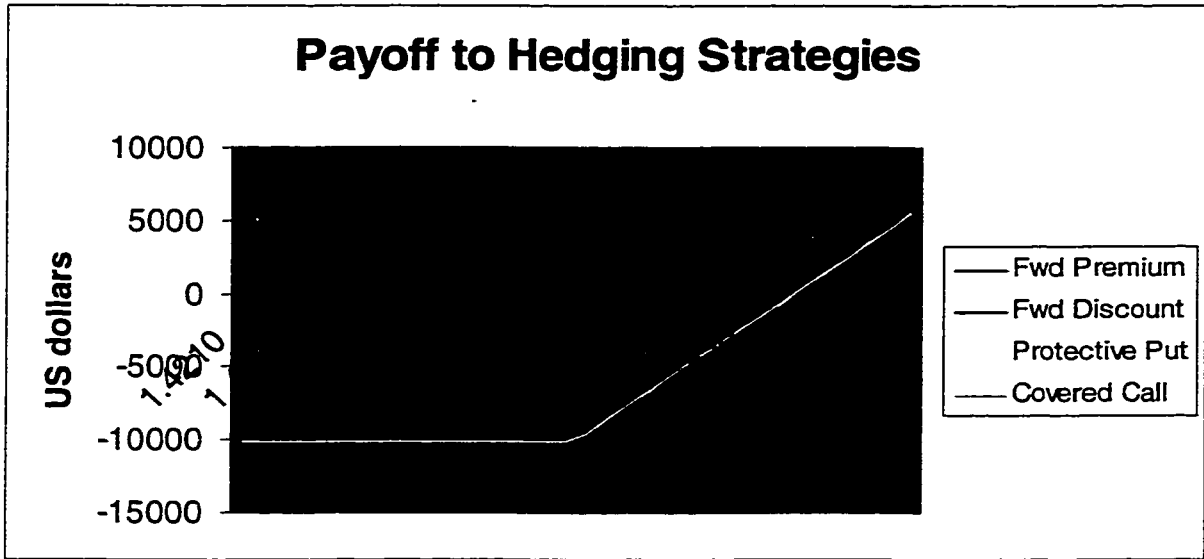
Figure 3: Volatility Swap Strategy

Payoff to Volatility Swap Strategy, With Different Realized Volatility Rates

Legend:
- Unhedged
- 2% vols
- 4% vols
- 5% vols
- 8% vols
- 10% vols
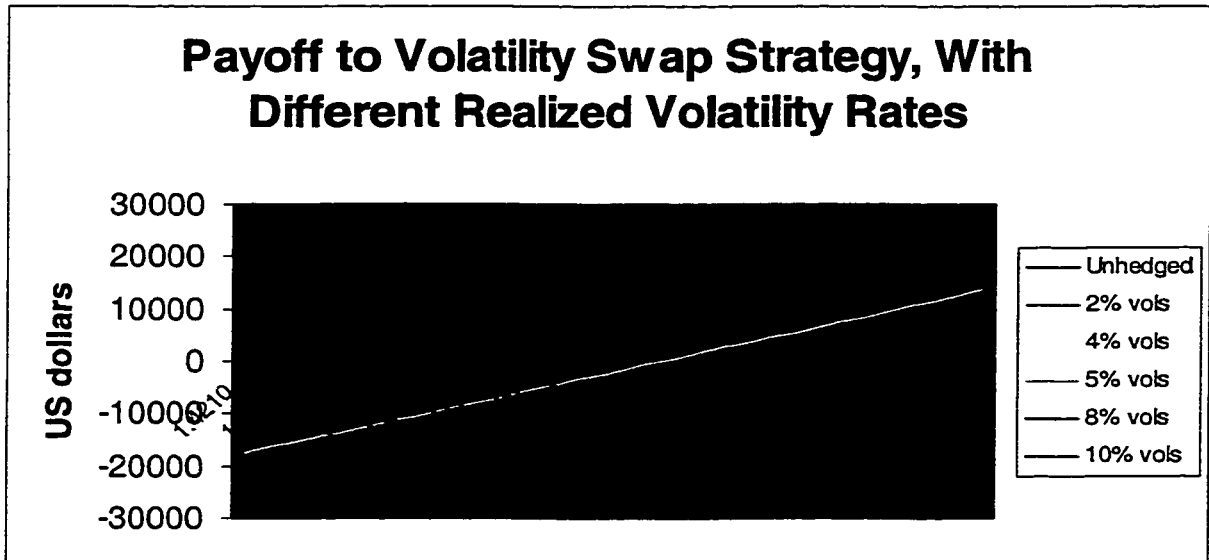
In the protective put strategy, the US investor is buying puts on the foreign currency. The US investor has to pay the premium on the put yet retains the right to exercise this option if the foreign currency depreciates from the strike price (quotted in European terms). As we can see from figure 2, positive currency returns arise when the currency depreciates from the strike rate and the value of the protection of the put is greater than the value paid for the put.

In the covered call strategy, if the foreign currency appreciates (from the strike price) then the call is exercised. If the foreign currency depreciates, then the call is not exercised, and the US investor must then sell the proceeds of their foreign equity investment at the prevailing spot rate. In all instances the investor retains the pro-ceeds from the sale of the call option. Figure 2 shows us that maximum currency profit arises when the foreign currency depreciates from the strike rate such that the call is exercised but the effective loss from the foreign currency sale is less than the value of the call.

Figure 3 illustrates the payoff to the volatility swap strategy. This strategy involves leaving the foreign exchange rates unhedged, and buying a foreign currency volatility swap. Returns for this strategy increase when the currency appreciates and/or the realized volatility of the currency is higher than the implied.

Another factor plays a role in the profitability of the above strategies. The fact that we do not know in advance the return on the foreign equity index, introduces tracking error into the classic hedging strategies. The above profit-loss diagrams all

assumed a zero equity return, or zero tracking error. When tracking error exists these strategies cannot hedge all of the foreign currency risk. However, the tracking error may have a positive influence on the hedging strategies depending on how the foreign currency moves.

When the foreign equity return is positive, and if the foreign currency appreciates from the initial purchase date to the final sales date, then the forward and option strategies will exhibit a positive return from the tracking error. If the foreign equity return is negative then the tracking error will produce a positive return only when the foreign currency depreciates from the initial purchase date to the final sales date.

(3.6) Sharpe Ratios

Each of the return series, for both the one month and the six month strategies, was analyzed for it's annualized risk-adjusted return quotients, as measured by the Sharpe ratio. In investment management, a portfolio manager or investor would like to have high profit, as measured by the return on investment, coupled with very low risk, as measured by the volatility of returns. There exists however, a fundamental relationship between profit and risk. The higher the expected profit, the greater the risk and similarly, the lower the expected profit, the lower the expected risk.[86] This trade-off in an investment can be expressed through the risk-adjusted return measure, the Sharpe ratio.

The Sharpe ratio is defined as 'the average excess return of an asset divided by the standard deviation of those returns'. All of the Sharpe ratios calculated in this thesis use an ex post version of the Sharpe Ratio.[87] This ratio is defined below.

Sharpe Ratio $= \overline{R}_m \ / \ \sigma_{Rm}$

where $\overline{R}_m =$ the mean of excess returns $= 1 \ / \ N \sum_{i=1}^{N} R_i - R_F$

$\sigma_{Rm} =$ standard deviation of the excess returns $= \sum_{i=1}^{N} \dfrac{\left((R_i - R_F) - \overline{R}_m\right)^2}{N}$

$R_i =$ the return on investment in period i

$R_f =$ return on the risk free interest rate over that period[88]

$N =$ number of return observations

In calculating the Sharpe ratios, I use the above equation to determine the average excess returns. However, the return distribution to the foreign equity portfolios in this thesis are not normally distributed. Thus this raises questions on the appropriateness of the Sharpe ratio as a performance measure. To answer these concerns I have also calculated the Sharpe ratios using a zero percent risk-free rate of interest. This does not have a significant effect on the results since each period's risk-free rate was small. This method of calculating the Sharpe ratios was found in Eun and Resnick (97). They state

---

[86] Choey and Weigend (97), p. 417
[87] As opposed to the ex ante version in Sharpe (94).
[88] Here LIBOR rates are used as a proxy for the risk-free rate.

that assuming a zero risk-free rate is standard in the literature of this sort.[89] Accordingly, a Sharpe ratio with a zero risk-free rate can "alternatively be viewed as a 'safety-first' measure of portfolio performance with the lower limit of return set at zero percent."[90] Such a measure was developed by Roy in 1952, in the article "Safety-first and the holding of assets" in Econometrica, Volume 20. This safety first criterion is a "very general measure of portfolio performance in which it is not necessary to assume that the underlying portfolio returns are normally distributed."[91]

For the one month strategies, there were 66 monthly excess return calculations in each series. The Sharpe ratio of the total investment period as well as each annual sub-period, was then simply the mean of those excess returns divided by the square root of the variance of those same excess returns. All ratios were reported as annualized.[92] Therefore the one month Sharpe ratios were annualized by multiplying them by $\sqrt{12}$.[93] The six month Sharpe ratios were annualized by multiplying them by $\sqrt{2}$. The Sharpe ratios appear in Section 4, tables 11 through 14 for the one month strategies, and in table 15 for the six month strategies.

---

[89] Other works that use a Sharpe ratio with zero risk-free rates are Jorion (1985, 1986) and Eun and Resnick (1988).

[90] Eun and Resnick (97) p. 35

[91] ibid

[92] Choey and Weigend (97) p. 417 demonstrate the method for annualizing Sharpe ratios. The annualization of a monthly Sharpe ratio is defined as the following:

$SR_T = \sqrt{T}\,\dfrac{\mu_e}{\sigma}$ where T = the number of months/year; μ_e =the monthly average excess return; and σ = the standard deviations of the monthly average excess returns

[93] Lundin (97) p. 26, also uses this calculation to annualize monthly Sharpe ratios.

(3.7) Transaction Costs

Any financial strategy inevitably includes trading and/or transaction costs. Trading costs refer to those costs incurred with the implementation of the strategy. Market liquidity and market timing costs are just a couple of examples. These costs tend to be more difficult to measure than transaction costs. Transaction costs arise from the actual execution of the strategy. These costs include among others, bid-ask spreads, credit risk spreads, and brokerage fees. Are these costs high enough to significantly alter the results of this thesis? Literature covering this subject states that it depends on the type of study performed and on the instruments used.

Shulman and Perold (88)[94] explain that in the case of hedging with forward contracts, since these contracts are extremely liquid world-wide, they have a very low liquidity premium. As well, the authors find that the bid-ask spreads are also very low, averaging only 0.12% per year. Hence in their view, transaction costs assumed with forward hedging strategies appear to be minimal.[95]

Constantinides (97) studies OTC traded derivatives to determine the impact of transaction costs. He believes that "transaction costs have a trivial effect on the liquidity premium."[96] He defines the liquidity premium as the mean rate of return of two substitutable assets, where one of them is subjected to transaction costs and the other is

---

[94] P. 48
[95] Shulman and Perold (88), p. 45

not. Constantinides believes that since the market is so large and liquid, hedging OTC plain vanilla derivatives is extremely easy. Therefore, in his view, this has contributed to a reduction in transaction costs and a tightening of the bid-ask spread to just a few points.

From the above authors' view points, and for simplicity's sake, I have decided not to include numerous transaction costs in my return calculations. While financing costs do represent a transaction cost, I assume the initial one million US dollar foreign equity investment amount is not financed. In the forward and the volatility swap strategies there is no additional up front cash flow to be financed or invested. However in the option strategies, there is a payment/receipt of the option premium. For comparison purposes, this premium amount is considered financed/invested at the one month LIBOR rate. For all of the strategies, I used data collected from mid-market prices. The only exception to this was the volatility data. Here, both the bid and the offer were used to calculate the option prices and the volatility swap returns. For the call options, since the strategy calls for a short call option position, I used the bid prices for the implied volatility rates. The put option prices were calculated using the offer side of the implied volatility rates since this strategy employs a long put option position. The volatility swaps also used the offered side of the implied volatility rates to determine the strike level for the swap. Since the spread between the bid and the offer for the volatility rates seemed quite wide, I also calculated volatility swap returns using the mid-market implied volatility rate as the strike price. The difference between the two volatility swap series should tell us

---

[96] Constantinides (97), p. 94

something about the change in risk-adjusted returns to this strategy when using a tighter

market. This will give us some idea of the impact of transaction costs on this strategy.

SECTION 4

RESULTS AND ANALYSIS

(4.1) Results

The following tables (11 through 14) present the annualized Sharpe ratios from each of the one month strategies for each currency. The last column in each of these tables represents the Sharpe ratio for that strategy applied over the entire October 1994, to March 2000 time period. Table 15 presents the six month strategy results from January 1995, to December 1999. I have included volatility swap strategies priced at both the offer and the mid of the implied volatility rates. I have also included the risk-adjusted returns from an unhedged foreign currency exposure. This allows us to see the extent to which the foreign currency returns affects on the volatility swap strategy results.

There are four sets of Sharpe ratios for each currency. The first is the risk-adjusted returns resulting from strategies that incorporate historical equity returns. The second set is the risk-adjusted returns assuming zero foreign equity returns. The third and fourth set again incorporate either true equity returns or zero equity returns, yet they also use zero risk-free rates when calculating the Sharpe ratios. Since these tables do not allow for clear discrimination between the Sharpe ratios in each of the sub-periods, I have also performed a dominance analysis for each currency. This is presented in tables 16 and 17.

Table 11: Annualized Sharpe Ratios for One Month Strategies, for the Canadian Dollar, October 1994, to March 2000.

Strategy	1994	1995	1996	1997	1998	1999	2000	1994-2000
With Rf*:								
- With Equity*								
Forwards	-1.36	0.40	1.67	0.72	-0.17	1.45	3.70	0.67
Puts	-1.93	0.39	0.75	0.31	-2.41	0.20	2.91	-0.28
Calls	-1.64	1.03	2.07	0.61	0.24	1.91	3.04	0.95
V Swaps (mid)	-2.14	0.63	1.75	-0.03	-0.33	1.53	2.43	0.48
V Swaps (offer)	-2.16	0.59	1.73	-0.05	-0.35	1.51	2.40	0.46
Unhedged	-2.07	0.76	1.85	0.04	-0.25	1.67	2.47	0.57
- Zero Equity*								
Forwards	0.58	-4.8	4.19	4.30	2.58	3.68	120.96	1.45
Puts	-24.98	-2.15	-2.15	-6.72	-2.49	-1.52	63.15	-2.67
Calls	-4.40	-1.91	-1.59	-2.98	-1.14	0.28	-1.73	-1.45
V Swaps (mid)	-8.65	-1.38	-0.59	-3.85	-1.94	-0.47	-5.68	-1.70
V Swaps (offer)	-8.74	-1.46	-0.64	-3.91	-2.04	-0.54	-5.78	-1.77
Unhedged	-8.23	-1.13	-0.41	-3.77	-1.64	-0.13	-4.89	-1.45
Zero Rf*:								
- With Equity								
Forwards	-0.92	0.99	2.10	1.08	0.03	1.77	4.19	1.00
Puts	-1.49	0.91	1.15	0.63	-2.16	0.49	3.41	0.04
Calls	-1.29	1.63	2.49	0.96	0.47	2.28	3.49	1.30
V Swaps (mid)	-1.79	1.11	2.19	0.34	-0.13	1.84	2.89	0.80
V Swaps (offer)	-1.80	1.07	2.17	0.32	-0.15	1.81	2.86	0.78
Unhedged	-1.72	1.24	2.29	0.42	-0.05	1.97	2.92	0.89
- Zero Equity								
Forwards	1.13	-4.55	4.40	4.44	2.97	4.04	131.4	1.63
Puts	1.14	1.92	3.29	2.71	2.33	2.33	144.02	2.16
Calls	-5.06	-3.71	-1.61	-3.30	-2.84	-1.53	-2.40	-2.54
V Swaps (mid)	-6.69	-0.17	0.35	-2.42	-1.11	0.42	-3.71	-0.66
V Swaps (offer)	-6.75	-0.24	0.31	-2.49	-1.21	0.35	-3.85	-0.72
Unhedged	-6.08	0.15	0.57	-2.19	-0.77	0.77	-3.00	-0.38

* The terms 'With Rf' refers to the fact that excess returns were used in Sharpe ratio calculations. 'Zero Rf' uses zero risk-free rates for return calculations. The term 'With Equity' refers to the fact that the true equity returns are included in the return calculations. Accordingly the term 'Without Equity' means that equity returns were assumed to be 0%.

Table 12: Annualized Sharpe Ratios for One Month Strategies, for the German Deutschemark, October 1994, to March 2000.

	Strategy	1994	1995	1996	1997	1998	1999	2000	1994-2000
With Rf*:									
- With Equity*									
	Forwards	1.75	0.33	2.05	1.48	0.65	1.43	1.42	1.16
	Puts	1.49	-0.12	1.20	1.18	0.62	0.75	0.62	0.75
	Calls	1.35	0.27	1.02	1.16	0.78	1.10	0.72	0.90
	V Swaps (mid)	0.73	-0.10	0.45	0.90	0.81	0.44	0.05	0.54
	V Swaps (offer)	0.69	-0.14	0.42	0.88	0.79	0.43	0.03	0.52
	Unhedged	0.93	0.05	0.56	0.95	0.87	0.51	0.15	0.63
- Zero Equity*									
	Forwards	-161.3	-40.04	-34.49	-23.66	-86.28	-28.37	-42.30	-17.84
	Puts	-2.28	-1.58	-2.97	-3.00	-0.72	-23.97	-28.93	-2.56
	Calls	-1.00	-0.54	-1.42	-1.46	0.53	-1.97	-1.53	-1.11
	V Swaps (mid)	-1.07	-0.87	-2.08	-1.75	0.08	-4.79	-3.81	-1.67
	V Swaps (offer)	-1.09	-0.92	-2.11	-1.80	0.03	-4.85	-3.95	-1.71
	Unhedged	-0.84	-0.64	-1.90	-1.73	0.29	-4.50	-3.37	-1.50
Zero Rf*:									
- With Equity									
	Forwards	2.47	0.72	2.49	1.68	0.84	1.64	1.65	1.41
	Puts	2.21	0.25	1.61	1.38	0.83	0.96	0.86	1.02
	Calls	2.02	0.68	1.37	1.36	0.98	0.32	0.90	1.16
	V Swaps (mid)	1.25	0.24	0.77	1.08	1.03	0.66	0.25	0.79
	V Swaps (offer)	1.22	0.21	0.75	1.07	1.01	0.65	0.22	0.77
	Unhedged	1.46	0.42	0.89	1.15	1.09	0.73	0.34	0.88
- Zero Equity									
	Forwards	4.18	20.70	22.10	19.23	31.61	18.02	55.70	12.98
	Puts	-0.40	-0.59	-1.43	-1.29	0.32	-16.80	-21.34	-1.21
	Calls	-0.28	0.35	-0.66	-0.59	2.07	-0.92	-0.94	-0.19
	V Swaps (mid)	-0.52	-0.32	-1.46	-1.15	0.76	-3.78	-3.22	-1.04
	V Swaps (offer)	-0.54	-0.37	-1.50	-1.18	0.71	-3.85	-3.33	-1.08
	Unhedged	1.46	0.42	0.89	1.15	1.09	0.73	0.34	0.88

* The terms 'With Rf' refers to the fact that excess returns were used in the Sharpe ratio calculations. 'Zero Rf' uses zero risk-free rates for return calculations. The term 'With Equity' refers to the fact that the true equity returns are included in the return calculations. Accordingly the term 'Without Equity' means that equity returns were assumed to be 0%.

Table 13: Annualized Sharpe Ratios for One Month Strategies, for the British Pound , October 1994, to March 2000.

	Strategy	1994	1995	1996	1997	1998	1999	2000	1994-2000
With Rf*:									
- With Equity*									
	Forwards	-0.07	1.71	0.84	1.10	0.45	1.02	-1.07	0.70
	Puts	-2.15	-9.52	-5.98	-6.91	-8.35	-6.79	-10.35	-6.88
	Calls	-3.02	1.70	0.70	1.44	0.59	1.04	-1.22	0.78
	V Swaps (mid)	-4.92	0.49	0.87	1.03	0.40	0.58	-1.65	0.43
	V Swaps (offer)	-5.01	0.42	0.84	1.00	0.38	0.55	-1.66	0.40
	Unhedged	-3.98	0.89	0.98	1.18	0.61	0.70	-1.51	0.60
- Zero Equity*									
	Forwards	-39.46	-106.1	-75.03	-36.44	-66.27	-60.59	-322.1	-27.99
	Puts	-9.90	-10.08	-6.01	-7.54	-10.31	-6.91	-10.16	-7.79
	Calls	-1.53	-1.04	-0.95	-0.26	-1.85	-0.97	-2.53	-1.11
	V Swaps (mid)	-2.65	-2.25	-0.05	-0.96	-1.39	-1.52	-4.30	-1.32
	V Swaps (offer)	-2.68	-2.33	-0.09	-1.04	-1.46	-1.58	-4.40	-1.39
	Unhedged	-2.24	-1.83	0.06	-0.37	-0.77	-1.20	-3.30	-0.95
Zero Rf*:									
- With Equity									
	Forwards	0.98	2.51	1.63	1.45	0.77	1.45	-0.83	1.13
	Puts	-1.20	-7.15	-4.76	-5.24	-6.18	-5.22	-7.49	-5.23
	Calls	-0.47	2.48	1.38	1.85	0.99	1.45	-1.00	1.24
	V Swaps (mid)	-3.26	1.25	2.07	1.62	0.81	0.95	-1.41	0.85
	V Swaps (offer)	-3.35	1.17	2.04	1.60	0.78	0.93	-1.43	0.82
	Unhedged	-2.36	1.57	1.41	1.48	0.91	1.06	-1.29	0.97
- Zero Equity									
	Forwards	1.32	-8.53	-7.06	-6.49	-26.02	-0.92	0.03	-3.54
	Puts	-7.51	-7.66	-4.81	-5.82	-7.83	-5.34	-7.34	-6.03
	Calls	-0.78	0.40	0.11	2.40	1.00	0.43	-1.21	0.43
	V Swaps (mid)	-1.96	-1.26	2.02	0.39	-0.15	-0.63	-3.11	-0.38
	V Swaps (offer)	-2.01	-1.35	1.96	0.31	-0.22	-0.69	-3.20	-0.44
	Unhedged	-1.57	-0.87	0.66	0.64	0.23	-0.34	-2.30	-0.10

* The terms 'With Rf' refers to the fact that excess returns were used in the Sharpe ratio calculations. 'Zero Rf' uses zero risk-free rates for return calculations. The term 'With Equity' refers to the fact that the true equity returns are included in the return calculations. Accordingly the term 'Without Equity' means that equity returns were assumed to be 0%.

Table 14: Annualized Sharpe Ratios for One Month Strategies, for the Japanese Yen, October 1994, to March 2000.

Strategy	1994	1995	1996	1997	1998	1999	2000	1994-2000
With Rf*:								
- With Equity*								
Forwards	0.13	0.00	-0.02	-1.13	-0.13	2.27	12.43	0.11
Puts	-0.83	-0.43	-0.59	-0.95	0.18	1.54	2.21	-0.10
Calls	-0.08	-0.65	-0.62	-1.64	-0.67	2.48	1.12	-0.33
V Swaps (mid)	-0.77	-0.94	-0.86	-0.99	0.11	1.85	0.26	-0.24
V Swaps (offer)	-0.79	-0.97	-0.88	-1.00	0.09	1.81	0.23	-0.27
Unhedged	-0.73	-0.94	-0.79	-1.04	0.06	2.04	0.51	-0.21
- Zero Equity*								
Forwards	-25.92	-3.72	-0.30	-2.32	-0.29	1.13	2.41	-1.25
Puts	-81.93	-1.27	-31	-0.21	0.74	-1.05	-0.96	-0.48
Calls	-0.62	-1.27	-2.62	-1.82	-1.08	0.75	-2.15	-1.17
V Swaps (mid)	-3.95	-1.22	-2.45	-0.39	0.46	-0.06	-1.32	-0.53
V Swaps (offer)	-3.97	-1.25	-2.53	-0.41	0.44	-0.11	-1.33	-0.56
Unhedged	-2.66	-0.83	-1.66	-0.05	0.67	0.78	-0.82	-0.12
Zero Rf*:								
- With Equity								
Forwards	0.51	0.23	-0.84	-0.09	2.62	2.62	15.11	0.38
Puts	0.46	-0.16	-0.33	-0.72	0.37	1.86	2.86	0.16
Calls	0.28	-0.38	-0.36	-1.37	-0.45	2.82	1.75	-0.07
Swaps (mid)	-0.42	-0.64	-0.63	-0.79	0.28	2.15	0.58	-0.01
V Swaps (offer)	-0.44	-0.67	-0.65	-0.80	0.00	2.11	0.55	-0.04
Unhedged	-0.38	-0.63	-0.56	-0.84	0.23	2.33	0.84	0.03
- Zero Equity								
Forwards	15.48	28.16	32.35	37.97	30.35	32.29	45.93	26.71
Puts	-32.63	-0.66	-1.77	0.35	1.04	-0.31	-0.31	0.69
Calls	0.87	0.73	-1.49	-1.00	-0.45	1.63	-1.45	-0.45
V Swaps (mid)	-2.53	-0.87	-1.80	-0.03	0.69	0.42	-0.97	-0.17
V Swaps (offer)	-2.60	-0.90	-1.84	-0.07	0.00	0.35	-1.00	-0.21
Unhedged	-0.77	-0.24	-0.48	-0.01	0.19	0.23	-0.24	0.03

* The terms 'With Rf' refers to the fact that excess returns were used in the Sharpe ratio calculations. 'Zero Rf' uses zero risk-free rates for return calculations. The term 'With Equity' refers to the fact that the true equity returns are included in the return calculations. Accordingly the term 'Without Equity' means that equity returns were assumed to be 0%.

Table 15: Six month Strategy Sharpe Ratios for the Period of January 1995 to December 1999.

Strategy		Canadian Dollar	German Deuatschemark	British Pound	Japanese Yen
With Rf*:					
- With Equity*					
	Forwards	0.59	1.08	0.98	0.08
	Puts	0.48	1.02	0.67	0.07
	Calls	0.65	0.88	1.43	-0.12
	V Swaps (mid)	0.50	0.77	1.20	-0.09
	V Swaps (offer)	0.48	0.77	1.17	-0.10
	Unhedged	0.54	0.81	1.23	-0.09
- Zero Equity*					
	Forwards	-1.46	-12.68	-10.95	-0.17
	Puts	-3.17	-1.27	-3.68	0.00
	Calls	-1.55	-0.71	-1.15	-0.45
	V Swaps (mid)	-1.58	-0.78	-1.44	-0.24
	V Swaps (offer)	-1.62	-0.79	-1.51	-0.25
	Unhedged	-1.43	-0.57	-1.34	-0.24
Zero Rf*:					
- With Equity					
	Forwards	1.06	1.31	1.68	0.34
	Puts	0.93	1.25	1.45	0.30
	Calls	1.12	1.08	2.04	0.08
	V Swaps (mid)	0.98	0.98	1.85	0.08
	V Swaps (offer)	0.96	0.97	1.82	0.07
	Unhedged	1.03	1.00	1.83	0.08
- Zero Equity					
	Forwards	-0.04	6.89	-1.67	5.17
	Puts	-0.51	-0.13	-1.39	0.46
	Calls	0.24	-0.05	1.41	0.04
	V Swaps (mid)	-0.24	-0.30	0.00	0.04
	V Swaps (offer)	-0.29	-0.31	-0.07	0.02
	Unhedged	-0.13	-0.08	0.18	0.04

* The terms 'With Rf' refers to the fact that excess returns were used in the Sharpe ratio calculations. 'Zero Rf' uses zero risk-free rates for return calculations. The term 'With Equity' refers to the fact that the true equity returns are included in the return calculations. Accordingly the term 'Without Equity' means that equity returns were assumed to be 0%.

The Sharpe ratios for the one month forward strategies when the equity returns were zero, were sometimes very large in absolute value. This is due to the fact that the standard deviation of excess returns with no tracking error, tends to be very low. This is because one is really only measuring the standard deviation of the change in the outright forward prices. Since the Sharpe ratio is calculated as the mean of excess returns divided by the standard deviations of those returns, the Sharpe ratio will therefore show a very high absolute value. When one takes the equity returns into account, it allows for more variability in the returns. This in turn allows for a higher standard deviation and thus a lower absolute value for the Sharpe ratio. As well, for the 1994 and 2000 sub-periods in particular, since they only contain three monthly observations each, the standard deviation of returns can be quite small causing a high absolute value for the Sharpe ratio.

(4.2)   Dominance Analysis

Since the results for the sub-periods in the above tables do not allow for clear discrimination among the various strategies, tables 16 and 17 present the results of a dominance analysis in which I compare the volatility swap strategies to the other strategies.[97] I used the results from the strategies that use returns in excess of the risk-free rates when calculating the Sharpe ratios, as opposed to those strategies that assume zero

---

[97] Similar to the dominance analysis outlined by Eun and Resnick (97).

risk-free rates.[98] Sharpe ratios for those strategies that include equity returns as well as those that do not are analyzed. The following tables represent the number of sub-periods that the strategy on the left hand side had a greater annualized Sharpe ratio than the volatility swap strategies.

Table 16: Dominance Analysis for One Month Strategies, October 1994, to March 2000

Vswap Strategy (mid)	Currency	CAD		DEM		GBP		JPY	
		With Equity	Without Equity	With Equity	Without Equity	With Equity	Without Equity	With Equity	Without Equity
Strategy									
Forwards		4	6	6	0	6	0	5	3
Puts		3	5	5	0	1	0	5	3
Calls		7	2	6	7	6	5	5	2
Unhedged		7	7	7	7	7	7	5	7

Table 17: Dominance Analysis for One Month Strategies, October 1994, to March 2000

Vswap Strategy (offer)	Currency	CAD		DEM		GBP		JPY	
		With Equity	Without Equity	With Equity	Without Equity	With Equity	Without Equity	With Equity	Without Equity
Strategy									
Forwards		4	6	6	0	6	0	5	3
Puts		3	5	6	0	1	0	5	3
Calls		7	2	6	7	6	5	5	2
Unhedged		7	7	7	7	7	7	5	7

These dominance results were computed using the Sharpe ratios from both the mid and the offered volatility swap strategies. A comparison of tables 16 and 17 allows

---

[98] This is done since the risk-free rate was very small each period and thus wouldn't significantly affect the

us to determine if using the mid implied volatility rate or the offered implied volatility rate to price the payout on the volatility swap strategy, made a difference when comparing it to the other strategies. As we can see, only in one annual sub-period did using the mid-market rate change the ranking of the volatility swap strategy when compared to the hedging strategies. Nevertheless, this difference did not affect the overall dominance of the volatility swap strategy though. From the volatility swap strategy results in Appendix 3D, we can see that there was only a slight difference in the annualized Sharpe ratios when calculated using mid implied volatility rates and compared to those using offered rates. It did not have a material effect when compared to the currency risk-management strategies. For this reason, during the remainder of this thesis, I will refer to only the Sharpe ratios of the volatility swap strategy which uses the mid-market implied volatility rates.

The dominance analysis also demonstrates the difference in the dominance of the volatility swap strategy when zero equity returns are assumed. For the British pound, there was a higher dominance of the volatility swap strategies. For the Canadian dollar, the German deutschemark, and the Japanese yen, the results were mixed depending on the strategy. Since the return series that includes zero equity returns is supposed to have no tracking error, it can be said that over this time period, for these currencies, that tracking error does play a part in the dominance of the volatility swap strategy when compared to the hedging strategies.

---

results.

(4.3) Analysis

There was a question put forth at the beginning of this thesis. Could a foreign exchange volatility swap strategy provide higher risk-adjusted returns than strategies using classic foreign exchange hedging instruments? In this section, the risk-adjusted returns of the volatility swap strategy is compared to each of the other classic hedging strategies. It is also compared to an unhedged currency position. This allows us to determine the relationship between the realized and implied volatility for each currency over the October 1994, to March 2000 time period. We have seen in Section 3.5, that the exchange rate environment of the underlying foreign currency can have a large impact on the return to the currency risk management strategies. For this purpose, I conducted several tests to determine the existence of trends in the underlying currencies. The results did not show any discernible trends for the currencies over the October 1994, to March 2000 time period. These tests can be found in Appendix 5.

The following analysis examines the volatility swap strategy for each currency and attempts to explain why it was either higher or lower than the hedging strategies. For each currency studied, I have included bar charts that compare the risk-adjusted returns from each strategy. As well, graphs of the realized vs. implied volatility rates, the forward premium, and the respective equity index returns have been included after the write-up of the analysis for each currency's strategies. Figure 4 shows the monthly

foreign exchange spot rates for each currency over the period studied.

Figure 4: Monthly Foreign Exchange Spot Rates from October 1994, to March 2000

Monthly Foreign Exchange Rates
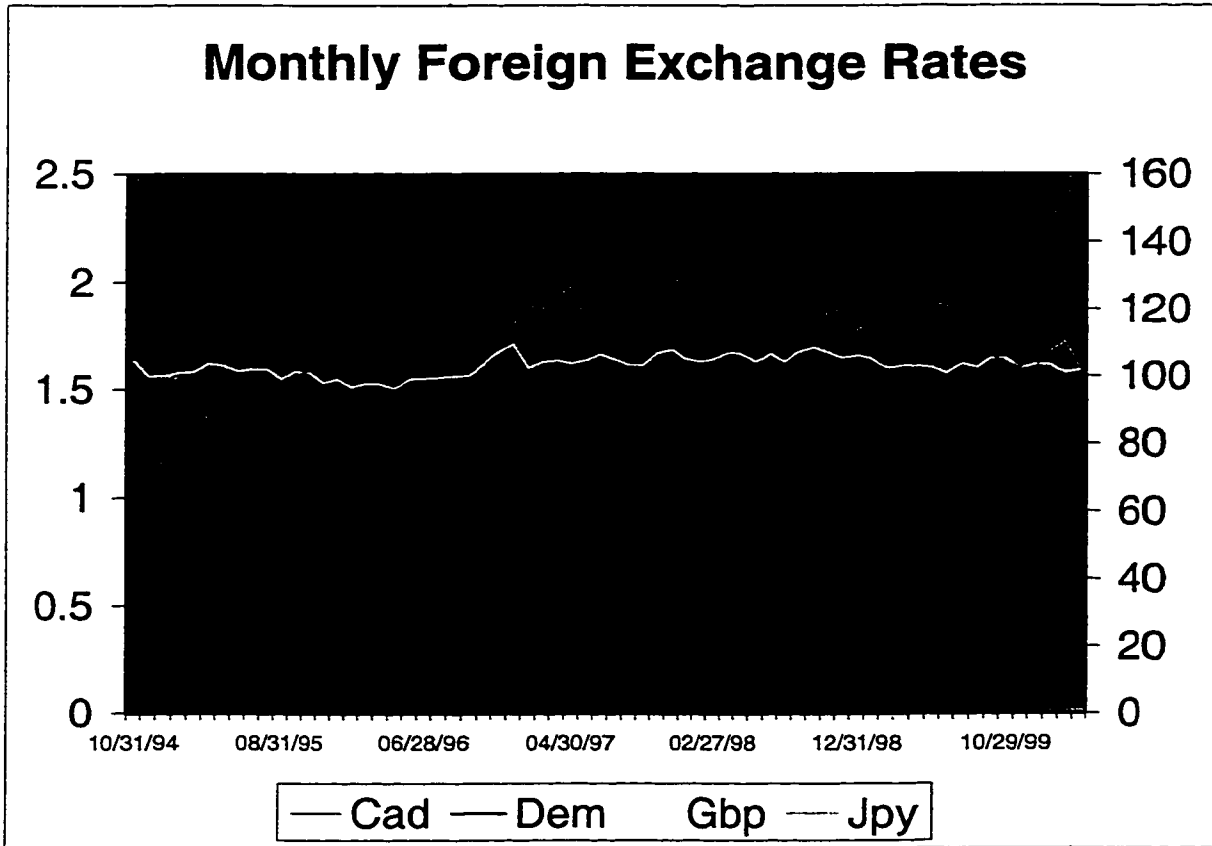
(i) Canadian Dollar Strategies

When one examines figure 5, which charts the results of the one month Canadian dollar strategies, it is obvious that the volatility swap strategy always had lower Sharpe ratios than the unhedged strategy. We know from the profit-loss diagram in Section 3.5, that the volatility swap strategy, that it outperforms the unhedged strategy when the realized volatility of the underlying currency over the life of the swap contract, is greater than the implied volatility at the beginning of the contract. Since the implied volatility is the market's perception of where the future volatility of the currency is expected to be, a currency volatility swap would protect the holder from any *unexpected* increases in volatility. A quick glance at figure 6 which compares the Canadian realized and implied volatility levels, reveals that the realized volatility was almost always less than the implied. This indicates that the Canadian dollar was not unexpectedly volatile over the course of this time period. Hence the volatility swap strategy exhibited lower Sharpe ratios than the unhedged strategy.

When comparing the volatility swap strategy to the forwards strategy, the former was higher than the latter just slightly in the 1996 and 1999 sub-periods, and quite a bit higher in the 1995 sub-period. During 1995, the forward points for the Canadian dollar turned positive, and hence locked-in a negative currency return. The Canadian Dollar also appreciated during this period, so the high return to the unhedged position was reflected in the volatility swap strategy. However, during the overall investment period,

the Canadian dollar forward points were on average negative and hence the forward strategy locked-in a positive currency return. See figure 7. This positive return was higher on average than the return to the volatility swap strategy The average excess returns were 0.93% and 0.67% respectively. Both strategies had roughly the same standard deviation of returns, 4.87 and 4.82, hence the forward strategy resulted in a higher annual overall risk-adjusted return.

The results for both the protective put and the covered call strategies depend in part on whether the market over or under values the option prices. The construction of the option strategies is such that the option strikes are set at the ATM forward rate. This is the same rate as the outright forward price used in the forward strategy. Efficient market theory states that the payment (or receipt) of the premium should offset any benefits derived from holding (or writing) the option. Thus the protective put and covered call strategies should "yield the same average results as from hedging in the forward market."[99] As can be seen from the bar chart of the Canadian dollar strategies, the option and the forward strategies do not yield the same average results. The market therefore, during this period, was not efficient in pricing the Canadian dollar call and put options.

The one month protected put strategy did very poorly for the overall October 1994, to March 2000 time period. However, when one examines the sub-periods, the volatility swap strategy actually had lower Sharpe ratios three out of seven times. It must

be noted that two of these sub-periods only had three monthly return values and thus may not be as significant. The holder of a foreign currency put exercises the put when the Canadian dollar depreciates from the strike price. During the entire investment period, the put was exercised 38 times for 66 monthly periods. Therefore more than half the time, the Canadian dollar depreciated. Had the premium on the put option been zero, then the depreciating currency may have caused a lower risk-adjusted return for the volatility swap strategy. However, the put option's price was not trivial, and as we have seen, put options were considered overvalued during this period. The put options did provide protection, but the the value of the put paid was greater than the savings the put provided. Comparing average excess returns over this period, the volatility swap returned 0.67% and the put strategy -0.40%. They both had similar standard deviations of the excess returns, 4.87 and 4.84. This resulted in a lower annualized Sharpe ratio for the put strategy.

The one month covered calls strategy exhibited the highest risk-adjusted return during the overall period, as well as for each sub-period. When compared to a volatility swap strategy, the call strategy does better when the underlying currency appreciates slightly or depreciates (unless the realized volatility is very high). In this strategy the call option is exercised when the Canadian dollar appreciates. The call option was exercised 28 times for the 66 monthly periods. Therefore during less than half the one month investment periods analyzed, the Canadian dollar appreciated. Since a volatility swap

---

[99] Eun and Resnick (97) p. 23

strategy benefits from an appreciating foreign currency, this gives us some indication of why the volatility swap strategy did so poorly against the calls strategy. In addition, the calls strategy includes the receipt of the premium for the call option. Since the Canadian dollar calls were assumed overpriced during this period, this would increase the return to the calls strategy. The average excess returns and standard deviation of those returns for the entire period are 1.23% and 4.49 for the call strategy, and 0.67% and 4.87 for the volatility swap strategy. This lead to a much higher annualized Sharpe ratio for the covered call strategy.

When comparing the Canadian dollar strategies with equity returns to those without (see figure 8), the volatility swap strategy Sharpe ratios remain lower than those for the forward, the calls and the unhedged strategies. When assuming zero equity returns, over the entire investment period, the volatility swap Sharpe ratio was only higher than the puts strategy. Since when assuming zero equity returns, the Sharpe ratios are supposed to be free of tracking error, obviously tracking error does not affect the Canadian dollar option hedging strategies when they are compared to the volatility swap strategy for the October 1994, to March 2000 period. The graph of the TSE 300 and the Canadian dollar, figure 9, illustrates the direction of tracking error. Tracking error is positive for the hedging strategies when the equity index return is greater than zero and the currency appreciates. Tracking error is also positive when the equity index return is less than zero and the currency depreciates.

For the six month Canadian dollar strategies, shown in figure 10, the Sharpe ratio for the volatility swap strategy is lower than those for each of the hedging strategies, except for the calls strategy. Therefore on average, over the period studied, the volatility swap strategy had the same dominance ranking when compared to the classic hedging strategies either over one or six month investment periods.

Since the volatility swap strategy also had a lower risk-adjusted return than the unhedged strategy, one can surmise that the relationship between Canadian dollar six month realized and implied volatilities, is similar to that of the one month realized and implied volatilities. Figure 11 shows a graph of the six month Canadian dollar volatilities. Once again it seems that, on average, dealers tend to overstate their forecasts of future volatilities.

Figure 5: Sharpe Ratios from One Month Canadian Dollar Strategies

Canadian Dollar Strategies With Equity Returns
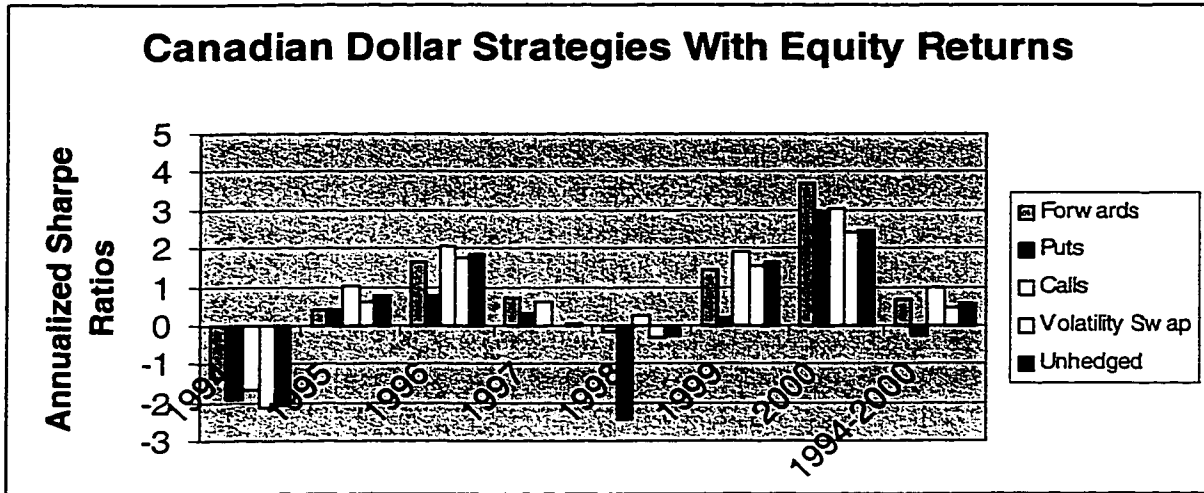
Figure 6: Comparison of One Month Canadian Dollar Realized and Implied Volatilities

Canadian Dollar Volatilities
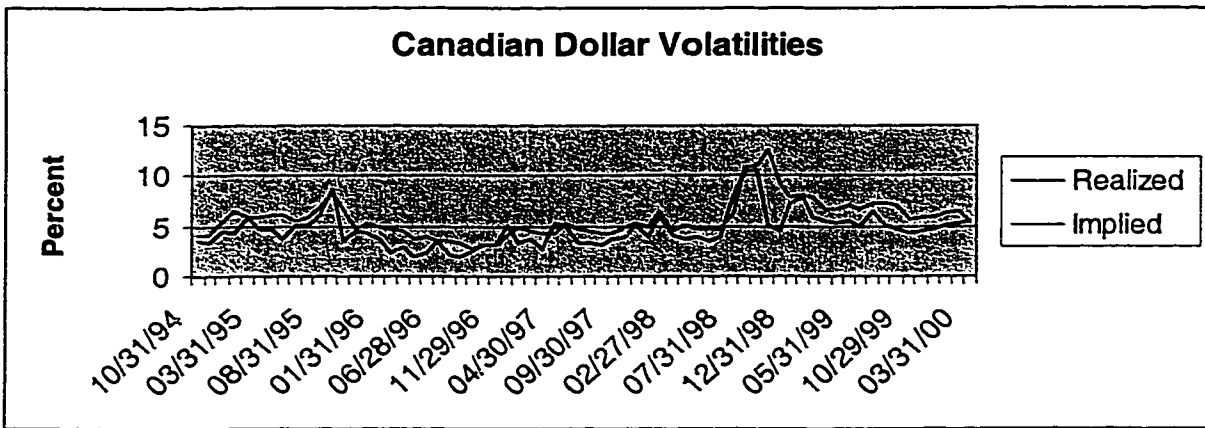
Figure 7: Canadian Dollar One Month Forward Points
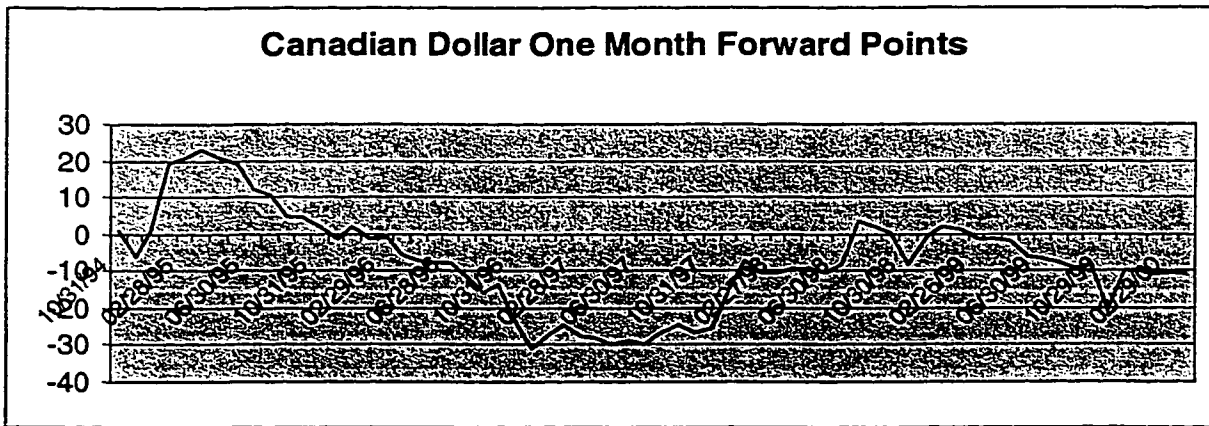
Canadian Dollar One Month Forward Points

Figure 7: Sharpe Ratios from One Month Canadian Dollar Strategies, With Zero Equity Returns

Canadian Dollar Strategies With Zero Equity Returns

Legend:
- Forwards
- Puts
- Calls
- Volatility Swap
- Unhedged
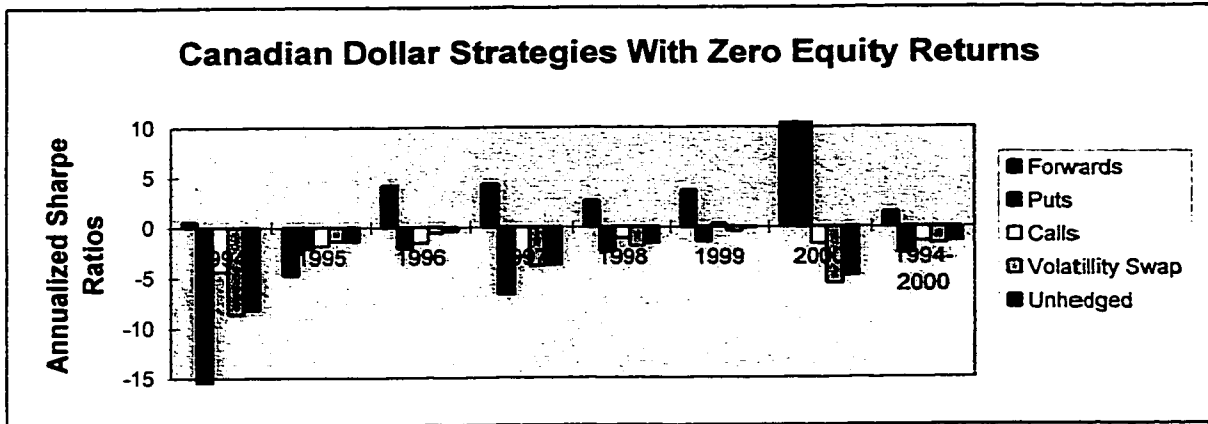
Figure 8: Canadian Dollar vs. the TSE 300

Canadian Dollar vs. TSE300

Legend: TSE — Canadian Dollar Spot
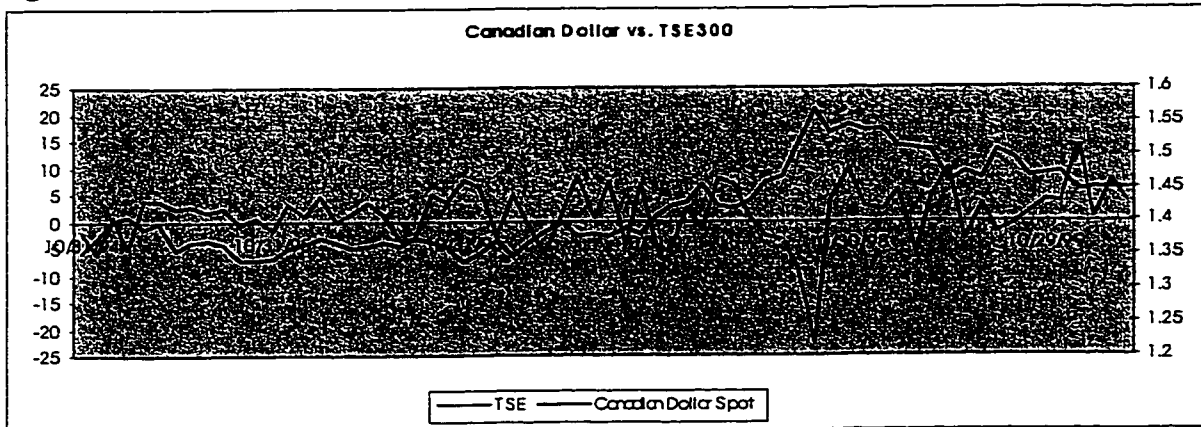
Figure 10: Sharpe Ratios from Six Month Canadian Dollar Strategies

Canadian Dollar Six Month Strategies

Legend:
- Forwards
- Puts
- Calls
- Volatility Swap
- Unhedged

Y-axis: Annualized Sharpe Ratios (0, 0.2, 0.4, 0.6, 0.8)
X-axis: 1994-2000
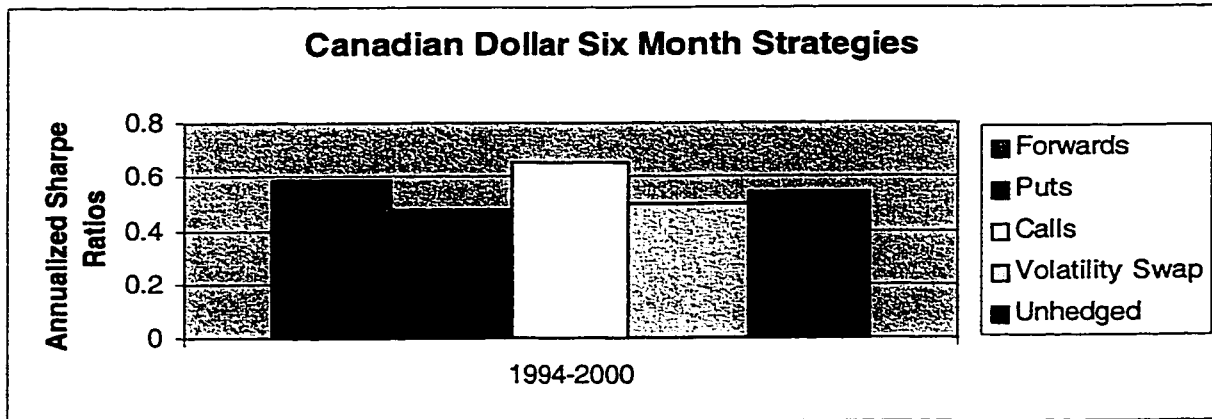
Figure 11: Comparison of Six Month Canadian Dollar Realized and Implied Volatilities

Canadian Dollar Six Month Volatilities

Legend:
- Realized
- Implied

Y-axis: Percent (0, 2, 4, 6, 8, 10)
X-axis: 1995, 1996, 1997, 1998, 1999
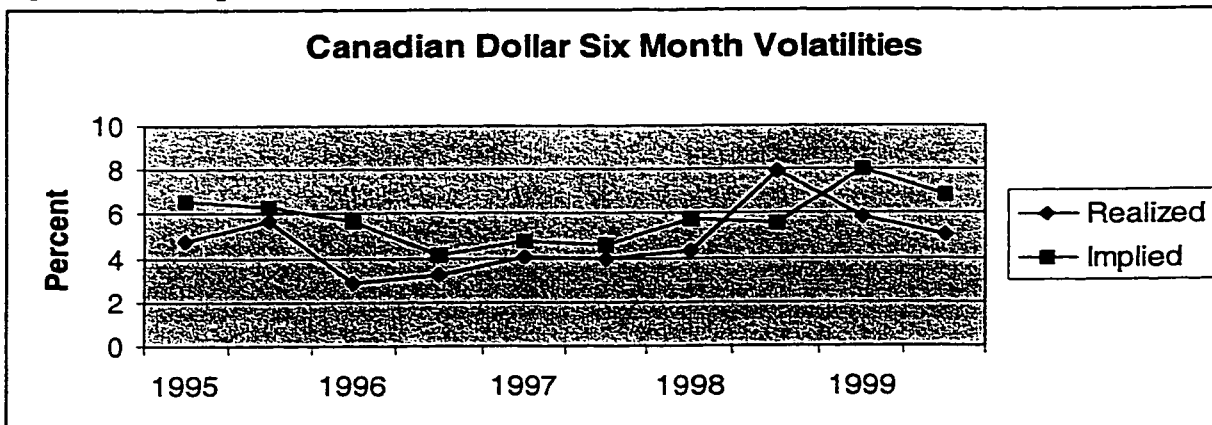
(ii)   German Deutschemark Strategies

As shown in figure 12, similar to the results for the Canadian dollar strategies, the German deutschemark volatility swap strategy had Sharpe ratios slightly lower than the unhedged strategy for each sub-period as well as the overall investment period. Again, a quick glance at the graph of the realized one month volatilities shows that they were generally below the implied volatility rates during the October 1994, to March 2000 time period.

The one month volatility swap strategy performed in general worse than the one month forward strategy. From figure 13, one can see that all the German deutschemark forward points were negative and quite large, resulting in a locked-in currency profit for the forward strategy. The one sub-period where the volatility swap strategy showed a higher risk-adjusted return, was 1998. During this period, while the forward strategy still had a positive currency return, the German deutschemark experienced some very large appreciations, and hence a positive currency return. This currency return outweighed the currency return to the forward strategy, on a risk-adjusted return basis.

The volatility swap strategy had a lower Sharpe ratio than the protective put strategy five out of the seven sub-periods, and as well for the overall October 1994, to March 2000 period. During the 1995 sub-periods, both strategies had similar Sharpe ratios. Only during the 1998 period, did the volatility swap strategy have a higher Sharpe ratio. We know the put strategy offers protection when the German deutschemark

depreciates against the US dollar. However, as we have already seen, this was not the case on average, for the 1998 sub-period. The German deutschemark experienced some very high currency returns during this time. Thus the volatility swap strategy exhibited a higher risk-adjusted return than the put strategy.

Comparison of the volatility swap strategy to the covered call strategy produces the same result. The calls strategy had higher Sharpe ratios than the volatility swap strategy over the entire period, and in all sub-periods but 1998. Once again the large appreciation of the deutschemark allowed for the relatively high risk-adjusted return to the volatility swap strategy in the 1998 sub-period.

When examining the tracking error of the one month, German deutschemark strategies for the October 1994, to March 2000 time period, we turn to the results for the strategies with zero equity returns. We can see in figure 15 that unlike when true equity returns are included, the volatility swap strategy did better than both the forward and the puts strategy over the entire period. We cannot quantify the amount of tracking error from these results. Nevertheless, it appears that tracking error to an investment in the DAX over the October 1994, to March 2000 time period did have an impact on both the forward and the puts strategy, when comparing them to the volatility swap strategy. The graph of the DAX equity index against the German deutschemark illustrates the direction of the tracking error.

The six month deutschemark strategies show similar results to the one month

strategies. The volatility swap strategy did not have higher risk-adjusted returns than any of the hedging strategies. The six month realized volatility was also lower than the six month implied volatility, meaning that the German deutschemark had no unexplained volatility over either the one month nor the six month investment periods from October 1994, to March 2000.

Figure 12: Sharpe Ratios from One Month German Deutschemark Strategies

German Deutschemark One Month Strategies With Equity Returns
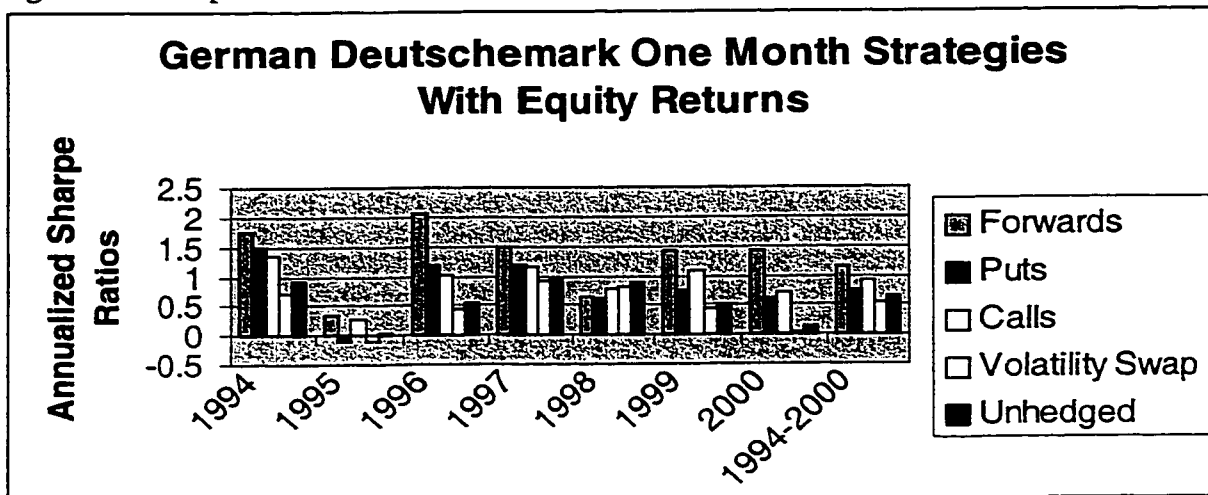
Figure 13: Comparison of One Month German Deutschemark Realized and Implied Volatilities

German Deutschemark Volatilities
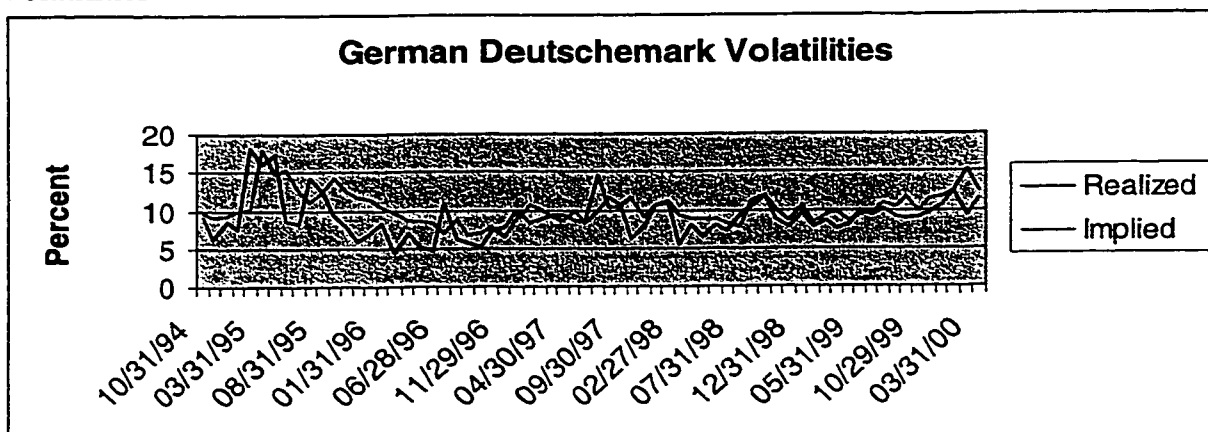
Figure 14: German Deutschemark One Month Forward Points

German Deutschemark One Month Forward Points
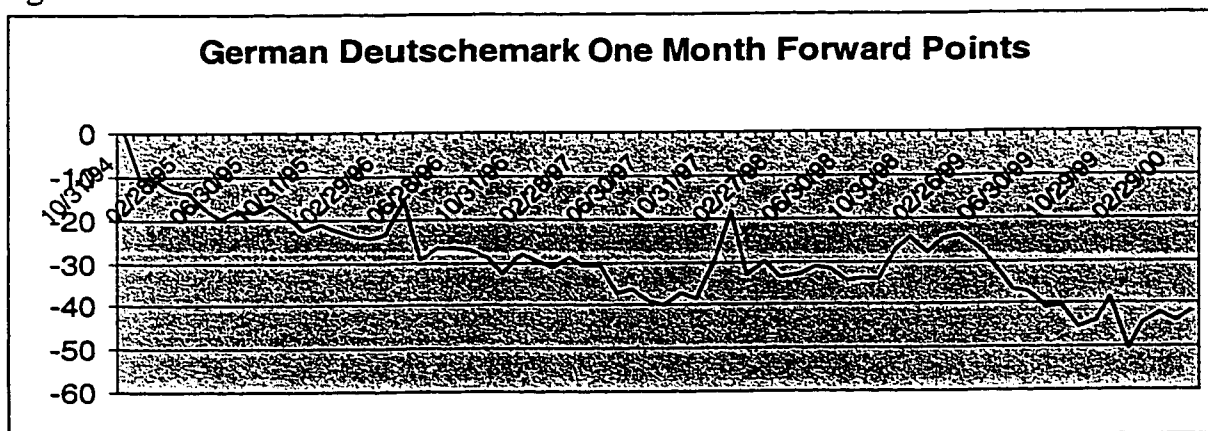
Figure 15: Sharpe Ratios from German Deutschemark One Month Strategies With Zero Equity Returns

German Deutschemark Strategies With Zero Equity Returns

Legend:
- Forwards
- Puts
- Calls
- Volatility Swap
- Unhedged
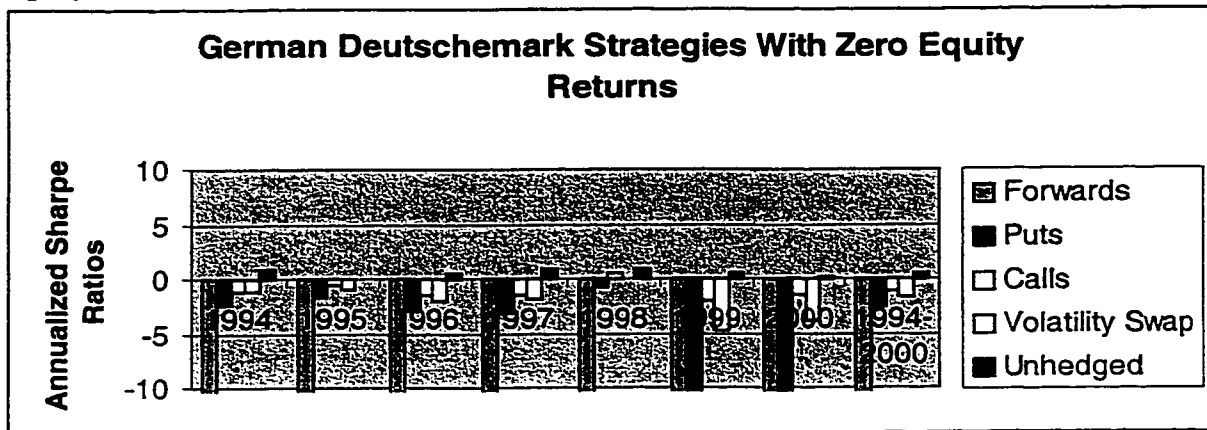
Figure16: German Deutschemark vs. the DAX

German Deutschemark Spot vs. the DAX

— DEM Spot — DAX
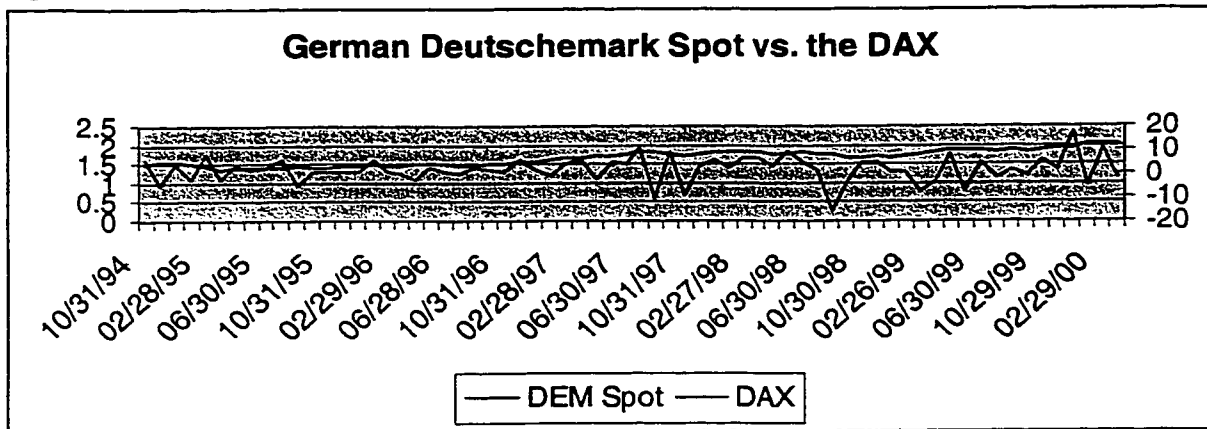
Figure 17: Sharpe Ratios from Six Month German Deutschemark Strategies

German Deutschemark Six Month Strategies With Equity
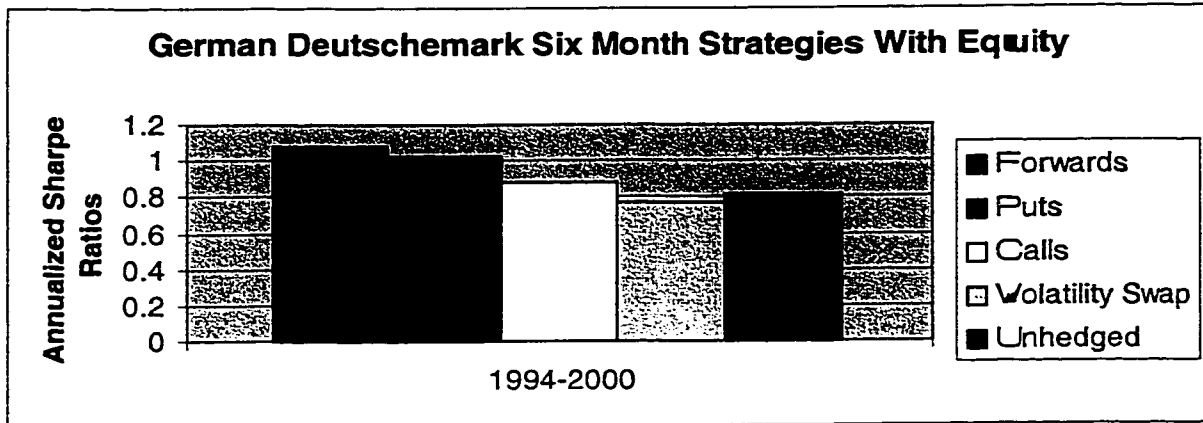
Figure 18: Comparison of Six Month German Deutschemark Realized and Implied Volatilities

German Deutschemark Six Month Volatilities
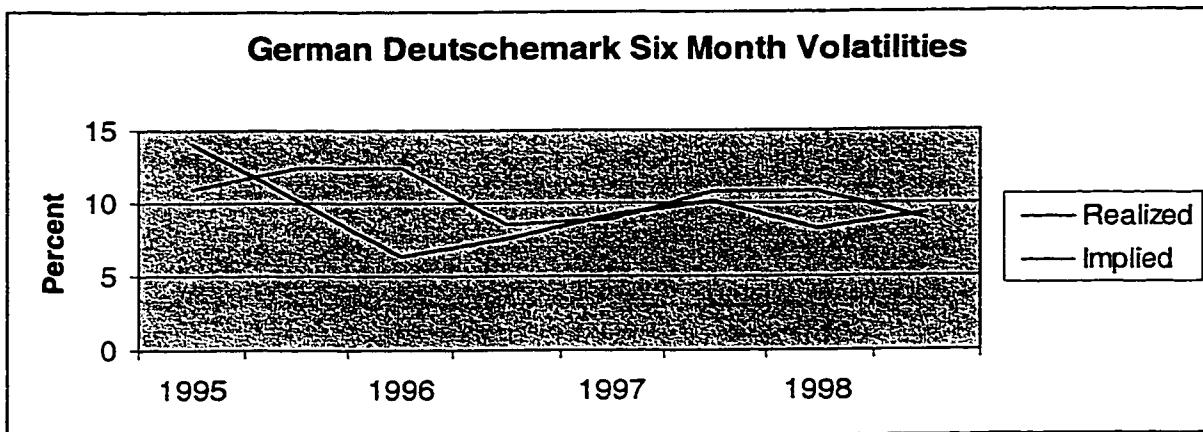
(iii)   British Pound Strategies

The one month volatility swap strategy for the British pound again showed lower risk-adjusted returns than the unhedged positions (see figure 19). From figure 20, we can see that at a few points the one month realized volatility was higher than the implied one month volatility. Although they did seem to cross quite a few times, nevertheless, on average, the realized volatility was lower than the implied.

The one month volatility swap strategy, although very close in a few sub-periods, produced generally lower risk-adjusted returns than the forwards strategy. From figure 21, we can see that the forward points were on average negative. For the British pound forwards strategy this locks-in a negative currency return. The British pound however, on average depreciated over this time period, resulting in varied results for the volatility swap strategy. On average both strategies returned positive risk-adjusted returns. These were 0.70 for the forwards strategy and 0.43 for the volatility swap strategy.

The one month protective puts strategy performed very poorly throughout this period. The put option was exercised 34 times over the 66 monthly periods. This tells us that the British pound was depreciating more than half the time. However the puts strategy exhibited a negative currency return practically every month. This implies that the value of the protection offered from the put was less than the cost of the put. This also implies that when the currency appreciated, it was not large enough so as to offer a positive currency return higher in value than the price paid for the put.

The one month covered calls strategy had quite a high Sharpe ratio over the October 1994, to March 2000 period when compared to the volatility swap strategy. The returns to the call strategy were positive practically every month. This means that even if the call was exercised, the value of the call was greater than the loss from the foreign currency. When the currency depreciated the call was not exercised and again the value of the call was greater than the loss to the foreign currency position. Here the calls strategy had an average excess return of 0.87% compared to 0.52% for the volatility swap strategy. The standard deviations were 3.89 and 4.25 respectively, resulting in Sharpe ratios of 0.78 and 0.48 respectively.

Tracking error made little difference in terms of the dominance of the one month volatility swap strategy when comparing it to the option hedging strategies. The forwards strategy however exhibited very low Sharpe ratios when the equity returns were assumed to be zero. This is due to the fact that the forward points were generally negative and since they were quite stable over this period, it caused a very low standard deviation of the excess returns. This resulted in the low risk-adjusted returns for this strategy.

As opposed to the one month strategies, the six month volatility swap strategy had a higher risk-adjusted return than the forward strategy. This demonstrates that for the British pound over this period, the length of the investment period over which the forward strategy is applied makes a difference when comparing it to the volatility swap strategy. Six month volatilities exhibited the same pattern as the one month volatilities.

The realized volatilities were being lower on average, than the implied volatilities.

British Pound Analysis

Figure19: Sharpe Ratios from One Month British Pound Strategies, With Equity

British Pound Strategies With Equity Returns

■ Forwards
■ Puts
□ Calls
▣ Volatility Swap
■ Unhedged
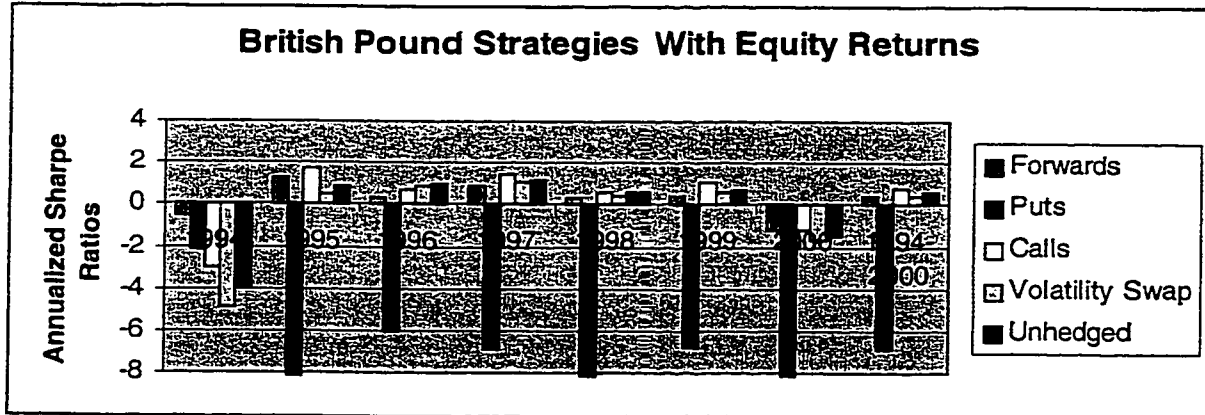
Figure 20: Comparison of One Month British Pound Realized and Implied Volatilities

British Pound Volatilities

—— Realized
—— Implied
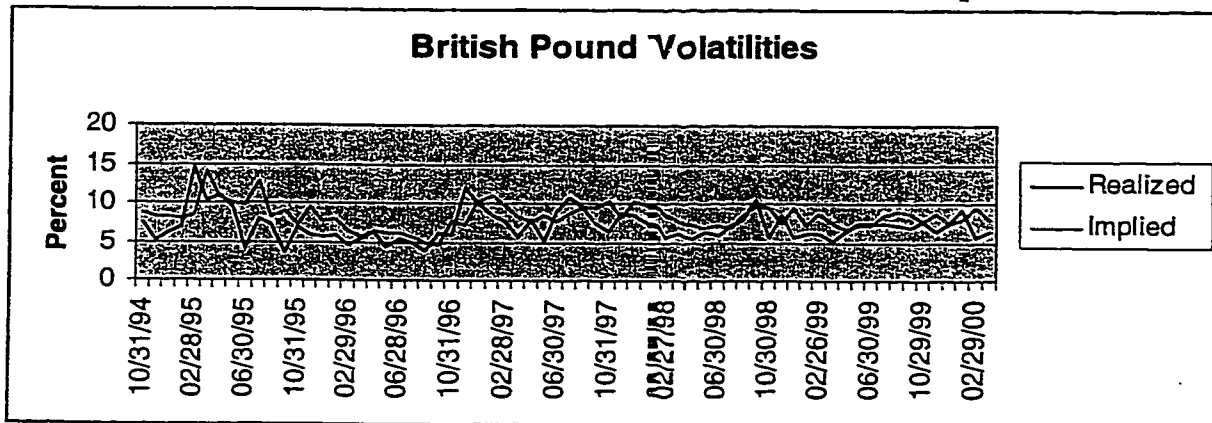
Figure 21: British Pound One Month Forward Points

British Pound One Month Forward Points
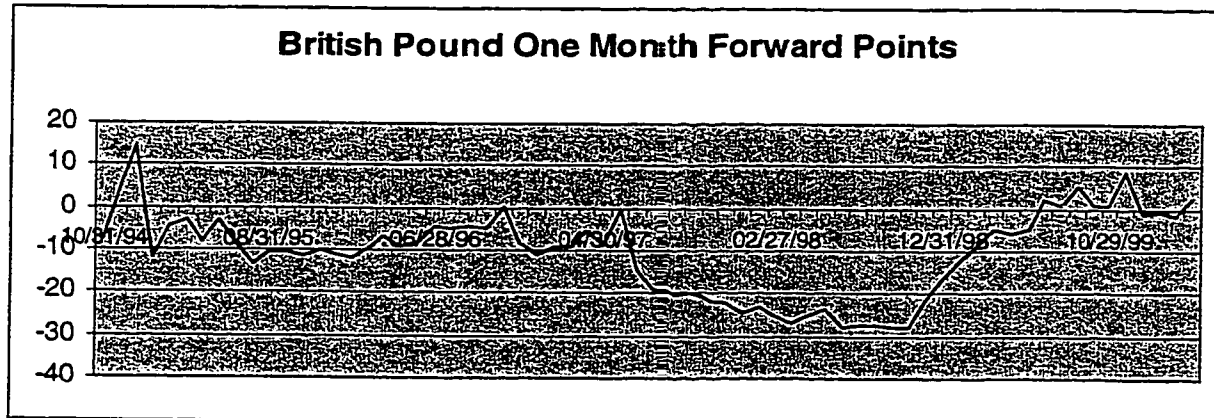
Figure 22: Sharpe Ratios for One Month Strategies With Zero Equity Returns

British Pound Strategies With Zero Equity
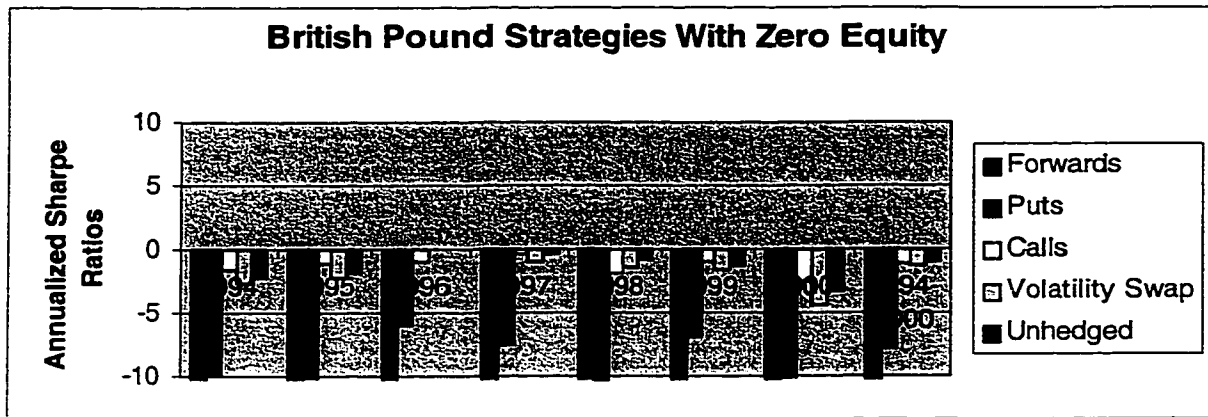
Figure 23: British Pound vs. FTSE

British Pound vs. FTSE
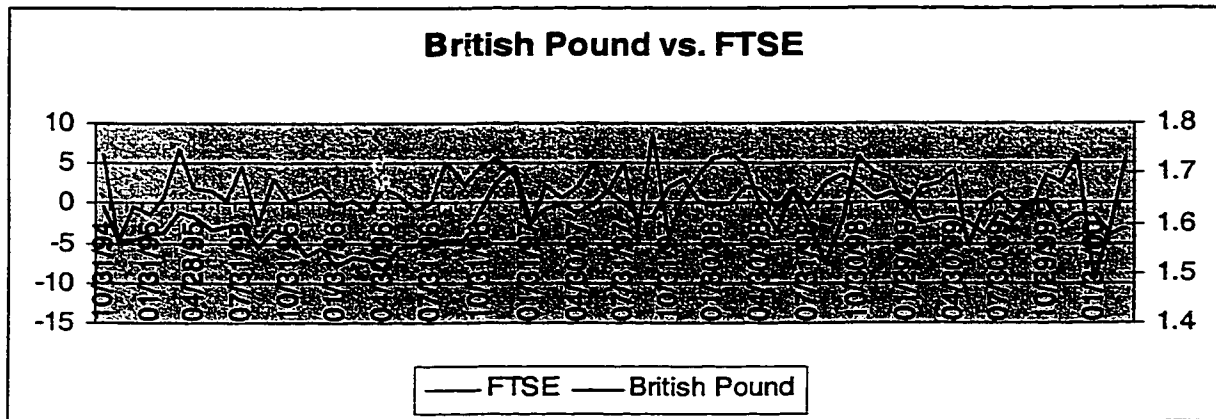
Figure 24: Sharpe Ratios from Six Month British Pound Strategies

British Pound Six Month Strategies

Legend:
- Forwards
- Puts
- Calls
- Volatility Swap
- Unhedged
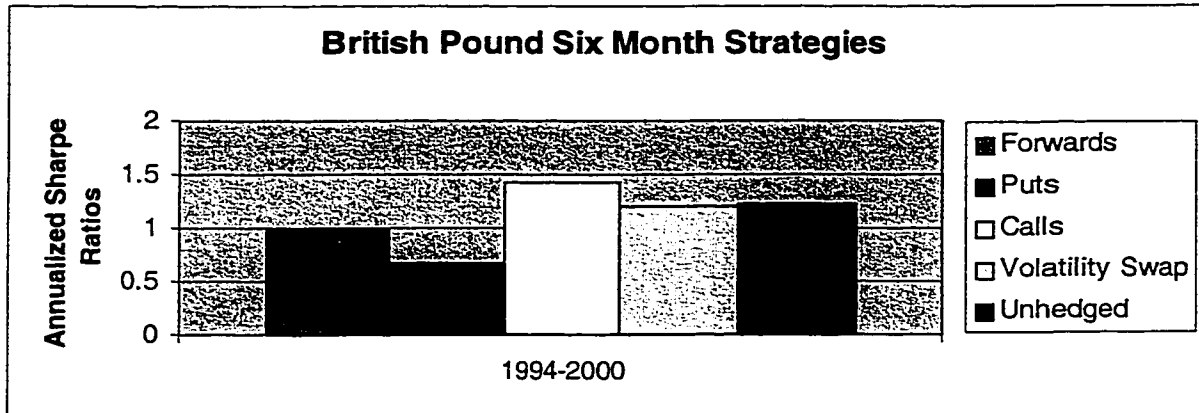
Figure 25: Comparison of Six Month British Pound Volatilities

British Pound Six Month Volatilities

Legend:
- Realized
- Implied
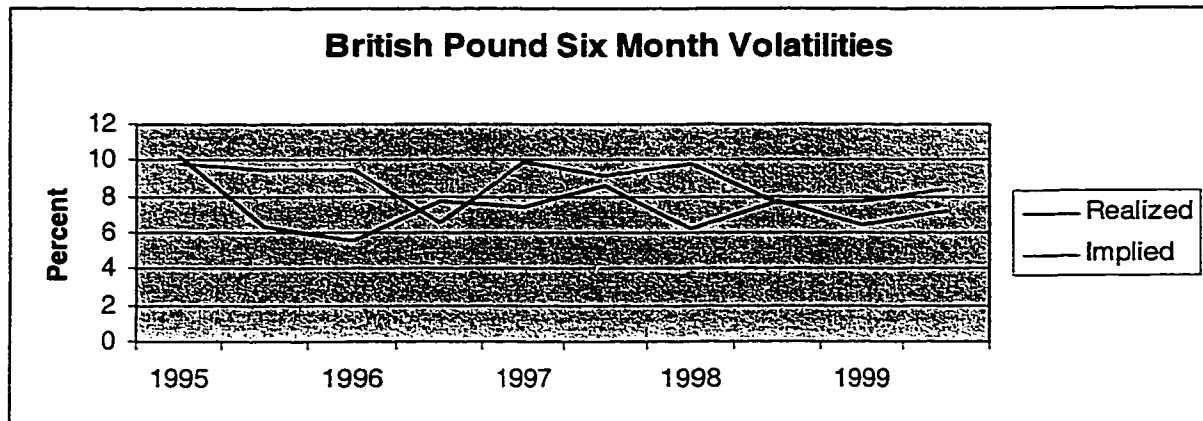
(iv)   Japanese Yen Strategies

The one month realized volatility was on average lower than the one month implied volatility for the Japanese yen over the October 1994, to March 2000 time period. However, the graph of the volatilities shows a different story than for the other currencies. Figure 27 shows many intersections between the two volatility curves. In fact there were many periods during which the realized volatility was higher than the implied. This is shown in the 1997 and 1998 sub-periods. Here the volatility swap strategy had a higher risk-adjusted return than the unhedged strategy. Nevertheless, for the overall period, the one month realized volatility was lower than the implied volatility.

During the 1997 and 1998 sub-periods the one month forward strategy had a lower risk-adjusted return than the volatility swap strategy. On average however, the Japanese yen did depreciate during the October 1994, to March 2000 time period, and the forward points were constantly negative (see figure 28). This explains the poor showing of the volatility swap strategy compared to the forwards strategy. In the 1997 and 1998 sub-period, the yen did however appreciate, and this allowed the volatility swap strategy to increase it's risk-adjusted return as compared to the forwards strategy.

On average the one month volatility swap strategy had lower risk-adjusted returns than the protective puts strategy. This is due to the fact that the yen depreciated by an amount less than the value of the put option.

The call strategy had on average, lower Sharpe ratios than the volatility swap

strategy over the October 1994, to March 2000 time period. This was not the case in every sub-period however. In five of the seven sub-periods the call strategy had higher Sharpe ratios. When we examine the average excess returns, we see that the volatility swap strategy had an average excess return of -0.48% as compared to -0.58% for the calls strategy. They also had Sharpe ratios (unannualized) of -0.07 and -0.10. Had the volatility swap strategy had the same standard deviation as the call strategy, it would have resulted in a Sharpe ratio of -0.08, which is still higher than -0.10. Therefore the difference in the risk-adjusted returns of the strategies comes from the excess returns to the strategies. From the profit/loss diagrams in Section 3.5, we saw that the call only does worse compared to a volatility swap strategy when the currency depreciates a very large amount or when it appreciates by more than the value of the call. Since we know the yen was very volatile during this time, it is plausible that the underlying currency return each period to the volatility swap strategy, were such that they outweighed the value of the call option in the covered call strategy.

When zero equity returns are assumed, the one month volatility swap strategy, as compared to the forwards strategy, has a higher risk-adjusted return (see figure 29). For the forwards strategy then, over the October 1994, to March 2000 period, the existence of basis risk or tracking error must have had a positive influence when compared to the volatility swap strategy.

The Japanese yen realized volatility, when measured over the six month

investment period, was still on average lower than the implied levels. Although figure 32 shows that, opposed to the other currency strategies studied, there were many times when the six month realized volatility was actually higher than the implied. Accordingly, the volatility swap strategy does not seem to do any better when compared to the hedging strategies over the six month investment periods, as opposed to the one month periods.

Figure 26: Sharpe Ratios from One Month Japanese Yen Strategies

Japanese Strategies With Equity Returns
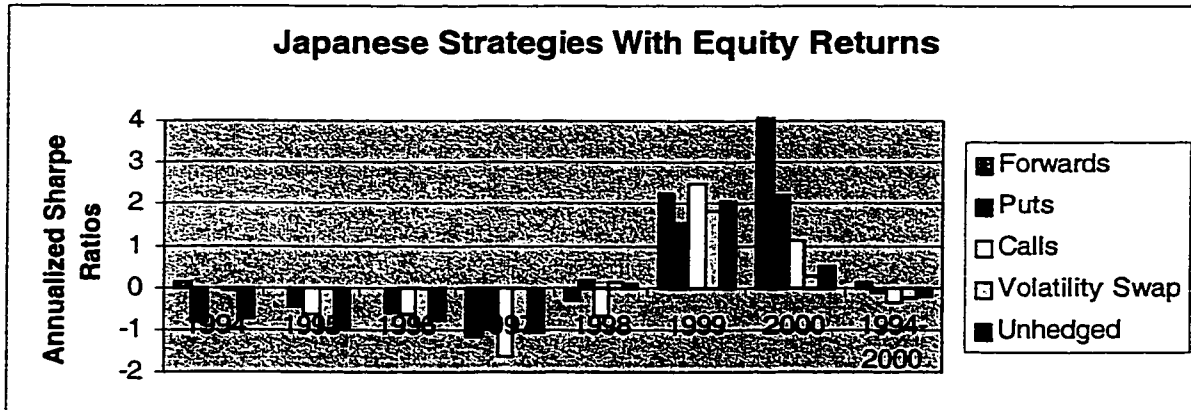
Figure 27: Comparison of One Month Japanese Yen Realized and Implied Volatilities

Japanese Yen Volatilities
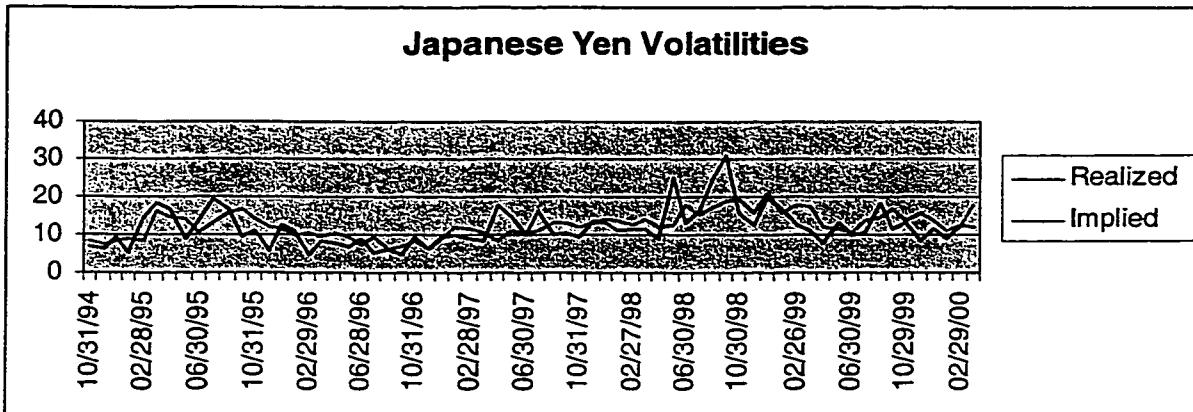
Figure 28: Japanese Yen One Month Forward Points
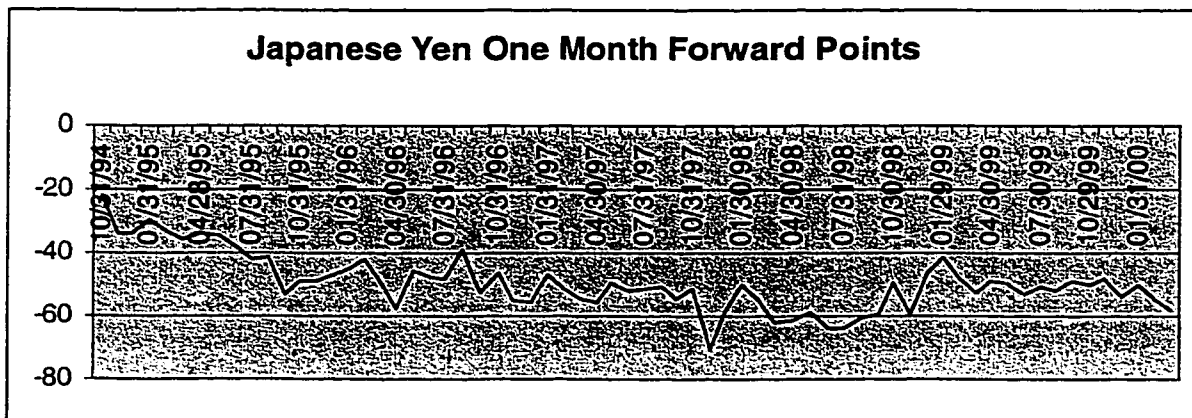
Japanese Yen One Month Forward Points

Figure 29: Sharpe Ratios from One Month Japanese Yen Strategies, With Zero Equity Returns

Japanese Strategies With Zero Equity

- Forwards
- Puts
- Calls
- Volatility Swap
- Unhedged
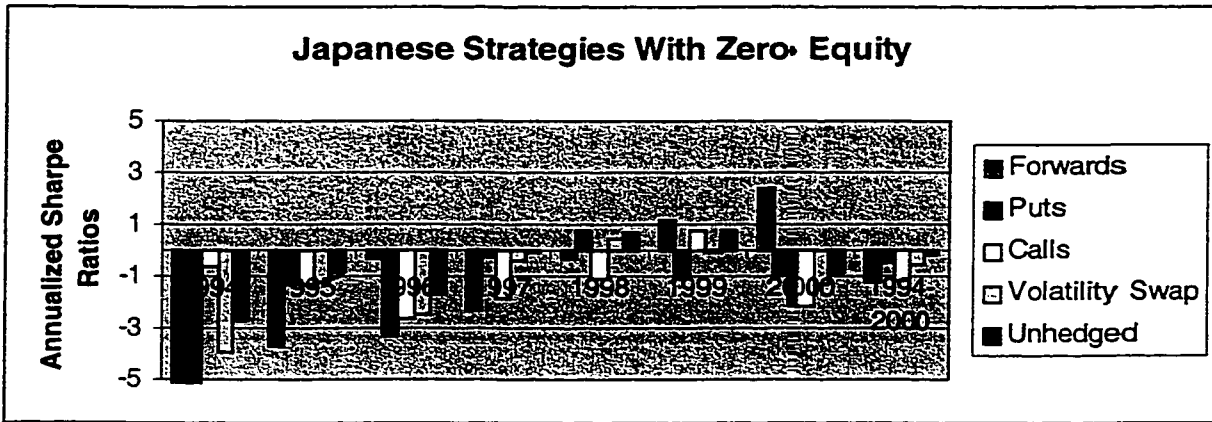
Figure 30: Japanese Yen vs. NIKKEI

Japanese Yen vs. NIKKEI

NIKKEI —— Japanese Yen

Figure 31: Sharpe Ratios from Six Month Japanese Yen Strategies
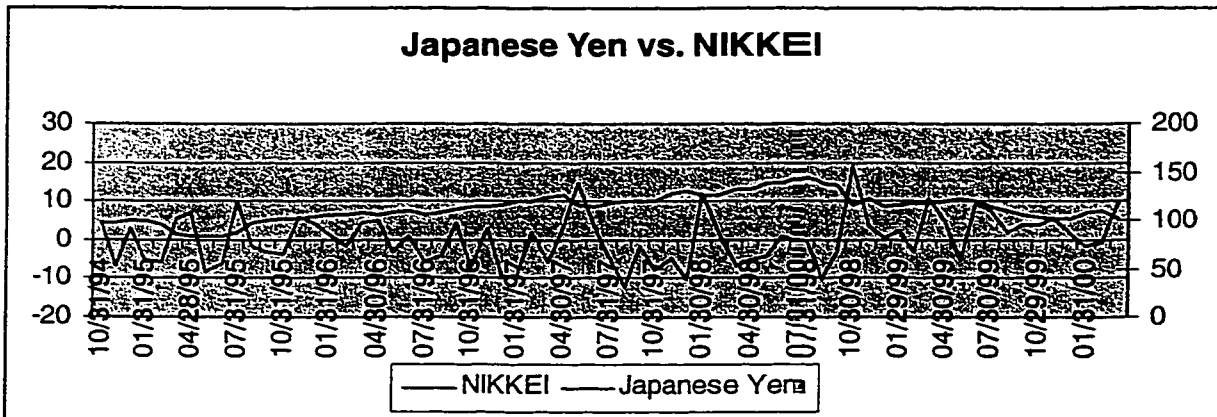
Japanese Yen Six Month Strategies

Legend:
- Forwards
- Puts
- Calls
- Volatility Swap
- Unhedged
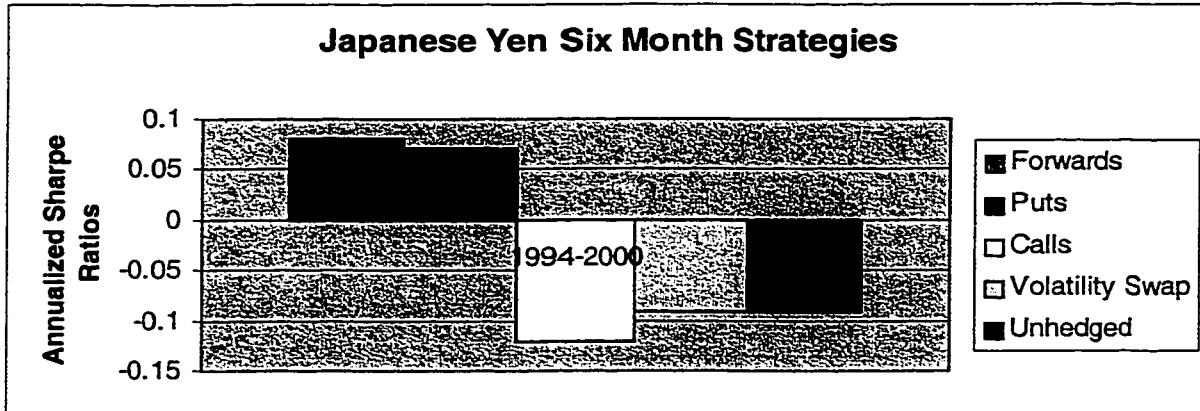
Figure 32: Comparison of Six Month Japanese Yen Realized and Implied Volatilities

Japanese Yen Six Month Volatilities

Legend:
- Realized
- Implied
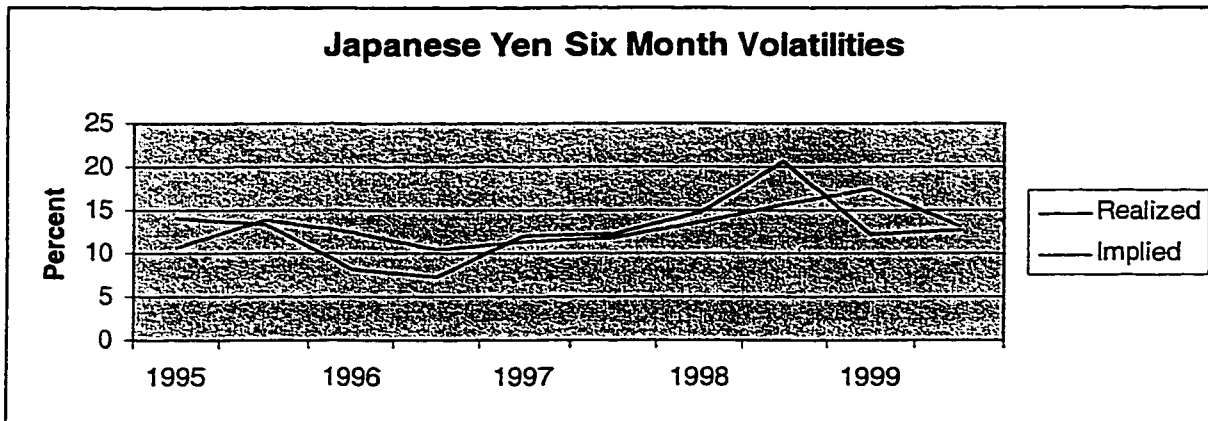
SECTION 5

SUMMARY AND CONCLUSIONS

(5.1) Summary

The introduction of foreign exchange risk from an international investment undertaken for it's diversification benefits constitutes a paradox in international investment theory. This thesis examines the problem of foreign exchange risk from the point of view of a portfolio manager.

International assets are often an integral part of the asset allocation decision since they produce diversification benefits. These diversification benefits serve to reduce the asset risk of a portfolio. To prove the existence of these benefits to a US investor, I performed a correlation analysis of the monthly foreign equity index returns from the United States, Canada, Germany, the United Kingdom and Japan, over the period of February 1971, to December 2000. I found that indeed over this period there were diversification benefits for a US investor from such an investment. I then determined the existence of foreign exchange risk to a US investor when investing in these foreign markets. To accomplish this, I performed a Purchasing Power Parity (PPP) study. Here I examined the shorter period of October 1994, to March 2000. During this time frame, the PPP was violated, implying the existence of foreign exchange risk.

Once the existence of foreign exchange risk is established, the question naturally arises about what to do about it. A portfolio manager is evaluated not only on the returns

they produce, but on their risk-adjusted returns. Therefore the addition of foreign exchange risk presents a problem. Classic hedging instruments such as forwards and options, while effective at hedging the foreign exchange risk, also have the added disadvantage of hedging the returns as well. Leaving the foreign exchange rates unhedged allows for upside profit potential when the underlying foreign currency appreciates, but it still produces foreign exchange risk.

This thesis examines a relatively new financial instrument, the volatility swap. A foreign currency volatility swap allows the holder to obtain a pure exposure to the future volatility of a currency. This thesis attempts to determine whether volatility swaps can be useful as currency risk management tools. To do this, I develop a strategy that leaves the foreign exchange exposure of a foreign equity investment unhedged, and buys volatility swaps on the underlying currency. This strategy is then compared on a risk-adjusted return basis, to strategies that use foreign exchange forwards and options. The risk-adjusted returns are computed by the Sharpe ratio. The strategies involve both one month and six month investment periods from October 1994, to March 2000. As well, since the classic hedging instruments also exhibit tracking error when hedging the foreign exchange risk of a foreign equity investment, I also calculated a series of Sharpe ratios when the equity returns were assumed to be zero.

(5.2) Conclusions

It was mentioned at the beginning of the thesis, that the main reason why investors hedge their foreign currency exposure is to reduce the additional risk associated with a foreign investment due to the currency component. As mentioned in this thesis, one of the problems with hedging foreign currency risk is that one has to give up any incremental returns from a foreign currency that appreciates during the course of the foreign investment. I wanted to see if by leaving the currency exposure unhedged, and by buying volatility swaps on the underlying currency, could one be compensated for the increased volatility of an unhedged return and hence receive a higher risk-adjusted return?

When compared to the other currency risk management strategies over the October 1994, to March 2000 time period, while the volatility swap strategy never had the highest Sharpe ratio, it didn't necessarily have the lowest either.

In general, the volatility swap strategy will be superior to the classic hedging strategies if the underlying foreign currency appreciates, by an amount greater than the call option, and if the realized volatility is greater than the implied volatility at the beginning of the investment period. Examining the course of the currencies covered, during the study period, revealed that they were generally depreciating over this time period. This can be seen by the relatively poor performance of an unhedged currency exposure during this time. When examining the volatilities of these currencies, they had on average realized volatilities that were less than the implied volatilities. This was true

for the one month and the six month strategies. An exception to this, is the Japanese yen which saw superior monthly realized volatility rates over the 1997 and 1998 sub-periods.

Except for the German deutschemark strategies, the dominance of the volatility swap strategy did depend on the length of the investment period. For instance, when comparing the Canadian dollar one month strategies, the volatility swap strategy had a higher Sharpe ratio than the protective put strategy. However, when comparing six month strategies, the volatility swap strategy had a lower risk-adjusted return than the protective put strategy.

The dominance of the volatility swap strategies also depended on the existence of tracking error. Tracking error can result in lower or higher results for the hedging strategies, depending on the direction of the equity returns and the foreign exchange rate. The return series that includes zero equity returns was assumed to contain no tracking error. The dominance of the volatility swap strategy did change when compared to strategies with no tracking error. Although it was not necessarily lower. Therefore the tracking error inherent in classic hedging strategies, while still a source of risk, over the October 1994, to March 2000 time period was not enough to warrant the disuse of classic hedging strategies when compared to a volatility swap strategy

While there were not many transaction costs assumed in this study, I did include the market spreads on the implied volatility rates. Two separate volatility swap strategy Sharpe ratios were computed. The first one used volatility swaps priced using mid-

market implied volatility rates. The second used volatility swaps priced using the offered side. The difference in these two represented a transaction cost. However, this cost was not high enough to materially affect the dominance of the volatility swap strategy when compared to the other risk-management strategies.

Over the October 1994, to March 2000 time period, the volatility swap strategy did not do exceptionally well on a risk-adjusted return basis when compared to the hedging strategies. It can be seen that it is very sensitive to the period over which it is applied. The foreign countries covered all experienced generally depreciating currencies which hardly ever experienced any unexpected volatility over the investment periods. Hence the limited time frame of this study represents a shortcoming of the empirical research.

There do exist other shortcomings of this study which should be mentioned. First of all, I have examined this study from the point of view of a US investor's portfolio that contains only one foreign investment. In practice however one would usually invest in more than one foreign asset in order to reap diversification benefits. This 'portfolio' of international assets, since they would most probably not have perfect correlation among each other, would help to diversify and reduce the foreign exchange risk produced from any international investment. In this context, the foreign exchange risk to the US investor would be lower than that presented in this thesis.

Additionally, financial theory tells us that there does exist mean reversion in foreign exchange rates. While it is not clear over what length of time this: occurs, it is generally accepted that mean reversion does exist. If this is so, then an unheadged foreign exchange exposure would, on average, realize an expected return of zero percent. This would considerably reduce any returns to the volatility swap strategy.

As a final point, I should mention a shortcoming with regard to the: relationship between the realized and implied volatilities observed during the course oof this study. The volatility swap strategy depends, on part, on the realized volatility being: greater than the implied volatility. However, as we have seen from the results, this is rarely the case. Literature on implied volatility tells us that market participants will revise upwards their view of implied volatilities due to such things as 'jump' risk and the chance oof unforeseen or low probability events. If this is so then the realized volatility will hardly ever be greater than the implied volatility, making the return to the volatility swap almost always negative. While there were two annual sub-periods in the study which showed a positive average return to the volatility swap for the Japanese Yen, one could argue that this type of result would always be present no matter which period was studied. In other words there will always be that certain period which shows unexpected volatility, but on average, the volatility swap will never pay off to the buyer.

Despite these shortcomings, the volatility swap strategy still has potential as a currency risk management tool. This is covered in the topics for further research presented below.

(5.3) Topics for Further Research

(1) The volatility swap strategy studied has the advantage of not having to fix the date of the sale of the foreign asset, as opposed to the classic hedging instruments that have fixed maturity dates. Due to this fact, the volatility swap strategy allows the investor or portfolio manager more flexibility in applying different hedging strategies.

There have been many studies stating the advantages of dynamic or tactical hedging strategies. These strategies attempt to increase the returns to a foreign currency position by applying different hedging or trading rules at various times during the investment period. It would be interesting to see the risk-adjusted returns from a study that used dynamic hedging strategies coupled with a foreign currency volatility swap purchase.

(2) The above analysis of the relationship between the realized and the implied currency volatilities for the Canadian dollar, the German deutschemark, the British pound and the Japanese yen, concluded that historic one month and six month realized volatilities are on average below the implied volatilities. Examining this relationship

over a longer time period, such as one year, would be interesting. Accordingly, examining the relationship over a different time period would prove beneficial to determine if these relationships are time dependent.

In addition, examining these strategies over longer investment periods, say one or two years, would be interesting. According to Chris and Morokoff (99), the market for volatility swaps is longer term in nature. Since classic hedging instruments become much less liquid in investment periods greater than one year, using the volatility swap strategy to manage foreign exchange risk for periods greater than one year could be advantageous when compared to the classic hedging strategies.

(3)   While my study focused on major currencies, it would also be interesting to apply it to exotic currencies. Such currencies, usually from emerging market economies, can tend to be very volatile. A consistent relationship between the realized and the implied volatilities of such currencies would provide a potential use for volatility swaps.

(4)   From the results of this thesis, a study that investigates the returns from a strategy that sells currency volatility swaps, is an obvious topic for research. The seller of a volatility swap earns a positive return when the realized volatility is lower than the implied. This was the case for practically each investment period covered during the October 1994, to March 2000 time period. Therefore a short volatility swap position

would exploit such a relationship. Further examination of the prices at which dealers would be willing to buy volatility swaps is warranted.

(5)   This thesis was based on the fact that international equity investments provide diversification benefits to a US investor. These benefits were proven by a correlation study on foreign equity returns measured in US dollars (therefore unhedged foreign exchange returns). While the volatility swap strategy leaves the foreign exchange returns unhedged, the classic hedging strategies hedge them. It would be interesting to see if diversification benefits increased or decreased when the foreign exchange returns are hedged. This could have an implication on the benefits of the volatility swap strategy as compared to the classic hedging strategies.

APPENDIX 1

HEDGING INSTRUMENTS AND THEIR PROBLEMS

Section 1 pointed out the importance of managing the volatility of the foreign exchange exposure from an international investment. Yet, until now, the only instruments readily available for hedging this risk not only hedged the volatility of the foreign currency prices but the direction of the prices as well.

In this thesis I will be analyzing OTC forwards and options, as these represent highly liquid hedging instruments available in the foreign exchange market. [100] However, when trying to hedge volatility, the main drawback with these instruments is their inherent exposure to not only the volatility of a currency, but also to the non risk-adjusted returns of that currency. For instance, when attempting to hedge the one month foreign currency volatility of an international equity investment[101] one would sell the foreign currency forward (either by selling a foreign currency forward contract, or by buying a put or selling a call, on the foreign currency). This transaction would hedge the volatility or risk of the foreign currency position but it would also lock-in (in the case of the forwards) or limit (as in the case of an option) your foreign currency returns (i.e. sales price). See figure 33 below.

---

[100] There are other products to hedge volatility risk, such as the log contract (Neuberger 94) and volatility gadgets (Derman, Kani and Kamal (96)) but these are not widely used or liquid instruments. Neuberger (94) also talks of a proposed implied volatility contract on the CBOE, but an "implied volatility contract does not provide a good hedge against actual volatility." p. 77

Figure 33: The two types of returns and risks produced by an international investment.

International Investment

Returns:
(i) foreign market return
(ii) foreign exchange return

Risks:
(i) foreign market risk
(ii)foreign exchange risk
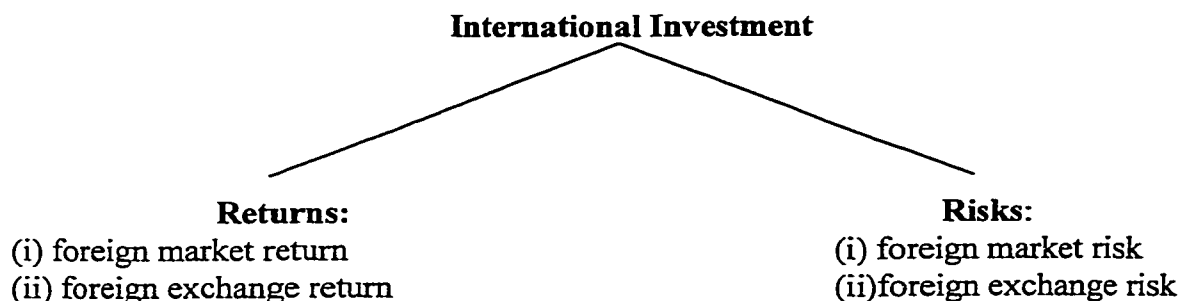
Classic foreign exchange hedging instruments hedge the foreign exchange risk but also the returns. Demeterfi et al. (99) points to the drawbacks of using options to hedge volatility. According to the authors, option's volatility exposure is "contaminated"[102] by it's price dependence. To remove exposure to the foreign currency price, an options trader could delta-hedge[103], but this type of hedging is "at best inaccurate, because the real world violates many of the Black-Scholes assumptions."[104]

Another drawback to using classic hedging instruments, can be referred to as the 'costs' of hedging. For option positions, when you are long options, obviously there is a cost involved (premium), when you are short the cost is the increased risk. For forwards

---

[101] It is assumed here, that one is long the foreign currency and expect to sell it in one month.
[102] p. 9
[103] A hedge in the underlying currency so as to replicate the exact movement of the price of the option via the price of the spot currency price.

there is no premium but your future rate is locked in so you cannot benefit from any upside potential. International investments with no fixed time to maturity nor any fixed return (such as equity indexes) can also cause forwards and options to incur 'basis risk', or 'tracking error', when hedging the foreign exchange exposure. There are two types of basis risk: time dependent and notional dependent.

Notional dependent basis risk comes from the fact that you do not know your final foreign investment return. Therefore you do not know exactly how much foreign currency to sell forward. Due to this basis risk, your hedge may be over/under estimated. Time dependent basis risk comes from the fact that you do not know the maturity date of your investment. Hence it is difficult to match the maturity date of your hedge. If your hedge is too short, you are under-hedged. If your hedge is too long, you are over-hedged. In either case you are exposed to basis risk since your investment and hedge are not matched.

Therefore forwards and/or options do not represent a 'perfect hedge' when trying to hedge foreign exchange risk. To hedge exclusively the volatility of an asset would require a financial instrument that gives one "pure" exposure to volatility, such as a 'volatility swap.'

---

[104] ibid p. 10

APPENDIX 2

THE IMPORTANCE OF VOLATILITY

An asset's volatility has become an increasingly important parameter, both for the asset allocation and investment management decisions. For investment or portfolio managers, the risk of the portfolios they manage is important not only in that it must coincide with the risk aversion level of their clients (investors) but also due to the fact that they are evaluated on a risk-adjusted return basis.

In Section 1, we discussed the importance of foreign exchange risk or volatility, from a foreign investment. Twenty years ago we moved from an individual asset decision to a total portfolio approach.[105] Now it is time to include volatility in our asset allocation and investment management decisions.

Zerolis (97) states that though volatility is extremely important, it is "the least understood variable."[106] While many analysts define and calculate volatility differently, Zerolis gives a good definition:

"Volatility is the annualized standard deviation of the natural log of (an asset's) returns (σ). When quoted as an annual percentage, volatility is how much one

---

[105] Solnik (97) p. 64

[106] p. 50

expects the price of the underlying (asset) to increase or decrease ($\pm$ 1 standard deviation for a normal distribution) two-thirds of the time in one year. Volatility does have a unit: 1 over the square root of time. So if the period is two years, the riskiness is not necessarily doubled; the appropriate factor is the square root of 2."

Guo (98) defines volatility as the most important determinant of options prices and hedging parameters. He finds from his empirical research that "compensation for variance risk is a significant component of the risk premia in the currency options markets."[107] Neuberger (94) points to the importance of volatility, especially in option pricing. For foreign exchange options, theory says that risk should be completely eliminated by delta-hedging but some risk does remain. This is called "residual risk".[108] Volatility is the main source of residual risk.

Types of Volatilities

When discussing the importance of volatility, it is necessary to point out that there exists several different types. Zerolis (97) demonstrates this fact. She finds that using different approaches to calculating volatility in options prices "does not necessarily yield the same number."[109]

---

[107] p. 506
[108] p. 75
[109] p. 50

There are two main types of volatility: historical and implied.[110] Historical volatility uses past prices, or economic data, to measure volatility.[111] It is generally calculated as the standard deviation of returns. However, the drawback with this method, is that one large price movement can significantly affect the results.[112] Implied volatility represents the market's view of volatility. Gavin Labelle (92) defines implied volatility as a process. In this process, market participants examine those option prices quoted in the market and then input these prices along with all other known parameters (strike price, maturity, and interest rates) into their option pricing model. The unknown parameter (volatility) is output. This is known as the "implied volatility." In other words, it is the volatility level implied by the option price.

This thesis studies not only these two types of volatilities, but the relationship between the two. Indeed this relationship is also used by option traders. Prices for options are quoted in terms of implied volatilities. Determining the best time to sell/buy options can depend on the relationship between historical and implied volatilities. For instance, if the implied volatility is greater than the historical volatility, this could mean

---

[110] Other types of volatilites worth mentioning include: 'particular volatility' (see Zerolis (97)); 'theoretical volatility' (see Pilipovic (95)); 'global' and 'local volatility' (see Derman et al. (96)); and 'actual volatility' (see Neuberger (94)).

[111] From Zerolis (97) and Dehnad (92) p. 9

[112] Solutions to this problem have been proposed. Trimmed standard deviation orders the prices from smallest to largest and then discards a certain percentage of prices at each end. Median absolute deviation uses the median price to calculate volatility, as opposed to the average price.

that option volatilities are increasing, or simply that option prices are over priced. There have been numerous articles published on trading volatilities.[113]

This thesis focuses on managing currency risk or volatility inherent in international investments. The increasing awareness of volatility as a parameter in the hedging decision encourages us to believe that the foreign exchange risk or volatility that arises from international investments, should not simply be assumed, but managed.

---

[113] Pilipovic (94) examines the different trading techniques for trading theoretical and implied volatilities. O'Keefe (93) outlines basic strategies investors can use to "take advantage of the shape of the volatility surface", whether that is a frown or a smile. Armstrong discusses trading generational volatility and government induced volatility. Finally, Derman et al (96) present rules that relate local and implied volatilities.

APPENDIX 3A

RETURN RESULTS FOR ONE MONTH FORW.ARD STRATEGIES

Canadian Dollar Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Outright	Eq Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	1.353	1-Dec	1.375	1	1.3531	-1.44	0.41	-1.43	-1.84	-0.01	-0.42
	30-Nov	1.375	2-Jan	1.402	-6	1.3744	-4.62	0.49	-4.44	-4.94	0.04	-0.45
	30-Dec	1.402	3-Jan	1.406	1	1.4021	2.94	0.49	2.91	2.43	0.01	-0.48
1995	31-Jan	1.408	3-Jan	1.393	19	1.4099	-4.65	0.49	-4.98	-5.47	-0.14	-0.63
	28-Feb	1.393	3-Apr	1.399	21	1.3951	2.67	0.50	2.36	1.86	-0.15	-0.65
	31-Mar	1.399	1-May	1.357	23	1.4013	4.58	0.50	4.38	3.88	-0.17	-0.67
	28-Apr	1.356	1-Jun	1.37	21	1.3581	-0.79	0.49	-1.09	-1.58	-0.15	-0.64
	31-May	1.37	3-Jul	1.372	19	1.3719	3.95	0.49	3.67	3.18	-0.14	-0.63
	30-Jun	1.372	1-Aug	1.356	12	1.3732	1.76	0.50	1.61	1.11	-0.09	-0.58
	31-Jul	1.368	1-Sep	1.343	10.5	1.3691	1.94	0.48	1.82	1.34	-0.08	-0.55
	31-Aug	1.343	2-Oct	1.341	4.75	1.3435	-2.13	0.48	-2.21	-2.68	-0.04	-0.51
	29-Sep	1.341	1-Nov	1.348	4.45	1.3414	0.29	0.48	0.22	-0.26	-0.03	-0.51
	31-Oct	1.343	1-Dec	1.359	2	1.3432	-1.56	0.47	-1.57	-2.04	-0.01	-0.49
	30-Nov	1.359	1-Jan	1.365	-1	1.3589	4.53	0.48	4.53	4.04	0.01	-0.48
	29-Dec	1.365	1-Feb	1.374	2.2	1.3652	1.12	0.46	1.08	0.62	-0.02	-0.48
1996	31-Jan	1.376	1-Mar	1.372	-1.25	1.3759	5.41	0.44	5.44	5.00	0.01	-0.43
	29-Feb	1.372	1-Apr	1.363	-0.45	1.3720	-0.70	0.43	-0.70	-1.13	0.00	-0.43
	29-Mar	1.363	1-May	1.363	-5.45	1.3625	0.75	0.44	0.83	0.39	0.04	-0.40
	30-Apr	1.363	3-Jun	1.37	-7.25	1.3623	3.53	0.44	3.62	3.18	0.05	-0.39
	31-May	1.37	1-Jul	1.361	-7.95	1.3692	1.94	0.44	2.07	1.63	0.06	-0.38
	29-Jun	1.364	1-Aug	1.375	-7.45	1.3633	-3.86	0.45	-3.72	-4.16	0.05	-0.39
	31-Jul	1.375	2-Sep	1.368	-11.3	1.3739	-2.28	0.44	-2.13	-2.57	0.08	-0.36
	30-Aug	1.368	1-Oct	1.361	-16	1.3664	4.35	0.44	4.60	4.16	0.12	-0.33
	30-Sep	1.362	1-Nov	1.34	-13.8	1.3606	2.87	0.44	3.12	2.68	0.10	-0.34
	31-Oct	1.34	2-Dec	1.349	-23.6	1.3376	5.82	0.44	6.13	5.69	0.17	-0.26
	29-Nov	1.349	1-Jan	1.354	-31.1	1.3459	7.46	0.45	7.89	7.44	0.23	-0.22
	31-Dec	1.37	3-Feb	1.347	-27.8	1.3672	-1.49	0.45	-1.10	-1.55	0.21	-0.24
1997	31-Jan	1.347	3-Mar	1.368	-24.6	1.3445	3.08	0.44	3.39	2.95	0.18	-0.26
	28-Feb	1.368	1-Apr	1.387	-27.5	1.3653	0.79	0.44	1.17	0.73	0.20	-0.24
	31-Mar	1.381	1-May	1.396	-28.3	1.3782	-5.00	0.46	-4.54	-5.00	0.20	-0.26
	30-Apr	1.396	2-Jun	1.38	-30	1.3930	2.16	0.46	2.62	2.16	0.22	-0.24
	30-May	1.38	1-Jul	1.38	-28.5	1.3772	6.78	0.46	7.20	6.74	0.21	-0.26
	30-Jun	1.381	1-Aug	1.378	-29.5	1.3781	0.87	0.46	1.30	0.84	0.22	-0.25
	31-Jul	1.378	1-Sep	1.388	-26.5	1.3754	6.83	0.46	7.17	6.71	0.19	-0.27
	29-Aug	1.388	1-Oct	1.378	-24.5	1.3856	-3.87	0.46	-3.54	-4.00	0.18	-0.28
	30-Sep	1.382	3-Nov	1.409	-26.4	1.3794	6.48	0.46	6.73	6.27	0.19	-0.27
	31-Oct	1.409	1-Dec	1.421	25.5	1.4116	-2.81	0.46	-3.15	-3.60	0.15	-0.31
	28-Nov	1.424	3-Jan	1.43	-15	1.4225	-4.82	0.48	-4.59	-5.07	0.18	-0.31
	2-Jan	1.43	2-Feb	1.448	-7.25	1.4293	2.87	0.46	2.93	2.47	0.10	-0.36
1998	30-Jan	1.458	2-Mar	1.424	-10.3	1.4570	0.01	0.45	0.16	-0.30	0.05	-0.40
	27-Feb	1.424	1-Apr	1.417	-10.6	1.4229	5.85	0.46	6.03	5.57	0.07	-0.39
	31-Mar	1.417	1-May	1.43	-9.5	1.4161	6.57	0.46	6.64	6.18	0.07	-0.39
	30-Apr	1.43	1-Jun	1.456	-9.25	1.4291	1.41	0.46	1.51	1.05	0.07	-0.39
	29-May	1.456	1-Jul	1.469	-10.4	1.4550	-0.98	0.46	-0.83	-1.29	0.06	-0.40
	30-Jun	1.469	3-Aug	1.512	-8.15	1.4682	-2.94	0.46	-2.75	-3.21	0.07	-0.39
	31-Jul	1.512	1-Sep	1.544	3.75	1.5124	-5.91	0.46	-5.84	-6.30	0.05	-0.41
	31-Aug	1.568	1-Oct	1.526	1.95	1.5682	-20.21	0.46	-20.79	-21.25	-0.02	-0.48
	30-Sep	1.526	2-Nov	1.541	0.55	1.5261	1.51	0.44	1.49	1.05	-0.01	-0.45
	30-Oct	1.541	1-Dec	1.531	-8.05	1.5402	10.58	0.43	10.76	10.33	0.00	-0.43
	30-Nov	1.532	1-Jan	1.527	-0.95	1.5319	2.18	0.46	2.20	1.75	0.05	-0.40
	31-Dec	1.537	1-Feb	1.514	2	1.5372	2.24	0.41	2.25	1.83	0.01	-0.41
1999	29-Jan	1.511	1-Mar	1.509	1.55	1.5112	3.76	0.40	3.74	3.34	-0.01	-0.42
	26-Feb	1.509	1-Apr	1.509	-1.45	1.5089	-6.19	0.40	-6.18	-6.58	-0.01	-0.41
	31-Mar	1.509	3-May	1.46	-1.15	1.5089	4.52	0.40	4.68	4.28	0.01	-0.39
	30-Apr	1.46	1-Jun	1.481	-2	1.4598	6.32	0.40	6.26	5.86	0.01	-0.39
	31-May	1.476	1-Jul	1.463	-6.25	1.4754	-2.46	0.40	-2.40	-2.80	0.01	-0.39
	30-Jun	1.474	2-Aug	1.503	-6.4	1.4734	2.46	0.43	2.50	2.07	0.04	-0.38
	30-Jul	1.505	1-Sep	1.495	-7.7	1.5042	1.01	0.42	1.12	0.70	0.04	-0.38
	31-Aug	1.495	1-Oct	1.468	-9.55	1.4940	-1.56	0.44	-1.46	-1.89	0.05	-0.38
	30-Sep	1.468	1-Nov	1.472	-8	1.4672	-0.19	0.44	-0.08	-0.52	0.07	-0.37
	29-Oct	1.472	1-Dec	1.475	-20.5	1.4700	4.29	0.44	4.56	4.12	0.05	-0.39
	30-Nov	1.475	3-Jan	1.446	-10	1.4740	3.68	0.52	3.89	3.37	0.14	-0.38
	31-Dec	1.447	1-Feb	1.442	-9.75	1.4460	11.84	0.47	12.01	11.54	0.07	-0.40
2000	31-Jan	1.45	1-Mar	1.452	-11	1.4489	0.80	0.48	0.95	0.47	0.07	-0.41
	29-Feb	1.452	3-Apr	1.454	-10.5	1.4510	7.64	0.48	7.77	7.29	0.08	-0.41
	31-Mar	1.454	1-May	1.487	-11	1.4529	3.65	0.50	3.72	3.22	0.07	-0.43

German Deutschemark Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Outright	Eq Ret	Rf	With Equity:		Without Equity	
									Return	Excess Return	Return	Excess Return
1994	31-Oct	1.508	2-Dec	1.568	-0.35	1.5080	2.98	0.41	2.87	2.45	0.00	-0.41
	30-Nov	1.568	2-Jan	1.549	-10	1.5670	-1.13	0.49	-1.01	-1.50	0.06	-0.43
	30-Dec	1.55	3-Feb	1.523	-11	1.5489	2.85	0.49	3.04	2.56	0.07	-0.41
1995	31-Jan	1.523	2-Mar	1.456	-13.5	1.5217	-4.05	0.49	-4.05	-4.54	0.09	-0.40
	28-Feb	1.456	3-Apr	1.412	-13.8	1.4546	4.00	0.50	4.32	3.83	0.10	-0.40
	31-Mar	1.372	4-May	1.379	-17.5	1.3703	-8.54	0.50	-8.25	-8.74	0.13	-0.37
	28-Apr	1.389	2-Jun	1.412	-19.5	1.3871	4.86	0.49	5.05	4.56	0.14	-0.35
	31-May	1.412	3-Jul	1.384	-18	1.4102	3.78	0.49	4.12	3.63	0.13	-0.36
	30-Jun	1.381	4-Aug	1.397	-18.5	1.3792	-0.39	0.50	-0.12	-0.62	0.13	-0.36
	31-Jul	1.385	4-Sep	1.469	-16.5	1.3834	6.47	0.48	6.32	5.85	0.11	-0.36
	31-Aug	1.469	4-Oct	1.429	-19.2	1.4671	0.88	0.48	1.18	0.70	0.13	-0.34
	29-Sep	1.428	3-Nov	1.414	-22.5	1.4258	-2.29	0.48	-2.00	-2.47	0.16	-0.32
	31-Oct	1.408	4-Dec	1.448	-21	1.4059	-0.87	0.47	-0.56	-1.03	0.15	-0.33
	30-Nov	1.448	2-Jan	1.438	-22.5	1.4458	3.46	0.48	3.79	3.31	0.16	-0.33
	29-Dec	1.438	2-Feb	1.487	-24	1.4356	0.49	0.46	0.80	0.34	0.16	-0.30
1996	31-Jan	1.487	4-Mar	1.469	-24.5	1.4846	9.60	0.44	10.05	9.60	0.17	-0.28
	29-Feb	1.469	4-Apr	1.482	-23.5	1.4667	0.14	0.43	0.45	0.02	0.16	-0.27
	29-Mar	1.477	2-May	1.532	-15.6	1.4754	0.50	0.44	0.68	0.24	0.10	-0.34
	30-Apr	1.532	3-Jun	1.531	-29.4	1.5291	0.78	0.44	1.16	0.72	0.19	-0.25
	31-May	1.523	5-Jul	1.526	-26.5	1.5204	1.50	0.44	1.84	1.40	0.17	-0.27
	28-Jun	1.52	2-Aug	1.469	-26.5	1.5174	0.73	0.45	1.12	0.67	0.18	-0.27
	31-Jul	1.469	2-Sep	1.479	-27	1.4663	-3.44	0.44	-3.05	-3.49	0.18	-0.26
	30-Aug	1.48	3-Oct	1.526	-29	1.4771	2.85	0.44	3.14	2.70	0.19	-0.25
	30-Sep	1.526	4-Nov	1.517	-32.5	1.5228	4.25	0.44	4.70	4.26	0.21	-0.23
	31-Oct	1.517	4-Dec	1.546	-28.2	1.5142	0.28	0.44	0.64	0.20	0.18	-0.26
	29-Nov	1.538	2-Jan	1.539	-29.7	1.5350	7.00	0.45	7.39	6.93	0.19	-0.26
	31-Dec	1.539	3-Feb	1.641	-31.2	1.5359	1.52	0.45	1.80	1.36	0.19	-0.26
1997	31-Jan	1.638	4-Mar	1.687	-29	1.6351	5.07	0.44	5.27	4.82	0.17	-0.27
	28-Feb	1.687	2-Apr	1.679	-30.7	1.6839	7.40	0.44	7.80	7.36	0.18	-0.26
	31-Mar	1.679	2-May	1.731	-30.5	1.6760	5.20	0.46	5.39	4.93	0.18	-0.29
	30-Apr	1.731	2-Jun	1.695	-37	1.7273	0.26	0.46	0.71	0.24	0.21	-0.25
	30-May	1.709	3-Jul	1.743	-36	1.7054	3.19	0.46	3.54	3.08	0.21	-0.26
	30-Jun	1.743	4-Aug	1.841	-39	1.7391	6.71	0.46	6.77	6.31	0.21	-0.25
	31-Jul	1.841	2-Sep	1.809	-39.9	1.8370	17.25	0.46	18.00	17.54	0.22	-0.24
	29-Aug	1.809	2-Oct	1.762	-37	1.8053	-12.01	0.46	-11.91	-12.36	0.21	-0.25
	30-Sep	1.762	31-Oct	1.733	-38.3	1.7582	6.70	0.46	7.26	6.80	0.22	-0.24
	30-Oct	1.725	2-Dec	1.766	-30.1	1.7220	-10.58	0.46	-10.00	-10.46	0.17	-0.29
	30-Nov	1.766	5-Jan	1.789	-18.2	1.7642	5.97	0.48	6.10	5.61	0.10	-0.38
	2-Jan	1.798	2-Feb	1.824	-33	1.7947	7.61	0.46	7.86	7.40	0.18	-0.28
1998	30-Jan	1.83	3-Mar	1.817	-29.6	1.8270	4.49	0.45	4.84	4.39	0.16	-0.29
	27-Feb	1.817	3-Apr	1.853	-33.4	1.8137	6.07	0.46	6.31	5.85	0.18	-0.28
	31-Mar	1.849	4-May	1.796	-33.2	1.8457	8.33	0.46	8.95	8.49	0.19	-0.28
	30-Apr	1.796	4-Jun	1.779	-31.2	1.7929	0.10	0.46	0.45	-0.01	0.18	-0.28
	29-May	1.785	2-Jul	1.805	-31.5	1.7819	9.04	0.46	9.29	8.83	0.17	-0.29
	30-Jun	1.805	3-Aug	1.779	-34.3	1.8016	5.90	0.46	6.37	5.91	0.19	-0.27
	31-Jul	1.78	4-Sep	1.754	-33.7	1.7766	-0.40	0.46	-0.02	-0.48	0.19	-0.26
	31-Aug	1.76	2-Oct	1.671	-33.8	1.7566	-17.71	0.46	-18.24	-18.70	0.21	-0.25
	30-Sep	1.671	2-Nov	1.654	-27	1.6683	-7.43	0.44	-7.18	-7.62	0.16	-0.27
	30-Oct	1.657	3-Dec	1.682	-24.2	1.6546	4.39	0.43	4.62	4.19	0.14	-0.28
	30-Nov	1.696	4-Jan	1.682	-28	1.6932	7.53	0.46	7.92	7.47	0.17	-0.29
	31-Dec	1.677	5-Feb	1.724	-24.9	1.6745	-0.40	0.41	-0.11	-0.52	0.14	-0.27
1999	29-Jan	1.722	2-Mar	1.776	-23.7	1.7196	3.15	0.40	3.32	2.92	0.13	-0.27
	26-Feb	1.776	2-Apr	1.81	-26.9	1.7733	-4.81	0.40	-4.42	-4.83	0.15	-0.26
	31-Mar	1.81	3-May	1.846	-31	1.8069	-0.56	0.40	-0.22	-0.62	0.17	-0.23
	30-Apr	1.848	4-Jun	1.89	-36.7	1.8443	10.42	0.40	10.58	10.18	0.19	-0.21
	31-May	1.873	2-Jul	1.897	-37	1.8693	-5.99	0.40	-5.53	-5.93	0.19	-0.21
	30-Jun	1.897	2-Aug	1.893	-40.7	1.8929	6.09	0.43	6.53	6.11	0.22	-0.20
	30-Jul	1.828	6-Sep	1.829	-40.3	1.8240	-5.14	0.42	-4.70	-5.12	0.22	-0.20
	31-Aug	1.847	4-Oct	1.834	-45.3	1.8425	3.31	0.44	3.83	3.39	0.25	-0.19
	30-Sep	1.834	4-Nov	1.858	-43.8	1.8296	-2.29	0.44	-1.79	-2.23	0.23	-0.21
	29-Oct	1.858	2-Dec	1.942	-38.4	1.8542	7.29	0.44	7.37	6.93	0.20	-0.24
	30-Nov	1.942	3-Jan	1.946	-50.2	1.9370	6.71	0.52	7.21	6.69	0.26	-0.26
	31-Dec	1.943	4-Feb	2.003	-44.3	1.9386	18.01	0.47	17.92	17.44	0.22	-0.25
2000	31-Jan	2.012	2-Mar	2.023	-42.3	2.0078	-1.76	0.48	-1.33	-1.81	0.21	-0.27
	29-Feb	2.023	3-Apr	2.038	-43.8	2.0186	11.83	0.48	12.18	11.70	0.21	-0.27
	31-Mar	2.043	4-May	2.162	-41.6	2.0388	-0.59	0.50	-0.17	-0.67	0.19	-0.31

British Pound Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Outright	Eq Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	1.631	2-Dec	1.56	-7.5	1.6303	2.35	0.41	2.20	1.79	-0.05	-0.46
	30-Nov	1.567	2-Jan	1.56	5.05	1.5675	-0.52	0.49	-0.48	-0.97	0.03	-0.46
	30-Dec	1.565	3-Feb	1.563	14.75	1.5665	-0.52	0.49	-0.42	-0.91	0.09	-0.39
1995	31-Jan	1.582	2-Mar	1.591	-12	1.5808	-2.41	0.49	-2.50	-2.99	-0.08	-0.57
	28-Feb	1.584	3-Apr	1.617	-4.5	1.5836	0.59	0.50	0.57	0.08	-0.03	-0.53
	31-Mar	1.621	4-May	1.617	-2.8	1.6207	4.27	0.50	4.25	3.75	-0.02	-0.51
	28-Apr	1.613	2-Jun	1.594	-8.3	1.6122	2.51	0.49	2.43	1.94	-0.05	-0.54
	31-May	1.589	3-Jul	1.598	-3	1.5887	3.19	0.49	3.19	2.70	-0.02	-0.51
	30-Jun	1.595	4-Aug	1.606	-8.5	1.5942	-0.14	0.50	-0.20	-0.70	-0.05	-0.55
	31-Jul	1.598	4-Sep	1.553	-13.5	1.5967	4.49	0.48	4.28	3.80	-0.08	-0.56
	31-Aug	1.55	4-Oct	1.583	-10.5	1.5490	0.42	0.48	0.36	-0.12	-0.07	-0.54
	29-Sep	1.585	3-Nov	1.579	-10.5	1.5840	0.87	0.48	0.80	0.33	-0.07	-0.54
	31-Oct	1.582	4-Dec	1.535	-11.5	1.5809	0.60	0.47	0.51	0.03	-0.07	-0.55
	30-Nov	1.531	2-Jan	1.555	-9.8	1.5300	3.83	0.48	3.83	3.34	-0.06	-0.55
	29-Dec	1.55	2-Feb	1.525	-11	1.5489	0.68	0.46	0.60	0.14	-0.07	-0.53
1996	31-Jan	1.515	4-Mar	1.53	-11.7	1.5138	1.90	0.44	1.84	1.40	-0.08	-0.52
	29-Feb	1.532	4-Apr	1.53	-9.65	1.5310	-0.84	0.43	-0.91	-1.34	-0.06	-0.50
	29-Mar	1.527	2-May	1.503	-6.95	1.5263	-0.75	0.44	-0.78	-1.22	-0.05	-0.49
	30-Apr	1.504	3-Jun	1.556	-9.25	1.5031	3.19	0.44	3.24	2.80	-0.06	-0.50
	31-May	1.55	5-Jul	1.557	-8	1.5492	-1.84	0.44	-1.90	-2.34	-0.05	-0.49
	28-Jun	1.553	2-Aug	1.541	-4.25	1.5526	-0.98	0.45	-1.00	-1.45	-0.03	-0.47
	31-Jul	1.556	2-Sep	1.559	-5	1.5555	-0.21	0.44	-0.24	-0.69	-0.03	-0.48
	30-Aug	1.562	3-Oct	1.566	-4.5	1.5616	4.44	0.44	4.42	3.98	-0.03	-0.47
	30-Sep	1.564	4-Nov	1.644	-4.85	1.5635	2.23	0.44	2.31	1.87	-0.03	-0.47
	31-Oct	1.628	4-Dec	1.639	0.25	1.6280	0.64	0.44	0.65	0.21	0.00	-0.44
	29-Nov	1.682	2-Jan	1.69	-8	1.6812	1.98	0.45	1.94	1.49	-0.05	-0.50
	31-Dec	1.715	3-Feb	1.613	-11	1.7139	1.49	0.45	1.34	0.89	-0.06	-0.51
1997	31-Jan	1.599	4-Mar	1.614	-9.1	1.5981	3.82	0.44	3.80	3.36	-0.06	-0.50
	28-Feb	1.628	2-Apr	1.642	-9	1.6271	0.76	0.44	0.71	0.27	-0.06	-0.50
	31-Mar	1.631	2-May	1.621	-5.45	1.6305	0.11	0.46	0.07	-0.39	-0.03	-0.50
	30-Apr	1.623	2-Jun	1.634	-8.55	1.6221	2.85	0.46	2.82	2.36	-0.05	-0.51
	30-May	1.639	3-Jul	1.69	-0.3	1.6390	4.18	0.46	4.31	3.84	0.00	-0.46
	30-Jun	1.666	4-Aug	1.628	-14.5	1.6646	-0.36	0.46	-0.44	-0.90	-0.09	-0.55
	31-Jul	1.639	2-Sep	1.592	-19	1.6371	6.58	0.46	6.28	5.82	-0.12	-0.57
	29-Aug	1.62	2-Oct	1.613	-20.4	1.6180	-1.83	0.46	-1.95	-2.41	-0.13	-0.59
	30-Sep	1.614	1-Nov	1.677	-20	1.6120	8.86	0.46	9.07	8.61	-0.12	-0.58
	30-Oct	1.677	2-Dec	1.682	-21.8	1.6748	-7.66	0.46	-7.82	-8.28	-0.13	-0.59
	28-Nov	1.688	5-Jan	1.627	-22.4	1.6858	-0.22	0.48	-0.34	-0.82	-0.13	-0.62
	2-Jan	1.648	2-Feb	1.637	-24.6	1.6455	6.29	0.46	6.09	5.63	-0.15	-0.61
1998	30-Jan	1.634	3-Mar	1.653	-23.4	1.6317	6.29	0.45	6.22	5.76	-0.14	-0.60
	27-Feb	1.645	3-Apr	1.658	-25.7	1.6424	5.66	0.46	5.54	5.08	-0.16	-0.62
	31-Mar	1.674	4-May	1.665	-26.8	1.6713	2.86	0.46	2.68	2.22	-0.16	-0.62
	30-Apr	1.671	4-Jun	1.64	-25	1.6685	-0.07	0.46	-0.21	-0.67	-0.15	-0.61
	29-May	1.634	2-Jul	1.656	-23.7	1.6316	-0.97	0.46	-1.13	-1.59	-0.15	-0.60
	30-Jun	1.67	3-Aug	1.63	-27.9	1.6672	-0.65	0.46	-0.80	-1.26	-0.17	-0.63
	31-Jul	1.633	4-Sep	1.672	-27.5	1.6302	0.08	0.46	-0.09	-0.55	-0.17	-0.63
	31-Aug	1.675	2-Oct	1.701	-27.5	1.6723	-10.07	0.46	-10.39	-10.85	-0.16	-0.62
	30-Sep	1.697	2-Nov	1.663	-28	1.6942	-3.52	0.44	-3.62	-4.05	-0.16	-0.60
	30-Oct	1.674	3-Dec	1.666	-27.8	1.6712	7.38	0.43	7.18	6.76	-0.17	-0.59
	30-Nov	1.648	4-Jan	1.658	-21.5	1.6459	5.62	0.46	5.52	5.06	-0.13	-0.59
	31-Dec	1.66	5-Feb	1.633	-16.5	1.6584	2.41	0.41	2.28	1.87	-0.10	-0.51
1999	29-Jan	1.645	2-Mar	1.615	-12.5	1.6438	0.23	0.40	0.15	-0.25	-0.08	-0.48
	26-Feb	1.604	2-Apr	1.603	-9.2	1.6031	4.73	0.40	4.67	4.27	-0.06	-0.46
	31-Mar	1.615	3-May	1.608	-5	1.6145	1.95	0.40	1.91	1.50	-0.03	-0.43
	30-Apr	1.608	4-Jun	1.608	-5.7	1.6074	4.08	0.40	4.05	3.65	-0.04	-0.44
	31-May	1.603	2-Jul	1.579	-4.95	1.6025	-4.98	0.40	-4.93	-5.33	-0.03	-0.43
	30-Jun	1.576	2-Aug	1.617	2.25	1.5762	1.48	0.43	1.54	1.11	0.01	-0.41
	30-Jul	1.622	6-Sep	1.607	0.6	1.6221	-1.37	0.42	-1.35	-1.78	0.00	-0.42
	31-Aug	1.609	4-Oct	1.656	5.45	1.6095	0.23	0.44	0.27	-0.16	0.03	-0.40
	30-Sep	1.647	4-Nov	1.623	0.8	1.6471	-3.47	0.44	-3.41	-3.85	0.00	-0.43
	29-Oct	1.643	2-Dec	1.598	0.77	1.6431	3.75	0.44	3.65	3.21	0.00	-0.44
	30-Nov	1.596	3-Jan	1.633	8.8	1.5969	5.46	0.52	5.64	5.12	0.06	-0.47
	31-Dec	1.616	4-Feb	1.591	-0.88	1.6159	5.05	0.47	4.96	4.49	-0.01	-0.48
2000	31-Jan	1.614	2-Mar	1.58	-0.82	1.6139	-9.55	0.48	-9.35	-9.83	-0.01	-0.48
	29-Feb	1.58	3-Apr	1.598	-1.67	1.5798	-0.57	0.48	-0.59	-1.07	-0.01	-0.49
	31-Mar	1.592	4-May	1.542	2.55	1.5923	4.94	0.50	4.80	4.30	0.02	

Japanese Yen Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Eq Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	96.97	2-Dec	98.87	-22.2	96.968	2.18	0.41	2.3171	1.90	0.22	-0.19
	30-Nov	98.87	2-Jan	99.6	-33.6	98.867	-4.57	0.49	-4.1700	-4.66	0.33	-0.16
	30-Dec	99.58	3-Feb	99.38	-33.5	99.577	3.39	0.49	3.7204	3.23	0.34	-0.15
1995	31-Jan	99.45	2-Mar	96.54	-29.4	99.447	-5.44	0.49	-5.3470	-5.84	0.31	-0.19
	28-Feb	96.54	3-Apr	89.53	-33.2	96.537	-8.56	0.50	-9.1967	-9.69	0.38	-0.11
	31-Mar	86.55	5-May	83.65	-35.4	86.546	-5.36	0.50	-5.1008	-5.60	0.42	-0.08
	28-Apr	84.33	2-Jun	84.44	-33.5	84.327	4.13	0.49	4.5286	4.04	0.40	-0.09
	31-May	84.44	3-Jul	84.72	-34.7	84.437	-8.15	0.49	-7.7117	-8.20	0.41	-0.08
	30-Jun	84.63	4-Aug	90.88	-37.3	84.626	-5.96	0.50	-5.1049	-5.60	0.41	-0.09
	31-Jul	88.26	4-Sep	97.71	-41.8	88.256	14.88	0.48	13.8768	13.40	0.43	-0.05
	31-Aug	97.71	4-Oct	100.54	-41.2	97.706	8.63	0.48	8.7845	8.31	0.41	-0.07
	29-Sep	99.72	3-Nov	103.1	-53.3	99.715	-1.13	0.48	-0.5690	-1.05	0.51	0.04
	31-Oct	102.07	4-Dec	102.07	-49.1	102.065	-1.44	0.47	-0.9712	-1.44	0.49	0.01
	30-Nov	102.07	4-Jan	103.51	-48.6	102.065	6.17	0.48	6.3701	5.89	0.46	-0.03
	29-Dec	103.51	2-Feb	106.96	-46.8	103.505	6.00	0.46	6.2727	5.81	0.44	-0.02
1996	31-Jan	106.96	4-Mar	105.13	-44.7	106.956	4.75	0.44	5.2688	4.83	0.43	-0.02
	29-Feb	105.13	4-Apr	107.45	-41.8	105.126	-3.30	0.43	-2.8521	-3.28	0.39	-0.04
	29-Mar	107.12	2-May	105.06	-49.3	107.115	6.37	0.44	6.9884	6.55	0.47	0.03
	30-Apr	105.06	3-Jun	107.46	-57.5	105.054	2.96	0.44	3.4082	2.97	0.53	0.09
	31-May	107.97	5-Jul	110.15	-45.5	107.965	-0.39	0.44	0.0344	-0.41	0.41	-0.03
	28-Jun	109.38	2-Aug	106.46	-47.5	109.375	2.62	0.45	3.1210	2.67	0.44	0.00
	31-Jul	106.46	2-Sep	108.46	-48	106.455	-8.16	0.44	-7.5125	-7.96	0.44	0.00
	30-Aug	108.88	3-Oct	111.22	-39	108.876	-2.54	0.44	-2.1319	-2.57	0.35	-0.09
	30-Sep	111.55	4-Nov	113.97	-52.5	111.545	6.89	0.44	7.2113	6.77	0.46	0.02
	31-Oct	113.97	4-Dec	114.08	-46	113.965	-5.05	0.44	-4.6811	-5.12	0.41	-0.03
	29-Nov	113.86	2-Jan	115.9	-55.2	113.854	2.70	0.45	3.1453	2.69	0.48	0.03
	31-Dec	115.9	3-Feb	121.47	-55.8	115.894	-7.89	0.45	-7.0558	-7.50	0.46	0.01
1997	31-Jan	121.36	4-Mar	120.39	-47	121.355	-5.33	0.44	-4.9120	-5.35	0.39	-0.06
	28-Feb	120.39	4-Apr	123.62	-51.3	120.385	1.24	0.44	1.6131	1.17	0.41	-0.03
	31-Mar	124.05	2-May	127.14	-54.2	124.045	-2.98	0.46	-2.4953	-2.96	0.43	-0.03
	30-Apr	127.14	2-Jun	115.9	-55.9	127.134	6.38	0.46	7.4256	6.96	0.48	0.02
	30-May	116.4	3-Jul	114.53	-49.5	116.395	4.79	0.46	5.3480	4.89	0.44	-0.03
	30-Jun	114.53	4-Aug	118.47	-52	114.525	2.67	0.46	3.0229	2.56	0.44	-0.02
	31-Jul	118.47	4-Sep	120.93	-51	118.465	-1.33	0.46	-0.8798	-1.34	0.42	-0.03
	29-Aug	120.93	2-Oct	120.47	-50.7	120.925	-10.34	0.46	-9.8583	-10.32	0.42	-0.04
	30-Sep	120.47	3-Nov	120.94	-54.5	120.465	-1.87	0.46	-1.4137	-1.87	0.45	-0.01
	30-Oct	120.05	4-Dec	127.74	-51.5	120.045	-7.99	0.46	-7.0154	-7.47	0.40	-0.06
	30-Nov	127.74	2-Jan	130.1	-70.8	127.733	1.08	0.48	1.5742	1.09	0.53	0.05
	2-Jan	130.57	2-Feb	125.55	-58.5	130.564	-8.28	0.46	-8.0778	-8.54	0.46	0.00
1998	30-Jan	126.79	3-Mar	126.11	-50	126.785	8.98	0.45	9.4268	8.97	0.40	-0.06
	27-Feb	126.11	3-Apr	133.63	-54.9	126.105	1.22	0.46	1.5477	1.09	0.41	-0.06
	31-Mar	133.3	4-May	132.76	-62	133.294	-1.81	0.46	-1.3464	-1.81	0.47	0.00
	30-Apr	132.76	4-Jun	138.9	-61	132.754	-5.36	0.46	-4.7076	-5.17	0.44	-0.02
	29-May	138.57	2-Jul	137.98	-59	138.564	0.19	0.46	0.6024	0.14	0.42	-0.04
	30-Jun	137.98	3-Aug	143.36	-63.9	137.974	1.02	0.46	1.4020	0.94	0.44	-0.02
	31-Jul	144.75	4-Sep	137.9	-63.5	144.744	3.47	0.46	4.2260	3.77	0.47	0.02
	31-Aug	141.04	2-Oct	136.65	-60.7	141.034	-13.87	0.46	-13.9693	-14.43	0.45	-0.01
	30-Sep	136.65	2-Nov	116.85	-59.4	136.644	-4.97	0.44	-5.3981	-5.84	0.52	0.08
	30-Oct	116.4	3-Dec	123.15	-49.5	116.395	1.18	0.43	1.5724	1.15	0.42	-0.01
	30-Nov	123.15	4-Jan	114.92	-59.5	123.144	9.73	0.46	11.2499	10.79	0.53	0.08
	31-Dec	113.6	5-Feb	112.97	-46.5	113.595	-7.00	0.41	-6.6106	-7.02	0.41	0.00
1999	29-Jan	116.24	2-Mar	119.09	-41	116.236	4.75	0.40	4.9190	4.52	0.34	-0.06
	26-Feb	119.09	2-Apr	118.47	-47.9	119.085	-0.91	0.40	-0.5003	-0.90	0.40	-0.01
	31-Mar	118.47	3-May	119.1	-52.5	118.465	10.22	0.40	10.5161	10.11	0.44	0.03
	30-Apr	119.29	7-Jun	121	-48.8	119.285	5.46	0.40	5.7979	5.40	0.40	0.00
	31-May	121.79	2-Jul	121.01	-49.2	121.785	-3.53	0.40	-3.1470	-3.55	0.41	0.00
	30-Jun	121.01	2-Aug	115.35	-53	121.005	8.80	0.43	9.7829	9.36	0.46	0.04
	30-Jul	114.63	3-Sep	109.1	-50.5	114.625	1.89	0.42	2.4323	2.01	0.46	0.04
	31-Aug	109.36	4-Oct	106.43	-52	109.355	-2.38	0.44	-1.9674	-2.40	0.49	0.05
	30-Sep	106.43	4-Nov	104.07	-48.9	106.425	0.97	0.44	1.4514	1.01	0.47	0.03
	29-Oct	104.15	2-Dec	101.63	-49.9	104.145	1.91	0.44	2.4251	1.99	0.49	0.05
	30-Nov	101.63	3-Jan	102.01	-48	101.625	3.43	0.52	3.9056	3.38	0.47	-0.05
	31-Dec	102.24	4-Feb	108.33	-53.5	102.235	2.03	0.47	2.4285	1.96	0.50	0.03
2000	31-Jan	107.37	2-Mar	109.96	-50	107.365	3.20	0.48	3.6459	3.17	0.46	-0.01
	29-Feb	109.96	3-Apr	105.51	-54.5	109.955	2.15	0.48	2.7731	2.29	0.52	0.04
	31-Mar	102.64	4-May	108.44	-58.1	102.634	1.89	0.50	2.3319	1.83	0.54	0.04

APPENDIX 3B

RETURN RESULTS FOR ONE MONTH PROTECTIVE PUT STRATEGIES

Canadian Dollar Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity:		Without Equity	
													Return	Excess Return	Return	Excess Return
1994	31-Oct	1.353	1-Dec	1.375	1	1.3531	4.3	0.516	-0.5181	-1.44	-1.42	0.41	-1.94	-2.35	-0.53	-0.94
	30-Nov	1.375	2-Jan	1.402	-6	1.3744	4.2	0.478	-0.4804	-4.62	-4.49	0.49	-4.97	-5.46	-0.44	-0.93
	30-Dec	1.402	3-Jan	1.406	1	1.4021	5.7	0.68	-0.6833	2.94	2.92	0.49	2.24	1.75	-0.69	-1.18
1995	31-Jan	1.408	3-Jan	1.393	19	1.4099	6.7	0.737	-0.7406	-4.65	-3.01	0.49	-3.75	-4.25	0.34	-0.16
	28-Feb	1.393	3-Apr	1.399	21	1.3951	6.2	0.717	-0.7206	2.67	2.51	0.50	1.79	1.29	-0.87	-1.37
	31-Mar	1.399	1-May	1.357	23	1.4013	6.2	0.68	-0.6834	4.58	2.64	0.50	1.96	1.46	2.41	1.92
	28-Apr	1.356	1-Jun	1.37	21	1.3581	6.4	0.764	-0.7678	-0.79	-0.94	0.49	-1.70	-2.20	-0.92	-1.41
	31-May	1.37	3-Jul	1.372	19	1.3719	6.2	0.706	-0.7095	3.95	3.81	0.49	3.10	2.61	-0.85	-1.34
	30-Jun	1.372	1-Aug	1.356	12	1.3732	5.8	0.692	-0.6954	1.76	7.81	0.50	7.12	6.62	0.48	-0.01
	31-Jul	1.368	1-Sep	1.343	10.5	1.3691	6.1	0.706	-0.7094	1.94	-1.81	0.48	-2.51	-2.99	1.15	0.68
	31-Aug	1.343	2-Oct	1.341	4.75	1.3435	7.2	0.806	-0.8098	-2.13	3.80	0.48	2.99	2.51	-0.66	-1.14
	29-Sep	1.341	1-Nov	1.348	4.45	1.3414	8.6	1.03	-1.0349	0.29	0.25	0.48	-0.78	-1.26	-1.07	-1.54
	31-Oct	1.343	1-Dec	1.359	2	1.3432	7.7	0.876	-0.8801	-1.56	-1.55	0.47	-2.43	-2.91	-0.89	-1.37
	30-Nov	1.359	1-Jan	1.365	-1	1.3589	5	0.559	-0.5617	4.53	4.52	0.48	3.96	3.47	-0.55	-1.04
	29-Dec	1.365	1-Feb	1.374	2.2	1.3652	5.6	0.68	-0.6831	1.12	1.10	0.46	0.42	-0.05	-0.70	-1.16
1996	31-Jan	1.376	1-Mar	1.372	-1.25	1.3759	5	0.56	-0.5625	5.41	-2.72	0.44	-3.28	-3.72	-0.27	-0.71
	29-Feb	1.372	1-Apr	1.363	-0.45	1.3720	4.9	0.548	-0.5504	-0.70	4.07	0.43	3.52	3.09	0.11	-0.32
	29-Mar	1.363	1-May	1.363	-5.45	1.3625	4.8	0.564	-0.5665	0.75	0.79	0.44	0.23	-0.22	-0.53	-0.97
	30-Apr	1.363	3-Jun	1.37	-7.25	1.3623	3.9	0.451	-0.4530	3.53	3.57	0.44	3.12	2.67	-0.40	-0.84
	31-May	1.37	1-Jul	1.361	-7.95	1.3692	4.2	0.494	-0.4962	1.94	-0.04	0.44	-0.54	-0.98	0.17	-0.28
	29-Jun	1.364	1-Aug	1.375	-7.45	1.3633	3.7	0.442	-0.4440	-3.86	-3.77	0.45	-4.22	-4.68	-0.39	-0.84
	31-Jul	1.375	2-Sep	1.368	-11.3	1.3739	3.7	0.42	-0.4219	-2.28	3.00	0.44	2.58	2.14	0.09	-0.35
	30-Aug	1.368	1-Oct	1.361	-16	1.3664	3.5	0.418	-0.4198	4.35	2.62	0.44	2.20	1.75	0.09	-0.35
	30-Sep	1.362	1-Nov	1.34	-13.8	1.3606	3.1	0.359	-0.3606	2.87	-4.63	0.44	-4.99	-5.43	1.28	0.84
	31-Oct	1.34	2-Dec	1.349	-23.6	1.3376	3.5	0.392	-0.3937	5.82	5.95	0.44	5.56	5.12	-0.22	-0.66
	29-Nov	1.349	1-Jan	1.354	-31.1	1.3459	3.45	0.424	-0.4259	7.46	7.66	0.45	7.24	6.79	-0.20	-0.65
	31-Dec	1.37	3-Feb	1.347	-27.8	1.3672	4.3	0.497	-0.4992	-1.49	4.56	0.45	4.06	3.61	1.21	0.76
1997	31-Jan	1.347	3-Mar	1.368	-24.6	1.3445	5.1	0.56	-0.5625	3.08	3.21	0.44	2.65	2.21	-0.38	-0.83
	28-Feb	1.368	1-Apr	1.387	-27.5	1.3653	4.7	0.244	-0.2451	0.79	0.98	0.44	0.73	0.29	-0.05	-0.49
	31-Mar	1.381	1-May	1.396	-28.3	1.3782	4.5	0.512	-0.5144	-5.00	-4.74	0.46	-5.25	-5.72	-0.31	-0.77
	30-Apr	1.396	2-Jun	1.38	-30	1.3930	4.6	0.523	-0.5254	2.16	1.50	0.46	0.97	0.51	0.63	0.17
	30-May	1.38	1-Jul	1.38	-28.5	1.3772	5.5	0.656	-0.6590	6.78	6.99	0.46	6.33	5.87	-0.45	-0.91
	30-Jun	1.381	1-Aug	1.378	-29.5	1.3781	4.9	0.567	-0.5696	0.87	-6.02	0.46	-6.59	-7.05	-0.35	-0.81
	31-Jul	1.378	1-Sep	1.388	-26.5	1.3754	4.8	0.537	-0.5395	6.83	6.98	0.46	6.44	5.98	-0.35	-0.81
	29-Aug	1.388	1-Oct	1.378	-24.5	1.3856	4.6	0.55	-0.5525	-3.87	6.78	0.46	6.23	5.77	0.17	-0.29
	30-Sep	1.382	3-Nov	1.409	-26.4	1.3794	4.6	0.532	-0.5344	6.48	6.54	0.46	6.01	5.55	-0.35	-0.81
	31-Oct	1.409	1-Dec	1.421	25.5	1.4116	5.2	0.611	-0.6138	-2.81	-2.97	0.46	-3.58	-4.04	-0.79	-1.25
	28-Nov	1.424	3-Jan	1.43	-15	1.4225	5.2	0.621	-0.6240	-4.82	-4.69	0.48	-5.32	-5.80	-0.52	-1.00
	2-Jan	1.43	2-Feb	1.448	-7.25	1.4293	5.5	0.676	-0.6791	2.87	2.88	0.46	2.20	1.74	-0.63	-1.09
1998	30-Jan	1.458	2-Mar	1.424	-10.3	1.4570	6.8	0.748	-0.7514	0.01	-3.63	0.45	-4.38	-4.84	1.64	1.18
	27-Feb	1.424	1-Apr	1.417	-6.1	1.4229	4.6	0.549	-0.5515	5.85	-5.22	0.46	-5.77	-6.23	-0.06	-0.52
	31-Mar	1.417	1-May	1.43	-9.5	1.4161	5.3	0.603	-0.6058	6.57	6.58	0.46	5.97	5.51	-0.54	-1.00
	30-Apr	1.43	1-Jun	1.456	-9.25	1.4291	4.8	0.537	-0.5395	1.41	1.45	0.46	0.91	0.45	-0.48	-0.94
	29-May	1.456	1-Jul	1.469	-10.4	1.4550	4.9	0.576	-0.5786	-0.98	-0.90	0.46	-1.48	-1.94	-0.51	-0.97
	30-Jun	1.469	3-Aug	1.512	-8.15	1.4682	4.8	0.555	-0.5576	-2.94	-2.80	0.46	-3.36	-3.82	-0.50	-0.96
	31-Jul	1.512	1-Sep	1.544	3.75	1.5124	6.6	0.788	-0.7916	-5.91	-5.81	0.46	-6.60	-7.06	-0.82	-1.28
	31-Aug	1.568	1-Oct	1.526	1.95	1.5682	11.8	1.343	-1.3492	-20.21	-1.86	0.46	-3.21	-3.67	1.40	0.94
	30-Sep	1.526	2-Nov	1.541	0.55	1.5261	11.6	1.32	-1.3258	1.51	1.49	0.44	0.16	-0.27	-1.33	-1.77
	30-Oct	1.541	1-Dec	1.531	-8.05	1.5402	13.1	1.54	-1.5466	10.58	-7.86	0.43	-9.41	-9.83	-0.89	-1.32
	30-Nov	1.532	1-Jan	1.527	-0.95	1.5319	10.2	1.25	-1.2557	2.18	-18.01	0.46	-19.27	-19.72	-1.25	-1.71
	31-Dec	1.537	1-Feb	1.514	2	1.5372	8.5	1.03	-1.0342	2.24	0.52	0.41	-0.51	-0.93	0.48	0.07
1999	29-Jan	1.511	1-Mar	1.509	1.55	1.5112	8.5	0.935	-0.9388	3.76	11.31	0.40	10.37	9.96	-0.81	-1.21
	26-Feb	1.509	1-Apr	1.509	-1.45	1.5089	8.4	1	-1.0040	-6.19	-6.19	0.40	-7.19	-7.59	-0.99	-1.40
	31-Mar	1.509	3-May	1.46	-1.15	1.5089	6.9	0.785	-0.7882	4.52	3.79	0.40	3.00	2.60	2.57	2.17
	30-Apr	1.46	1-Jun	1.481	-2	1.4598	7	0.836	-0.8393	6.32	6.24	0.40	5.40	5.00	-0.83	-1.23
	31-May	1.476	1-Jul	1.463	-6.25	1.4754	7.4	0.842	-0.8454	-2.46	-6.19	0.40	-7.04	-7.44	0.04	-0.36
	30-Jun	1.474	2-Aug	1.503	-6.4	1.4734	6.9	0.823	-0.8265	2.46	2.45	0.43	1.63	1.20	-0.78	-1.21
	30-Jul	1.505	1-Sep	1.495	-7.7	1.5042	7.5	0.895	-0.8988	1.01	4.81	0.42	3.91	3.49	-0.23	-0.65
	31-Aug	1.495	1-Oct	1.468	-9.55	1.4940	7.5	0.854	-0.8577	-1.56	-1.60	0.44	-2.46	-2.89	0.98	0.54
	30-Sep	1.468	1-Nov	1.472	-8	1.4672	7.4	0.828	-0.8316	-0.19	-0.13	0.44	-0.96	-1.40	-0.78	-1.22
	29-Oct	1.472	1-Dec	1.475	-20.5	1.4700	6	0.705	-0.7081	4.29	4.42	0.44	3.71	3.27	-0.57	-1.01
	30-Nov	1.475	3-Jan	1.446	-10	1.4740	6.3	0.763	-0.7670	3.68	0.25	0.52	-0.51	-1.04	1.24	0.71
	31-Dec	1.447	1-Feb	1.442	-9.75	1.4460	6.1	0.74	-0.7435	11.84	-0.46	0.47	-1.20	-1.68	-0.40	-0.87
2000	31-Jan	1.45	1-Mar	1.452	-11	1.4489	6.6	0.74	-0.7435	0.80	0.87	0.48	0.13	-0.35	-0.67	-1.15
	29-Feb	1.452	3-Apr	1.454	-10.5	1.4510	6.8	0.786	-0.7898	7.64	7.70	0.48	6.91	6.43	-0.72	-1.20
	31-Mar	1.454	1-May	1.487	-11	1.4529	5.5	0.647	-0.6502	3.65	3.64	0.50	2.99	2.50	-0.58	-1.07

German Deutschemark Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity:		Without Equity	
												Return	Excess Return	Return	Excess Return
1994	31-Oct	1.508	2-Dec	1.568	-0.35	1.5080	1.12	-1.12	2.98	2.86	0.41	1.74	1.33	-1.12	-1.53
	30-Nov	1.568	2-Jan	1.549	-10	1.5670	1.03	-1.04	-1.13	0.08	0.49	-0.95	-1.44	0.19	-0.30
	30-Dec	1.55	3-Feb	1.523	-11	1.5489	1.15	-1.16	2.85	4.67	0.49	3.51	3.03	0.62	0.13
1995	31-Jan	1.523	2-Mar	1.456	-13.5	1.5217	1.11	-1.12	-4.05	0.37	0.49	-0.75	-1.24	3.49	2.99
	28-Feb	1.456	3-Apr	1.412	-13.8	1.4546	1.17	-1.18	4.00	7.24	0.50	6.07	5.57	1.94	1.44
	31-Mar	1.372	4-May	1.379	-17.5	1.3703	2.19	-2.20	-8.54	-8.37	0.50	-10.57	-11.07	-2.07	-2.57
	28-Apr	1.389	2-Jun	1.412	-19.5	1.3871	1.81	-1.82	4.86	4.91	0.49	3.10	2.60	-1.68	-2.17
	31-May	1.412	3-Jul	1.384	-18	1.4102	1.76	-1.77	3.78	5.88	0.49	4.11	3.62	0.25	-0.24
	30-Jun	1.381	4-Aug	1.397	-18.5	1.3792	1.57	-1.58	-0.39	-0.26	0.50	-1.83	-2.33	-1.45	-1.94
	31-Jul	1.385	4-Sep	1.469	-16.5	1.3834	1.33	-1.34	6.47	6.21	0.48	4.88	4.40	-1.22	-1.70
	31-Aug	1.469	4-Oct	1.429	-19.2	1.4671	1.50	-1.51	0.88	3.71	0.48	2.20	1.72	1.29	0.82
	29-Sep	1.428	3-Nov	1.414	-22.5	1.4258	1.76	-1.77	-2.29	-1.32	0.48	-3.09	-3.57	-0.78	-1.26
	31-Oct	1.408	4-Dec	1.448	-21	1.4059	1.48	-1.49	-0.87	-0.71	0.47	-2.19	-2.67	-1.34	-1.82
	30-Nov	1.448	2-Jan	1.438	-22.5	1.4458	1.33	-1.34	3.46	4.18	0.48	2.84	2.35	-0.64	-1.13
	29-Dec	1.438	2-Feb	1.487	-24	1.4356	1.40	-1.41	0.49	0.64	0.46	-0.77	-1.23	-1.25	-1.71
1996	31-Jan	1.487	4-Mar	1.469	-24.5	1.4846	1.20	-1.21	9.60	10.94	0.44	9.73	9.29	0.02	-0.42
	29-Feb	1.469	4-Apr	1.482	-23.5	1.4667	1.17	-1.18	0.14	0.30	0.43	-0.88	-1.31	-1.02	-1.45
	29-Mar	1.477	2-May	1.532	-15.6	1.4754	1.07	-1.07	0.50	0.58	0.44	-0.49	-0.94	-0.97	-1.42
	30-Apr	1.532	3-Jun	1.531	-29.4	1.5291	1.00	-1.00	0.78	0.97	0.44	-0.03	-0.47	-0.81	-1.25
	31-May	1.523	5-Jul	1.526	-26.5	1.5204	0.99	-0.99	1.50	1.67	0.44	0.68	0.23	-0.82	-1.26
	28-Jun	1.52	2-Aug	1.469	-26.5	1.5174	0.86	-0.86	0.73	4.23	0.45	3.36	2.92	2.61	2.16
	31-Jul	1.469	2-Sep	1.479	-27	1.4663	1.03	-1.03	-3.44	-3.23	0.44	-4.27	-4.71	-0.85	-1.30
	30-Aug	1.48	3-Oct	1.526	-29	1.4771	0.81	-0.81	2.85	2.95	0.44	2.14	1.70	-0.62	-1.07
	30-Sep	1.526	4-Nov	1.517	-32.5	1.5228	0.82	-0.82	4.25	4.86	0.44	4.04	3.60	-0.23	-0.67
	31-Oct	1.517	4-Dec	1.546	-28.2	1.5142	0.94	-0.94	0.28	0.46	0.44	-0.49	-0.93	-0.76	-1.20
	29-Nov	1.538	2-Jan	1.539	-29.7	1.5350	0.80	-0.80	7.00	7.19	0.45	6.39	5.94	-0.61	-1.06
	31-Dec	1.539	3-Feb	1.641	-31.2	1.5359	1.05	-1.05	1.52	1.61	0.45	0.56	0.11	-0.86	-1.31
1997	31-Jan	1.638	4-Mar	1.687	-29	1.6351	1.20	-1.21	5.07	5.09	0.44	3.89	3.45	-1.03	-1.48
	28-Feb	1.687	2-Apr	1.679	-30.7	1.6839	1.23	-1.24	7.40	7.91	0.44	6.67	6.23	-0.76	-1.20
	31-Mar	1.679	2-May	1.731	-30.5	1.6760	1.08	-1.08	5.20	5.22	0.46	4.13	3.67	-0.91	-1.37
	30-Apr	1.731	2-Jun	1.695	-37	1.7273	0.96	-0.96	0.26	2.39	0.46	1.43	0.97	1.16	0.70
	30-May	1.709	3-Jul	1.743	-36	1.7054	1.18	-1.19	3.19	3.34	0.46	2.15	1.69	-0.98	-1.44
	30-Jun	1.743	4-Aug	1.841	-39	1.7391	0.97	-0.97	6.71	6.56	0.46	5.59	5.12	-0.76	-1.22
	31-Jul	1.841	2-Sep	1.809	-39.9	1.8370	1.18	-1.19	17.25	19.33	0.46	18.14	17.68	0.58	0.13
	29-Aug	1.809	2-Oct	1.762	-37	1.8053	1.38	-1.39	-12.01	-9.66	0.46	-11.04	-11.50	1.28	0.82
	30-Sep	1.762	31-Oct	1.733	-38.3	1.7582	1.21	-1.22	6.70	8.49	0.46	7.27	6.81	0.46	0.00
	30-Oct	1.725	2-Dec	1.766	-30.1	1.7220	1.37	-1.38	-10.58	-10.17	0.46	-11.54	-12.00	-1.21	-1.66
	30-Nov	1.766	5-Jan	1.789	-18.2	1.7642	1.06	-1.07	5.97	5.99	0.48	4.93	4.44	-0.96	-1.45
	2-Jan	1.798	2-Feb	1.824	-33	1.7947	1.21	-1.22	7.61	7.68	0.46	6.47	6.00	-1.03	-1.50
1998	30-Jan	1.83	3-Mar	1.817	-29.6	1.8270	1.25	-1.26	4.49	5.23	0.45	3.98	3.52	-0.54	-1.00
	27-Feb	1.817	3-Apr	1.853	-33.4	1.8137	1.14	-1.15	6.07	6.13	0.46	4.98	4.52	-0.97	-1.43
	31-Mar	1.849	4-May	1.796	-33.2	1.8457	1.02	-1.02	8.33	11.53	0.46	10.51	10.04	1.93	1.46
	30-Apr	1.796	4-Jun	1.779	-31.2	1.7929	1.09	-1.10	0.10	1.06	0.46	-0.04	-0.50	-0.14	-0.60
	29-May	1.785	2-Jul	1.805	-31.5	1.7819	1.06	-1.06	9.04	9.11	0.46	8.05	7.59	-0.89	-1.35
	30-Jun	1.805	3-Aug	1.779	-34.3	1.8016	0.96	-0.96	5.90	7.44	0.46	6.48	6.02	0.50	0.04
	31-Jul	1.78	4-Sep	1.754	-33.7	1.7766	0.92	-0.92	-0.40	1.08	0.46	0.15	-0.31	0.56	0.10
	31-Aug	1.76	2-Oct	1.671	-33.8	1.7566	1.33	-1.34	-17.71	-13.32	0.46	-14.66	-15.12	3.99	3.53
	30-Sep	1.671	2-Nov	1.654	-27	1.6683	1.34	-1.35	-7.43	-6.48	0.44	-7.83	-8.27	-0.32	-0.76
	30-Oct	1.657	3-Dec	1.682	-24.2	1.6546	1.25	-1.26	4.39	4.47	0.43	3.22	2.79	-1.11	-1.54
	30-Nov	1.696	4-Jan	1.682	-28	1.6932	1.00	-1.00	7.53	8.42	0.46	7.42	6.96	-0.17	-0.63
	31-Dec	1.677	5-Feb	1.724	-24.9	1.6745	1.31	-1.32	-0.40	-0.25	0.41	-1.56	-1.98	-1.17	-1.58
1999	29-Jan	1.722	2-Mar	1.776	-23.7	1.7196	1.38	-1.39	3.15	3.19	0.40	1.80	1.40	-1.25	-1.65
	26-Feb	1.776	2-Apr	1.81	-26.9	1.7733	1.13	-1.13	-4.81	-4.57	0.40	-5.70	-6.11	-0.99	-1.39
	31-Mar	1.81	3-May	1.846	-31	1.8069	1.11	-1.11	-0.56	-0.38	0.40	-1.50	-1.90	-0.95	-1.35
	30-Apr	1.848	4-Jun	1.89	-36.7	1.8443	1.06	-1.06	10.42	10.38	0.40	9.32	8.92	-0.87	-1.27
	31-May	1.873	2-Jul	1.897	-37	1.8693	1.08	-1.08	-5.99	-5.72	0.40	-6.81	-7.21	-0.89	-1.29
	30-Jun	1.897	2-Aug	1.893	-40.7	1.8929	1.09	-1.09	6.09	6.32	0.43	5.22	4.80	-0.88	-1.31
	30-Jul	1.828	6-Sep	1.829	-40.3	1.8240	1.33	-1.34	-5.14	-4.92	0.42	-6.26	-6.68	-1.12	-1.54
	31-Aug	1.847	4-Oct	1.834	-45.3	1.8425	1.20	-1.21	3.31	4.04	0.44	2.84	2.40	-0.50	-0.93
	30-Sep	1.834	4-Nov	1.858	-43.8	1.8296	1.41	-1.42	-2.29	-2.03	0.44	-3.45	-3.88	-1.18	-1.62
	29-Oct	1.858	2-Dec	1.942	-38.4	1.8542	1.19	-1.20	7.29	7.17	0.44	5.98	5.54	-1.00	-1.44
	30-Nov	1.942	3-Jan	1.946	-50.2	1.9370	1.31	-1.32	6.71	6.95	0.52	5.64	5.11	-1.06	-1.58
	31-Dec	1.943	4-Feb	2.003	-44.3	1.9386	1.43	-1.44	18.01	17.70	0.47	16.26	15.79	-1.22	-1.69
2000	31-Jan	2.012	2-Mar	2.023	-42.3	2.0078	1.35	-1.36	-1.76	-1.54	0.48	-2.90	-3.38	-1.15	-1.63
	29-Feb	2.023	3-Apr	2.038	-43.8	2.0186	1.79	-1.80	11.83	11.96	0.48	10.16	9.68	-1.58	-2.06
	31-Mar	2.043	4-May	2.162	-41.6	2.0388	1.51	-1.52	-0.59	-0.37	0.50	-1.88	-2.38	-1.33	-1.82

British Pound Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	1.631	2-Dec	1.567	-7.5	1.6303	8.9	1.01	-0.97	2.35	2.21	0.41	1.24	0.79	-1.02	-1.43
	30-Nov	1.567	2-Jan	1.56	5.05	1.5675	8.3	0.93	-0.93	-0.52	-0.03	0.49	-0.96	-1.42	-0.90	-1.39
	30-Dec	1.565	3-Feb	1.58	14.75	1.5665	8.5	1.02	-1.03	-0.52	-0.95	0.49	-1.98	-2.47	-1.99	-2.48
1995	31-Jan	1.582	2-Mar	1.584	-12	1.5808	8.3	0.91	-0.92	-2.41	-0.13	0.49	-1.04	-1.57	-1.04	-1.54
	28-Feb	1.584	3-Apr	1.599	-4.5	1.5836	8.7	0.99	-1.00	0.59	-0.94	0.50	-1.94	-2.47	-1.95	-2.45
	31-Mar	1.621	4-May	1.613	-2.8	1.6207	14.5	1.70	-1.70	4.27	0.02	0.50	-1.69	-2.21	-1.72	-2.22
	28-Apr	1.613	2-Jun	1.589	-8.3	1.6122	11.2	1.34	-1.32	2.51	0.05	0.49	-1.27	-1.80	-1.37	-1.87
	31-May	1.589	3-Jul	1.593	-3	1.5887	10.4	1.16	-1.17	3.19	-0.25	0.49	-1.42	-1.94	-1.42	-1.91
	30-Jun	1.595	4-Aug	1.6	-8.5	1.5942	10.5	1.25	-1.26	-0.14	-0.31	0.50	-1.57	-2.11	-1.57	-2.07
	31-Jul	1.598	4-Sep	1.55	-13.5	1.5967	13.7	1.59	-1.55	4.49	0.09	0.48	-1.46	-2.01	-1.63	-2.10
	31-Aug	1.55	4-Oct	1.59	-10.5	1.5490	8.6	1.01	-1.04	0.42	-2.52	0.48	-3.56	-4.10	-3.62	-4.10
	29-Sep	1.585	3-Nov	1.58	-10.5	1.5840	9.3	1.11	-1.11	0.87	0.07	0.48	-1.05	-1.60	-1.18	-1.66
	31-Oct	1.582	4-Dec	1.531	-11.5	1.5809	7.9	0.90	-0.88	0.60	0.08	0.47	-0.80	-1.35	-0.95	-1.42
	30-Nov	1.531	2-Jan	1.55	-9.8	1.5300	9.9	1.18	-1.20	3.83	-1.23	0.48	-2.43	-2.98	-2.44	-2.93
	29-Dec	1.55	2-Feb	1.515	-11	1.5489	8.2	0.98	-0.96	0.68	0.07	0.46	-0.89	-1.42	-1.03	-1.49
1996	31-Jan	1.515	4-Mar	1.532	-11.7	1.5138	8.2	0.92	-0.94	1.90	-1.11	0.44	-2.04	-2.56	-2.06	-2.50
	29-Feb	1.532	4-Apr	1.525	-9.65	1.5310	6.7	0.85	-0.85	-0.84	0.06	0.43	-0.78	-1.30	-0.91	-1.34
	29-Mar	1.527	2-May	1.504	-6.95	1.5263	6.1	0.72	-0.71	-0.75	0.05	0.44	-0.66	-1.16	-0.75	-1.20
	30-Apr	1.504	3-Jun	1.537	-9.25	1.5031	7	0.80	-0.82	3.19	-2.15	0.44	-2.96	-3.46	-3.01	-3.45
	31-May	1.55	5-Jul	1.558	-8	1.5492	6.3	0.74	-0.75	-1.84	-0.51	0.44	-1.26	-1.76	-1.26	-1.71
	28-Jun	1.553	2-Aug	1.556	-4.25	1.5526	6.3	0.75	-0.76	-0.98	-0.19	0.45	-0.95	-1.42	-0.95	-1.40
	31-Jul	1.556	2-Sep	1.558	-5	1.5555	5.8	0.65	-0.65	-0.21	-0.13	0.44	-0.78	-1.25	-0.78	-1.22
	30-Aug	1.562	3-Oct	1.565	-4.5	1.5616	5.3	0.62	-0.63	4.44	-0.19	0.44	-0.82	-1.29	-0.82	-1.26
	30-Sep	1.55	4-Nov	1.628	-4.85	1.5635	4.8	0.56	-0.58	2.23	-3.93	0.44	-4.51	-4.99	-4.67	-5.11
	31-Oct	1.628	4-Dec	1.682	0.25	1.6280	7.9	0.93	-0.96	0.64	-3.21	0.44	-4.17	-4.67	-4.28	-4.72
	29-Nov	1.682	2-Jan	1.715	-8	1.6812	7.5	0.90	-0.92	1.98	-1.92	0.45	-2.84	-3.34	-2.88	-3.33
	31-Dec	1.715	3-Feb	1.614	-11	1.7139	10.7	1.22	-1.15	1.49	0.07	0.45	-1.08	-1.59	-1.21	-1.66
1997	31-Jan	1.599	4-Mar	1.628	-9.1	1.5981	11.1	1.22	-1.25	3.82	-1.78	0.44	-3.03	-3.53	-3.06	-3.50
	28-Feb	1.628	2-Apr	1.631	-9	1.6271	9.9	1.18	-1.19	0.76	-0.18	0.44	-1.37	-1.87	-1.37	-1.82
	31-Mar	1.631	2-May	1.623	-5.45	1.6305	8.5	0.97	-0.97	0.11	0.03	0.46	-0.93	-1.43	-1.00	-1.46
	30-Apr	1.623	2-Jun	1.641	-8.55	1.6221	7.9	0.88	-0.90	2.85	-1.10	0.46	-1.99	-2.50	-2.01	-2.47
	30-May	1.639	3-Jul	1.639	-0.3	1.6390	8.6	1.01	-1.03	4.18	-1.21	0.46	-2.23	-2.75	-2.25	-2.71
	30-Jun	1.666	4-Aug	1.639	-14.5	1.6646	7.9	0.91	-0.90	-0.36	0.09	0.46	-0.81	-1.36	-0.99	-1.45
	31-Jul	1.639	2-Sep	1.62	-19	1.6371	9	1.07	-1.07	6.58	0.12	0.46	-0.95	-1.51	-1.18	-1.64
	29-Aug	1.62	2-Oct	1.614	-20.4	1.6180	9.8	1.15	-1.15	-1.83	0.13	0.46	-1.03	-1.61	-1.28	-1.74
	30-Sep	1.614	1-Nov	1.672	-20	1.6120	9.9	1.13	-1.17	8.86	-3.47	0.46	-4.64	-5.22	-4.77	-5.23
	30-Oct	1.677	2-Dec	1.688	-21.8	1.6748	10.5	1.23	-1.25	-7.66	-0.65	0.46	-1.90	-2.49	-1.90	-2.36
	28-Nov	1.688	5-Jan	1.657	-22.4	1.6858	8.5	1.01	-1.00	-0.22	0.14	0.48	-0.87	-1.47	-1.13	-1.62
	2-Jan	1.648	2-Feb	1.64	-24.6	1.6455	10.4	1.18	-1.18	6.29	0.15	0.46	-1.03	-1.64	-1.33	-1.80
1998	30-Jan	1.634	3-Mar	1.645	-23.4	1.6317	10	1.10	-1.11	6.29	-0.67	0.45	-1.78	-2.39	-1.79	-2.24
	27-Feb	1.645	3-Apr	1.673	-25.7	1.6424	8.6	1.03	-1.05	5.66	-1.67	0.46	-2.72	-3.33	-2.75	-3.21
	31-Mar	1.674	4-May	1.671	-26.8	1.6713	8	0.91	-0.91	2.86	0.16	0.46	-0.75	-1.36	-1.07	-1.54
	30-Apr	1.671	4-Jun	1.639	-25	1.6685	7.3	0.87	-0.86	-0.07	0.15	0.46	-0.71	-1.31	-1.01	-1.47
	29-May	1.634	2-Jul	1.67	-23.7	1.6316	7.2	0.85	-0.87	-0.97	-2.16	0.46	-3.03	-3.63	-3.07	-3.53
	30-Jun	1.67	3-Aug	1.64	-27.9	1.6672	7.3	0.83	-0.82	-0.65	0.17	0.46	-0.65	-1.26	-0.98	-1.44
	31-Jul	1.633	4-Sep	1.669	-27.5	1.6302	7.1	0.85	-0.87	0.08	-2.16	0.46	-3.03	-3.64	-3.08	-3.54
	31-Aug	1.675	2-Oct	1.697	-27.5	1.6723	8.7	0.99	-1.01	-10.07	-1.30	0.46	-2.31	-2.91	-2.32	-2.78
	30-Sep	1.697	2-Nov	1.675	-28	1.6942	10	1.12	-1.11	-3.52	0.17	0.44	-0.94	-1.54	-1.27	-1.71
	30-Oct	1.674	3-Dec	1.654	-27.8	1.6712	9.8	1.15	-1.14	7.38	0.17	0.43	-0.98	-1.57	-1.31	-1.73
	30-Nov	1.648	4-Jan	1.662	-21.5	1.6459	7.8	0.87	-0.88	5.62	-0.84	0.46	-1.73	-2.29	-1.73	-2.19
	31-Dec	1.66	5-Feb	1.638	-16.5	1.6584	10	1.21	-1.20	2.41	0.10	0.41	-1.10	-1.61	-1.30	-1.71
1999	29-Jan	1.645	2-Mar	1.604	-12.5	1.6438	7.5	0.83	-0.81	0.23	0.08	0.40	-0.74	-1.22	-0.89	-1.29
	26-Feb	1.604	2-Apr	1.615	-9.2	1.6031	9.1	1.09	-1.10	4.73	-0.68	0.40	-1.78	-2.24	-1.78	-2.19
	31-Mar	1.615	3-May	1.608	-5	1.6145	7.6	0.92	-0.92	1.95	0.03	0.40	-0.89	-1.33	-0.95	-1.35
	30-Apr	1.608	4-Jun	1.604	-5.7	1.6074	6.9	0.84	-0.84	4.08	0.04	0.40	-0.80	-1.24	-0.87	-1.27
	31-May	1.603	2-Jul	1.576	-4.95	1.6025	7.4	0.84	-0.83	-4.98	0.03	0.40	-0.80	-1.24	-0.86	-1.26
	30-Jun	1.576	2-Aug	1.618	2.25	1.5762	7.5	0.84	-0.86	1.48	-2.60	0.43	-3.46	-3.88	-3.53	-3.96
	30-Jul	1.622	6-Sep	1.607	0.6	1.6221	8.8	1.05	-1.04	-1.37	0.00	0.42	-1.05	-1.48	-1.04	-1.46
	31-Aug	1.609	4-Oct	1.647	5.45	1.6095	9.2	1.05	-1.08	0.23	-2.31	0.44	-3.38	-3.80	-3.44	-3.87
	30-Sep	1.647	4-Nov	1.646	0.8	1.6471	8.9	1.06	-1.06	-3.47	0.00	0.44	-1.07	-1.51	-1.06	-1.50
	29-Oct	1.643	2-Dec	1.596	0.77	1.6431	7.9	0.93	-0.91	3.75	0.00	0.44	-0.91	-1.35	-0.90	-1.34
	30-Nov	1.596	3-Jan	1.619	8.8	1.5969	9	1.01	-1.03	5.46	-1.42	0.52	-2.45	-2.89	-2.47	-2.99
	31-Dec	1.616	4-Feb	1.608	-0.88	1.6159	7.8	0.99	-0.99	5.05	0.01	0.47	-0.99	-1.43	-1.00	-1.47
2000	31-Jan	1.614	2-Mar	1.58	-0.82	1.6139	8.2	0.92	-0.90	-9.55	0.01	0.48	-0.90	-1.39	-0.91	-1.38
	29-Feb	1.58	3-Apr	1.593	-1.67	1.5798	9.8	1.11	-1.13	-0.57	-0.82	0.48	-1.94	-2.44	-1.95	-2.43
	31-Mar	1.592	4-May	1.559	2.55	1.5923	8.2	0.96	-0.95	4.94	-0.02	0.50	-0.96	-1.45	-0.93	-1.43

Japanese Yen Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	96.97	2-Dec	98.87	-22.2	96.968	1.00	-1.0041	2.18	2.14	0.41	1.13	0.72	-1.00	-1.41
	30-Nov	98.87	2-Jan	99.6	-33.6	98.867	0.88	-0.8843	-4.57	-4.54	0.49	-5.42	-5.91	-0.88	-1.37
	30-Dec	99.58	3-Feb	99.38	-33.5	99.577	1.01	-1.0149	3.39	3.60	0.49	2.59	2.10	-0.81	-1.30
1995	31-Jan	99.45	2-Mar	96.54	-29.4	99.447	1.03	-1.0351	-5.44	-2.59	0.49	-3.63	-4.12	1.98	1.49
	28-Feb	96.54	3-Apr	89.53	-33.2	96.537	0.98	-0.9849	-8.56	-1.40	0.50	-2.39	-2.88	6.84	6.35
	31-Mar	86.55	5-May	83.65	-35.4	86.546	2.01	-2.0200	-5.36	-2.08	0.50	-4.10	-4.59	1.45	0.95
	28-Apr	84.33	2-Jun	84.44	-33.5	84.327	1.81	-1.8189	4.13	4.13	0.49	2.31	1.82	-1.81	-2.31
	31-May	84.44	3-Jul	84.72	-34.7	84.437	1.61	-1.6179	-8.15	-8.12	0.49	-9.74	-10.23	-1.61	-2.11
	30-Jun	84.63	4-Aug	90.88	-37.3	84.626	1.36	-1.3668	-5.96	-5.54	0.50	-6.91	-7.41	-1.36	-1.86
	31-Jul	88.26	4-Sep	97.71	-41.8	88.256	1.59	-1.5976	14.88	13.44	0.48	11.85	11.37	-1.59	-2.07
	31-Aug	97.71	4-Oct	100.54	-41.2	97.706	1.88	-1.8890	8.63	8.39	0.48	6.50	6.03	-1.88	-2.36
	29-Sep	99.72	3-Nov	103.1	-53.3	99.715	2.09	-2.1000	-1.13	-1.08	0.48	-3.18	-3.66	-2.09	-2.57
	31-Oct	102.07	4-Dec	102.07	-49.1	102.065	1.65	-1.6578	-1.44	-1.44	0.47	-3.10	-3.57	-1.65	-2.13
	30-Nov	102.07	4-Jan	103.51	-48.6	102.065	1.48	-1.4872	6.17	6.09	0.48	4.60	4.12	-2.88	-3.36
	29-Dec	103.51	2-Feb	106.96	-46.8	103.505	1.46	-1.4667	6.00	5.81	0.46	4.34	3.88	-1.46	-1.92
1996	31-Jan	106.96	4-Mar	105.13	-44.7	106.956	1.19	-1.1953	4.75	6.58	0.44	5.38	4.94	0.55	0.10
	29-Feb	105.13	4-Apr	107.45	-41.8	105.126	1.30	-1.3056	-3.30	-3.23	0.43	-4.53	-4.97	-1.30	-1.73
	29-Mar	107.12	2-May	105.06	-49.3	107.115	1.16	-1.1651	6.37	8.45	0.44	7.29	6.85	0.80	0.35
	30-Apr	105.06	3-Jun	107.46	-57.5	105.054	1.28	-1.2857	2.96	2.90	0.44	1.62	1.18	-1.28	-1.72
	31-May	107.97	5-Jul	110.15	-45.5	107.965	1.17	-1.1752	-0.39	-0.37	0.44	-1.55	-1.99	-1.17	-1.61
	28-Jun	109.38	2-Aug	106.46	-47.5	109.375	0.92	-0.9241	2.62	5.43	0.45	4.51	4.06	1.82	1.37
	31-Jul	106.46	2-Sep	108.46	-48	106.455	1.09	-1.0948	-8.16	-8.00	0.44	-9.10	-9.54	-1.09	-1.53
	30-Aug	108.88	3-Oct	111.22	-39	108.876	0.79	-0.7935	-2.54	-2.48	0.44	-3.28	-3.72	-0.79	-1.23
	30-Sep	111.55	4-Nov	113.97	-52.5	111.545	0.85	-0.8538	6.89	6.75	0.44	5.89	5.45	-0.85	-1.29
	31-Oct	113.97	4-Dec	114.08	-46	113.965	0.99	-0.9943	-5.05	-5.05	0.44	-6.04	-6.48	-0.99	-1.43
	29-Nov	113.86	2-Jan	115.9	-55.2	113.854	0.78	-0.7835	2.70	2.66	0.45	1.88	1.43	-0.78	-1.23
	31-Dec	115.9	3-Feb	121.47	-55.8	115.894	1.08	-1.0848	-7.89	-7.53	0.45	-8.61	-9.06	-1.08	-1.53
1997	31-Jan	121.36	4-Mar	120.39	-47	121.355	1.27	-1.2756	-5.33	-4.56	0.44	-5.84	-6.28	-0.47	-0.91
	28-Feb	120.39	4-Apr	123.62	-51.3	120.385	1.32	-1.3258	1.24	1.21	0.44	-0.12	-0.56	-1.32	-1.76
	31-Mar	124.05	2-May	127.14	-54.2	124.045	1.12	-1.1252	-2.98	-2.91	0.46	-4.03	-4.49	-1.12	-1.58
	30-Apr	127.14	2-Jun	115.9	-55.9	127.134	1.26	-1.2658	6.38	16.69	0.46	15.43	14.96	8.43	7.97
	30-May	116.4	3-Jul	114.53	-49.5	116.395	1.17	-1.1754	4.79	6.50	0.46	5.33	4.87	0.46	0.00
	30-Jun	114.53	4-Aug	118.47	-52	114.525	0.90	-0.9042	2.67	2.59	0.46	1.68	1.22	-0.90	-1.36
	31-Jul	118.47	4-Sep	120.93	-51	118.465	1.16	-1.1653	-1.33	-1.30	0.46	-2.46	-2.92	-1.16	-1.62
	29-Aug	120.93	2-Oct	120.47	-50.7	120.925	0.79	-0.7936	-10.34	-10.00	0.46	-10.79	-11.25	-0.41	-0.87
	30-Sep	120.47	3-Nov	120.94	-54.5	120.465	0.84	-0.8439	-1.87	-1.86	0.46	-2.71	-3.17	-1.23	-1.69
	30-Oct	120.05	4-Dec	127.74	-51.5	120.045	0.99	-0.9945	-7.99	-7.50	0.46	-8.50	-8.96	-0.99	-1.45
	30-Nov	127.74	2-Jan	130.1	-70.8	127.733	0.78	-0.7838	1.08	1.06	0.48	0.28	-0.20	-0.78	-1.26
	2-Jan	130.57	2-Feb	125.55	-58.5	130.564	1.06	-1.0649	-8.28	-4.61	0.46	-5.68	-6.14	2.93	2.47
1998	30-Jan	126.79	3-Mar	126.11	-50	126.785	1.37	-1.3762	8.98	9.56	0.45	8.19	7.73	-0.84	-1.29
	27-Feb	126.11	3-Apr	133.63	-54.9	126.105	1.39	-1.3964	1.22	1.16	0.46	-0.24	-0.70	-1.39	-1.85
	31-Mar	133.3	4-May	132.76	-62	133.294	1.21	-1.2156	-1.81	-1.41	0.46	-2.63	-3.09	-0.81	-1.27
	30-Apr	132.76	4-Jun	138.9	-61	132.754	1.06	-1.0649	-5.36	-5.12	0.46	-6.18	-6.64	-1.06	-1.52
	29-May	138.57	2-Jul	137.98	-59	138.564	1.30	-1.3060	0.19	0.62	0.46	-0.69	-1.15	-0.88	-1.34
	30-Jun	137.98	3-Aug	143.36	-63.9	137.974	1.25	-1.2557	1.02	0.98	0.46	-0.27	-0.73	-1.25	-1.71
	31-Jul	144.75	4-Sep	137.9	-63.5	144.744	1.37	-1.3763	3.47	8.61	0.46	7.23	6.77	3.59	3.13
	31-Aug	141.04	2-Oct	136.65	-60.7	141.034	1.50	-1.5069	-13.87	-11.10	0.46	-12.61	-13.06	1.71	1.25
	30-Sep	136.65	2-Nov	116.85	-59.4	136.644	1.51	-1.5166	-4.97	11.13	0.44	9.61	9.18	15.43	14.99
	30-Oct	116.4	3-Dec	123.15	-49.5	116.395	1.45	-1.4562	1.18	1.12	0.46	-0.34	-0.76	-1.45	-1.88
	30-Nov	123.15	4-Jan	114.92	-59.5	123.144	1.60	-1.6073	9.73	17.58	0.46	15.98	15.52	5.55	5.10
	31-Dec	113.6	5-Feb	112.97	-46.5	113.595	1.14	-1.1447	-7.00	-6.48	0.41	-7.62	-8.04	-0.59	-1.00
1999	29-Jan	116.24	2-Mar	119.09	-41	116.236	1.78	-1.7872	4.75	4.64	0.40	2.85	2.45	-1.78	-2.19
	26-Feb	119.09	2-Apr	118.47	-47.9	119.085	2.23	-2.2390	-0.91	-0.39	0.40	-2.63	-3.03	-1.72	-2.12
	31-Mar	118.47	3-May	119.1	-52.5	118.465	2.01	-2.0181	10.22	10.18	0.40	8.16	7.75	-2.01	-2.42
	30-Apr	119.29	7-Jun	121	-48.8	119.285	1.53	-1.5361	5.46	5.39	0.40	3.85	3.45	-1.53	-1.93
	31-May	121.79	2-Jul	121.01	-49.2	121.785	1.37	-1.3755	-3.53	-2.91	0.40	-4.29	-4.69	-0.73	-1.13
	30-Jun	121.01	2-Aug	115.35	-53	121.005	1.23	-1.2352	8.80	14.14	0.43	12.91	12.48	3.67	3.25
	30-Jul	114.63	3-Sep	109.1	-50.5	114.625	1.68	-1.6871	1.89	7.06	0.42	5.37	4.95	3.38	2.96
	31-Aug	109.36	4-Oct	106.43	-52	109.355	1.68	-1.6873	-2.38	0.31	0.44	-1.38	-1.82	1.07	0.63
	30-Sep	106.43	4-Nov	104.07	-48.9	106.425	2.07	-2.0791	0.97	3.26	0.44	1.18	0.74	0.19	-0.25
	29-Oct	104.15	2-Dec	101.63	-49.9	104.145	1.64	-1.6472	1.91	4.44	0.44	2.79	2.35	0.83	0.39
	30-Nov	101.63	3-Jan	102.01	-48	101.625	1.88	-1.8899	3.43	3.43	0.52	1.54	1.01	-1.89	-2.41
	31-Dec	102.24	4-Feb	108.33	-53.5	102.235	1.75	-1.7583	2.03	1.92	0.47	0.16	-0.31	-1.75	-2.23
2000	31-Jan	107.37	2-Mar	109.96	-50	107.365	1.24	-1.2459	3.20	3.13	0.48	1.88	1.40	-1.24	-1.72
	29-Feb	109.96	3-Apr	105.51	-54.5	109.955	1.53	-1.5373	2.15	6.46	0.48	4.92	4.44	2.68	2.20
	31-Mar	102.64	4-May	108.44	-58.1	102.634	2.09	-2.1004	1.89	1.80	0.50	-0.30	-0.80	-2.10	-2.59

APPENDIX 3C

RETURN RESULTS FOR ONE MONTH COVERED CALL STRATEGIES

Canadian Dollar Calls Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (b)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	1.353	30-Nov	1.375	1	1.3531	4	0.482	0.4840	-1.44	-3.01	0.41	-2.53	-2.94	-1.12	-1.53
	30-Nov	1.375	30-Dec	1.402	-6	1.3744	3.9	0.444	0.4462	-4.62	-6.46	0.49	-6.01	-6.50	-1.48	-1.97
	30-Dec	1.402	2-Feb	1.406	1	1.4021	5.3	0.632	0.6351	2.94	2.64	0.49	3.28	2.79	0.35	-0.14
1995	31-Jan	1.408	28-Feb	1.393	19	1.4099	6.2	0.680	0.6834	-4.65	-0.76	0.49	-0.08	-0.57	0.55	0.05
	28-Feb	1.393	31-Mar	1.399	21	1.3951	5.7	0.660	0.6633	2.67	2.23	0.50	2.89	2.40	0.23	-0.26
	31-Mar	1.399	2-May	1.357	23	1.4013	5.8	0.634	0.6371	4.58	4.49	0.50	5.13	4.63	0.47	-0.03
	28-Apr	1.356	31-May	1.37	21	1.3581	5.9	0.707	0.7105	-0.79	-1.81	0.49	-1.09	-1.59	-0.31	-0.80
	31-May	1.37	30-Jun	1.372	19	1.3719	5.9	0.672	0.6753	3.95	3.80	0.49	4.48	3.99	0.53	0.04
	30-Jun	1.372	2-Aug	1.356	12	1.3732	5.1	0.611	0.6140	1.76	-0.38	0.50	0.24	-0.26	0.53	0.03
	31-Jul	1.368	31-Aug	1.343	10.5	1.3691	5.7	0.660	0.6631	1.94	2.71	0.48	3.38	2.90	0.58	0.11
	31-Aug	1.343	29-Sep	1.341	4.75	1.3435	6.8	0.762	0.7656	-2.13	-4.29	0.48	-3.52	-4.00	0.73	0.25
	29-Sep	1.341	1-Nov	1.348	4.45	1.3414	8	0.960	0.9646	0.29	-0.23	0.48	0.73	0.26	0.45	-0.03
	31-Oct	1.343	30-Nov	1.359	2	1.3432	5.9	0.672	0.6752	-1.56	-2.72	0.47	-2.04	-2.52	-0.50	-0.98
	30-Nov	1.359	29-Dec	1.365	-1	1.3589	4.5	0.504	0.5064	4.53	4.07	0.48	4.58	4.09	0.07	-0.42
	29-Dec	1.365	1-Feb	1.374	2.2	1.3652	4.9	0.585	0.5877	1.12	0.46	0.46	1.05	0.59	-0.07	-0.53
1996	31-Jan	1.376	29-Feb	1.372	-1.25	1.3759	4.7	0.526	0.5283	5.41	7.81	0.44	8.34	7.90	0.54	0.10
	29-Feb	1.372	29-Mar	1.363	-0.45	1.3720	4.5	0.504	0.5062	-0.70	0.26	0.43	0.76	0.33	0.51	0.08
	29-Mar	1.363	30-Apr	1.363	-5.45	1.3625	4.3	0.506	0.5082	0.75	0.75	0.44	1.26	0.82	0.51	0.07
	30-Apr	1.363	31-May	1.37	-7.25	1.3623	3.6	0.416	0.4178	3.53	3.00	0.44	3.42	2.98	-0.09	-0.54
	31-May	1.37	2-Jul	1.361	-7.95	1.3692	3.8	0.448	0.4500	1.94	1.81	0.44	2.26	1.82	0.51	0.07
	28-Jun	1.364	31-Jul	1.375	-7.45	1.3633	3.4	0.400	0.4018	-3.86	-4.63	0.45	-4.22	-4.67	-0.40	-0.85
	31-Jul	1.375	30-Aug	1.368	-11.3	1.3739	3.4	0.387	0.3887	-2.28	-1.36	0.44	-0.97	-1.42	0.47	0.03
	30-Aug	1.368	2-Oct	1.361	-16	1.3664	3.1	0.370	0.3716	4.35	4.28	0.44	4.65	4.21	0.49	0.05
	30-Sep	1.362	31-Oct	1.34	-13.8	1.3606	2.5	0.289	0.2903	2.87	2.82	0.44	3.11	2.67	0.39	-0.05
	31-Oct	1.34	29-Nov	1.349	-23.6	1.3376	3.1	0.347	0.3485	5.82	5.11	0.44	5.46	5.02	-0.32	-0.76
	29-Nov	1.349	3-Jan	1.354	-31.1	1.3459	3.25	0.399	0.4008	7.46	7.07	0.45	7.47	7.02	0.03	-0.42
	31-Dec	1.37	31-Jan	1.347	-27.8	1.3672	3.9	0.451	0.4530	-1.49	-0.82	0.45	-0.37	-0.81	0.66	0.21
1997	31-Jan	1.347	28-Feb	1.368	-24.6	1.3445	4.7	0.517	0.5193	3.08	1.50	0.44	2.02	1.57	-1.02	-1.46
	28-Feb	1.368	2-Apr	1.387	-27.5	1.3653	4.3	0.500	0.5022	0.79	-0.59	0.44	-0.09	-0.53	-0.87	-1.31
	31-Mar	1.381	30-Apr	1.396	-28.3	1.3782	4.1	0.478	0.4802	-5.00	-6.02	0.46	-5.54	-6.00	-0.59	-1.06
	30-Apr	1.396	30-May	1.38	-30	1.3930	4.2	0.478	0.4802	2.16	5.91	0.46	6.39	5.93	0.70	0.24
	30-May	1.38	1-Jul	1.38	-28.5	1.3772	5	0.599	0.6018	6.78	6.78	0.46	7.39	6.92	0.60	0.14
	30-Jun	1.381	31-Jul	1.378	-29.5	1.3781	4.6	0.532	0.5345	0.87	1.08	0.46	1.61	1.15	0.75	0.29
	31-Jul	1.378	29-Aug	1.388	-26.5	1.3754	4.4	0.492	0.4942	6.83	6.06	0.46	6.56	6.10	-0.23	-0.68
	29-Aug	1.388	1-Oct	1.378	-24.5	1.3856	4.2	0.494	0.4963	-3.87	-3.11	0.46	-2.61	-3.07	0.67	0.21
	30-Sep	1.382	31-Oct	1.409	-26.4	1.3794	3.9	0.451	0.4531	6.48	4.44	0.46	4.89	4.43	-1.46	-1.92
	31-Oct	1.409	2-Dec	1.421	25.5	1.4116	4.6	0.541	0.5435	-2.81	-3.63	0.46	-3.09	-3.55	-0.30	-0.76
	28-Nov	1.424	31-Dec	1.43	-15	1.4225	4.7	0.561	0.5637	-4.82	-5.22	0.48	-4.65	-5.14	0.14	-0.34
	2-Jan	1.43	4-Feb	1.448	-7.25	1.4293	5.2	0.592	0.5947	2.87	1.59	0.46	2.18	1.72	-0.65	-1.11
1998	30-Jan	1.458	27-Feb	1.424	-10.3	1.4570	6.3	0.520	0.5224	0.01	3.27	0.45	3.80	3.34	0.59	0.14
	27-Feb	1.424	1-Apr	1.417	-10.6	1.4229	4.3	0.513	0.5154	5.85	5.99	0.46	6.50	6.04	0.59	0.13
	31-Mar	1.417	30-Apr	1.43	-9.5	1.4161	4.5	0.564	0.5666	6.57	5.60	0.46	6.17	5.71	-0.34	-0.80
	30-Apr	1.43	29-May	1.456	-9.25	1.4291	4.5	0.504	0.5063	1.41	-0.40	0.46	0.10	-0.36	-1.28	-1.74
	29-May	1.456	30-Jun	1.469	-10.4	1.4550	4.6	0.540	0.5425	-0.98	-1.86	0.46	-1.32	-1.77	-0.34	-0.80
	30-Jun	1.469	31-Jul	1.512	-8.15	1.4682	4.5	0.520	0.5224	-2.94	-5.70	0.46	-5.17	-5.63	-2.32	-2.78
	31-Jul	1.512	2-Sep	1.544	3.75	1.5124	6.1	0.728	0.7313	-5.91	-7.86	0.46	-7.13	-7.59	-1.34	-1.80
	31-Aug	1.568	30-Sep	1.526	1.95	1.5682	10	1.138	1.1432	-20.21	-13.36	0.46	-12.21	-12.67	1.13	0.67
	30-Sep	1.526	30-Oct	1.541	0.55	1.5261	10.6	1.206	1.2113	1.51	0.52	0.44	1.73	1.29	0.24	-0.20
	30-Oct	1.541	1-Dec	1.531	-8.05	1.5402	12	1.410	1.4160	10.58	12.52	0.43	13.94	13.51	1.47	1.04
	30-Nov	1.532	4-Jan	1.527	-0.95	1.5319	8.5	1.040	1.0448	2.18	-0.18	0.46	0.87	0.41	1.37	0.92
	31-Dec	1.537	3-Feb	1.514	2	1.5372	7.3	0.884	0.8876	2.24	3.00	0.41	3.88	3.47	0.87	0.46
1999	29-Jan	1.511	26-Feb	1.509	1.55	1.5112	7.7	0.847	0.8504	3.76	1.83	0.40	2.68	2.27	0.84	0.44
	26-Feb	1.509	31-Mar	1.509	-1.45	1.5089	7.5	0.895	0.8986	-6.19	-6.19	0.40	-5.30	-5.70	0.90	0.49
	31-Mar	1.509	30-Apr	1.46	-1.15	1.5089	6.5	0.740	0.7430	4.52	2.74	0.40	3.48	3.08	0.75	0.35
	30-Apr	1.46	2-Jun	1.481	-2	1.4598	6.5	0.776	0.7791	6.32	4.81	0.40	5.59	5.19	-0.64	-1.04
	31-May	1.476	2-Jul	1.463	-6.25	1.4754	6.9	0.835	0.8384	-2.46	-1.60	0.40	-0.76	-1.16	0.88	0.48
	30-Jun	1.474	2-Aug	1.503	-6.4	1.4734	6.6	0.788	0.7914	2.46	0.48	0.43	1.27	0.85	-1.14	-1.56
	30-Jul	1.505	1-Sep	1.495	-7.7	1.5042	7.1	0.847	0.8506	1.01	4.04	0.42	4.89	4.47	0.90	0.48
	31-Aug	1.495	30-Sep	1.468	-9.55	1.4940	7	0.797	0.8005	-1.56	-0.25	0.44	0.55	0.11	0.87	0.43
	30-Sep	1.468	29-Oct	1.472	-8	1.4672	6.8	0.761	0.7643	-0.19	-0.46	0.44	0.31	-0.13	0.49	0.05
	29-Oct	1.472	30-Nov	1.475	-20.5	1.4700	5.6	0.658	0.6609	4.29	4.08	0.44	4.74	4.30	0.46	0.02
	30-Nov	1.475	3-Jan	1.446	-10	1.4740	5.7	0.690	0.6936	3.68	2.44	0.52	3.13	2.61	0.76	0.24
	31-Dec	1.447	2-Feb	1.442	-9.75	1.4460	5.6	0.678	0.6812	11.84	10.48	0.47	11.16	10.69	0.75	0.28
2000	31-Jan	1.45	29-Feb	1.452	-11	1.4489	6.1	0.683	0.6863	0.80	0.66	0.48	1.35	0.87	0.55	0.07
	29-Feb	1.452	31-Mar	1.454	-10.5	1.4510	6.4	0.740	0.7436	7.64	7.49	0.48	8.23	7.75	0.61	0.13
	31-Mar	1.454	2-May	1.487	-11	1.4529	5	0.588	0.5909	3.65	1.35	0.50	1.94	1.45	-1.63	-2.13

German Deutschemark Calls Strategy Returns

Year	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	1.508	30-Nov	1.568	-0.35	1.5080	1.060	1.0644	2.98	-0.96	0.41	0.10	-0.31	-2.76	-3.17
	30-Nov	1.568	29-Dec	1.549	-10	1.5670	1.000	1.0049	-1.13	-1.08	0.49	-0.07	-0.56	1.07	0.58
	30-Dec	1.55	1-Feb	1.523	-11	1.5489	1.110	1.1154	2.85	2.97	0.49	4.09	3.60	1.19	0.70
1995	31-Jan	1.523	28-Feb	1.456	-13.5	1.5217	1.070	1.0753	-4.05	-4.14	0.49	-3.07	-3.56	1.17	0.67
	28-Feb	1.456	30-Mar	1.412	-13.8	1.4546	1.140	1.1457	4.00	4.23	0.50	5.37	4.87	1.24	0.75
	31-Mar	1.372	2-May	1.379	-17.5	1.3703	1.110	1.1155	-8.54	-9.01	0.50	-7.89	-8.39	0.61	0.11
	28-Apr	1.389	31-May	1.412	-19.5	1.3871	1.710	1.7184	4.86	3.15	0.49	4.87	4.37	0.09	-0.40
	31-May	1.412	29-Jun	1.384	-18	1.4102	1.690	1.6983	3.78	3.99	0.49	5.69	5.19	1.83	1.34
	30-Jun	1.381	2-Aug	1.397	-18.5	1.3792	1.420	1.4271	-0.39	-1.53	0.50	-0.11	-0.60	0.28	-0.21
	31-Jul	1.385	31-Aug	1.469	-16.5	1.3834	1.270	1.2761	6.47	0.38	0.48	1.66	1.18	-4.44	-4.92
	31-Aug	1.469	2-Oct	1.429	-19.2	1.4671	1.450	1.4569	0.88	1.04	0.48	2.50	2.02	1.59	1.11
	29-Sep	1.428	1-Nov	1.414	-22.5	1.4258	1.650	1.6579	-2.29	-2.15	0.48	-0.50	-0.97	1.82	1.34
	31-Oct	1.408	30-Nov	1.448	-21	1.4059	1.380	1.3865	-0.87	-3.61	0.47	-2.23	-2.70	-1.38	-1.85
	30-Nov	1.448	29-Dec	1.438	-22.5	1.4458	1.280	1.2862	3.46	3.64	0.48	4.92	4.44	1.44	0.96
	29-Dec	1.438	31-Jan	1.487	-24	1.4356	1.310	1.3161	0.49	-2.82	0.46	-1.50	-1.96	-1.98	-2.44
1996	31-Jan	1.487	29-Feb	1.469	-24.5	1.4846	1.140	1.1450	9.60	9.88	0.44	11.02	10.58	1.31	0.87
	29-Feb	1.469	2-Apr	1.482	-23.5	1.4667	1.120	1.1248	0.14	-0.74	0.43	0.38	-0.05	0.25	-0.18
	29-Mar	1.477	30-Apr	1.532	-15.6	1.4754	0.950	0.9542	0.50	-3.11	0.44	-2.16	-2.60	-2.64	-3.08
	30-Apr	1.532	30-May	1.531	-29.4	1.5291	0.970	0.9743	0.78	0.85	0.44	1.82	1.38	1.17	0.72
	31-May	1.523	2-Jul	1.526	-26.5	1.5204	0.940	0.9442	1.50	1.30	0.44	2.24	1.80	0.75	0.31
	28-Jun	1.52	31-Jul	1.469	-26.5	1.5174	0.810	0.8136	0.73	0.94	0.45	1.75	1.30	0.99	0.55
	31-Jul	1.469	29-Aug	1.479	-27	1.4663	0.980	0.9844	-3.44	-4.09	0.44	-3.11	-3.55	0.31	-0.14
	30-Aug	1.48	1-Oct	1.526	-29	1.4771	0.770	0.7734	2.85	-0.25	0.44	0.52	0.08	-2.24	-2.68
	30-Sep	1.526	31-Oct	1.517	-32.5	1.5228	0.780	0.7834	4.25	4.49	0.44	5.27	4.83	1.00	0.56
	31-Oct	1.517	2-Dec	1.546	-28.2	1.5142	0.880	0.8838	0.28	-1.60	0.44	-0.72	-1.16	-0.99	-1.43
	29-Nov	1.538	31-Dec	1.539	-29.7	1.5350	0.750	0.7534	7.00	6.94	0.45	7.69	7.24	0.69	0.24
	31-Dec	1.539	30-Jan	1.641	-31.2	1.5359	0.970	0.9743	1.52	-4.79	0.45	-3.82	-4.27	-5.24	-5.69
1997	31-Jan	1.638	28-Feb	1.687	-29	1.6351	1.160	1.1651	5.07	2.02	0.44	3.18	2.74	-1.74	-2.18
	28-Feb	1.687	31-Mar	1.679	-30.7	1.6839	1.190	1.1953	7.40	7.61	0.44	8.81	8.37	1.38	0.94
	31-Mar	1.679	30-Apr	1.731	-30.5	1.6760	1.010	1.0147	5.20	2.04	0.46	3.05	2.59	-1.99	-2.45
	30-Apr	1.731	29-May	1.695	-37	1.7273	0.930	0.9343	0.26	0.49	0.46	1.42	0.96	1.15	0.69
	30-May	1.709	1-Jul	1.743	-36	1.7054	1.130	1.1352	3.19	1.18	0.46	2.32	1.85	-0.82	-1.28
	30-Jun	1.743	31-Jul	1.841	-39	1.7391	0.930	0.9343	6.71	1.03	0.46	1.96	1.50	-4.39	-4.85
	31-Jul	1.841	29-Aug	1.809	-39.9	1.8370	1.130	1.1352	17.25	17.78	0.46	18.91	18.46	1.36	0.90
	29-Aug	1.809	30-Sep	1.762	-37	1.8053	1.330	1.3361	-12.01	-12.12	0.46	-10.78	-11.24	1.55	1.09
	30-Sep	1.762	29-Oct	1.733	-38.3	1.7582	1.150	1.1553	6.70	7.04	0.46	8.19	7.73	1.38	0.92
	30-Oct	1.725	28-Nov	1.766	-30.1	1.7220	1.250	1.2557	-10.58	-12.66	0.46	-11.40	-11.86	-1.07	-1.52
	30-Nov	1.766	30-Dec	1.789	-18.2	1.7642	1.025	1.0300	5.97	4.61	0.48	5.64	5.15	-0.26	-0.74
	2-Jan	1.798	29-Jan	1.824	-33	1.7947	1.150	1.1553	7.61	6.08	0.46	7.23	6.77	-0.27	-0.73
1998	30-Jan	1.83	27-Feb	1.817	-29.6	1.8270	1.200	1.2055	4.49	4.68	0.45	5.89	5.43	1.37	0.91
	27-Feb	1.817	1-Apr	1.853	-33.4	1.8137	1.090	1.0950	6.07	4.01	0.46	5.10	4.64	-0.85	-1.31
	31-Mar	1.849	30-Apr	1.796	-33.2	1.8457	0.980	0.9845	8.33	8.76	0.46	9.75	9.29	1.17	0.71
	30-Apr	1.796	2-Jun	1.779	-31.2	1.7929	1.040	1.0448	0.10	0.28	0.46	1.32	0.86	1.22	0.76
	29-May	1.785	30-Jun	1.779	-31.5	1.7819	1.020	1.0247	9.04	7.83	0.46	8.86	8.40	-0.08	-0.54
	30-Jun	1.805	30-Jul	1.779	-34.3	1.8016	0.920	0.9242	5.90	6.18	0.46	7.10	6.64	1.12	0.66
	31-Jul	1.78	2-Sep	1.754	-33.7	1.7766	0.890	0.8941	-0.40	-0.21	0.46	0.68	0.22	1.09	0.63
	31-Aug	1.76	30-Sep	1.671	-33.8	1.7566	1.230	1.2356	-17.71	-18.45	0.46	-17.21	-17.67	1.44	0.98
	30-Sep	1.671	29-Oct	1.654	-27	1.6683	1.290	1.2956	-7.43	-7.35	0.44	-6.05	-6.49	1.46	1.02
	30-Oct	1.657	1-Dec	1.682	-24.2	1.6546	1.150	1.1549	4.39	2.84	0.43	4.00	3.57	-0.33	-0.76
	30-Nov	1.696	30-Dec	1.682	-28	1.6932	0.930	0.9342	7.53	7.76	0.46	8.69	8.23	1.10	0.64
	31-Dec	1.677	3-Feb	1.724	-24.9	1.6745	1.260	1.2652	-0.40	-3.12	0.41	-1.85	-2.27	-1.46	-1.87
1999	29-Jan	1.722	26-Feb	1.776	-23.7	1.7196	1.310	1.3153	3.15	0.01	0.40	1.33	0.93	-1.73	-2.13
	26-Feb	1.776	31-Mar	1.81	-26.9	1.7733	1.090	1.0944	-4.81	-6.60	0.40	-5.50	-5.91	-0.78	-1.19
	31-Mar	1.81	29-Apr	1.846	-31	1.8069	1.080	1.0843	-0.56	-2.50	0.40	-1.42	-1.82	-0.87	-1.27
	30-Apr	1.848	2-Jun	1.89	-36.7	1.8443	1.020	1.0241	10.42	7.97	0.40	8.99	8.59	-1.20	-1.60
	31-May	1.873	30-Jun	1.897	-37	1.8693	1.040	1.0442	-5.99	-7.18	0.40	-6.14	-6.54	-0.22	-0.62
	30-Jun	1.897	29-Jul	1.893	-40.7	1.8929	1.040	1.0444	6.09	6.31	0.43	7.36	6.93	1.26	0.83
	30-Jul	1.828	2-Sep	1.829	-40.3	1.8240	1.260	1.2653	-5.14	-5.20	0.42	-3.93	-4.35	1.21	0.79
	31-Aug	1.847	30-Sep	1.834	-45.3	1.8425	1.150	1.1550	3.31	3.58	0.44	4.74	4.30	1.40	0.96
	30-Sep	1.834	2-Nov	1.858	-43.8	1.8296	1.360	1.3660	-2.29	-3.56	0.44	-2.19	-2.63	0.07	-0.36
	29-Oct	1.858	30-Nov	1.942	-38.4	1.8542	1.150	1.1551	7.29	2.65	0.44	3.81	3.37	-3.17	-3.61
	30-Nov	1.942	29-Dec	1.946	-50.2	1.9370	1.250	1.2566	6.71	6.49	0.52	7.75	7.22	1.05	0.53
	31-Dec	1.943	2-Feb	2.003	-44.3	1.9386	1.370	1.3765	18.01	14.48	0.47	15.86	15.38	-1.62	-2.09
2000	31-Jan	2.012	29-Feb	2.023	-42.3	2.0078	1.290	1.2962	-1.76	-2.30	0.48	-1.00	-1.48	0.75	0.27
	29-Feb	2.023	30-Mar	2.038	-43.8	2.0186	1.710	1.7182	11.83	11.01	0.48	12.73	12.25	0.98	0.50
	31-Mar	2.043	2-May	2.162	-41.6	2.0388	1.450	1.4572	-0.59	-6.06	0.50	-4.61	-5.10	-4.05	-4.54

British Pound Calls Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (b)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	1.631	30-Nov	1.567	-7.5	1.630	8.3	1.630	0.91	2.35	-1.67	0.41	-0.76	-1.20	-3.01	-3.43
	30-Nov	1.567	29-Dec	1.56	5.1	1.568	8	1.568	0.89	-0.52	-0.96	0.49	-0.07	-0.53	0.45	-0.04
	30-Dec	1.565	1-Feb	1.58	14.8	1.566	8.1	1.566	0.98	-0.52	-0.43	0.49	0.55	0.07	1.08	0.59
1995	31-Jan	1.582	28-Feb	1.584	-12.0	1.581	7.8	1.581	0.86	-2.41	-2.49	0.49	-1.63	-2.15	0.79	0.29
	28-Feb	1.584	30-Mar	1.599	-4.5	1.584	8.2	1.584	0.95	0.59	0.57	0.50	1.51	0.99	0.92	0.42
	31-Mar	1.621	2-May	1.613	-2.8	1.621	13.5	1.621	1.59	4.27	3.76	0.50	5.35	4.82	1.09	0.60
	28-Apr	1.613	31-May	1.589	-8.3	1.612	10.2	1.612	1.20	2.51	0.99	0.49	2.19	1.66	-0.28	-0.78
	31-May	1.589	29-Jun	1.593	-3.0	1.589	9.8	1.589	1.10	3.19	3.18	0.49	4.29	3.77	1.09	0.59
	30-Jun	1.595	2-Aug	1.6	-8.5	1.594	9.1	1.594	1.09	-0.14	-0.20	0.50	0.90	0.35	1.04	0.54
	31-Jul	1.598	31-Aug	1.55	-13.5	1.597	12.1	1.597	1.37	4.49	1.35	0.48	2.71	2.16	-1.64	-2.12
	31-Aug	1.55	2-Oct	1.59	-10.5	1.549	8	1.549	0.97	0.42	0.36	0.48	1.33	0.78	0.90	0.42
	29-Sep	1.585	1-Nov	1.58	-10.5	1.584	8.7	1.584	1.04	0.87	0.56	0.48	1.60	1.05	0.73	0.25
	31-Oct	1.582	30-Nov	1.531	-11.5	1.581	6.4	1.581	0.71	0.60	-2.65	0.47	-1.94	-2.49	-2.52	-2.99
	30-Nov	1.531	29-Dec	1.55	-9.8	1.530	9.3	1.530	1.13	3.83	3.81	0.48	4.94	4.40	1.07	0.58
	29-Dec	1.55	31-Jan	1.515	-11.0	1.549	7.4	1.549	0.86	0.68	-1.59	0.46	-0.73	-1.26	-1.39	-1.86
1996	31-Jan	1.515	29-Feb	1.532	-11.7	1.514	7.6	1.514	0.86	1.90	1.84	0.44	2.70	2.19	0.79	0.34
	29-Feb	1.532	2-Apr	1.525	-9.7	1.531	6.1	1.531	0.78	-0.84	-1.30	0.43	-0.52	-1.03	0.32	-0.11
	29-Mar	1.527	30-Apr	1.504	-7.0	1.526	5.2	1.526	0.60	-0.75	-2.24	0.44	-1.64	-2.13	-0.90	-1.34
	30-Apr	1.504	30-May	1.537	-9.3	1.503	6	1.503	0.70	3.19	3.20	0.44	3.90	3.41	0.64	0.20
	31-May	1.55	2-Jul	1.558	-8.0	1.549	6	1.549	0.71	-1.84	-1.90	0.44	-1.19	-1.68	0.66	0.22
	28-Jun	1.553	31-Jul	1.556	-4.3	1.553	5.8	1.553	0.70	-0.98	-1.01	0.45	-0.31	-0.79	0.67	0.22
	31-Jul	1.556	29-Aug	1.558	-5.0	1.556	5.3	1.556	0.60	-0.21	-0.24	0.44	0.35	-0.12	0.56	0.12
	30-Aug	1.562	1-Oct	1.565	-4.5	1.562	4.5	1.562	0.53	4.44	4.42	0.44	4.95	4.48	0.50	0.06
	30-Sep	1.564	31-Oct	1.628	-4.9	1.564	4.5	1.564	0.54	2.23	2.28	0.44	2.83	2.35	0.51	0.07
	31-Oct	1.628	2-Dec	1.682	0.3	1.628	7.4	1.628	0.90	0.64	0.67	0.44	1.57	1.07	0.90	0.47
	29-Nov	1.682	31-Dec	1.715	-8.0	1.681	7	1.681	0.86	1.98	1.97	0.45	2.83	2.33	0.81	0.35
	31-Dec	1.715	30-Jan	1.614	-11.0	1.714	9.7	1.714	1.04	1.49	-4.49	0.45	-3.44	-3.95	-4.85	-5.29
1997	31-Jan	1.599	28-Feb	1.628	-9.1	1.598	10.7	1.598	1.20	3.82	3.83	0.44	5.03	4.53	1.15	0.70
	28-Feb	1.628	31-Mar	1.631	-9.0	1.627	9.5	1.627	1.14	0.76	0.71	0.44	1.85	1.35	1.09	0.64
	31-Mar	1.631	30-Apr	1.623	-5.5	1.630	8	1.630	0.91	0.11	-0.38	0.46	0.53	0.03	0.42	-0.04
	30-Apr	1.623	29-May	1.641	-8.6	1.622	7.4	1.622	0.84	2.85	2.83	0.46	3.67	3.16	0.79	0.33
	30-May	1.639	1-Jul	1.659	-0.3	1.639	8.2	1.639	0.98	4.18	4.23	0.46	5.21	4.68	0.98	0.52
	30-Jun	1.666	31-Jul	1.639	-14.5	1.665	7.4	1.665	0.85	-0.36	-1.48	0.46	-1.13	-1.67	-0.77	-1.24
	31-Jul	1.639	29-Aug	1.62	-19.0	1.637	8.4	1.637	0.99	6.58	5.34	0.46	6.34	5.78	-0.17	-0.62
	29-Aug	1.62	30-Sep	1.614	-20.4	1.618	9.3	1.618	1.09	-1.83	-2.20	0.46	-1.10	-1.69	0.72	0.26
	30-Sep	1.614	29-Oct	1.672	-20.0	1.612	9	1.612	1.07	8.86	9.05	0.46	10.11	9.53	0.94	0.48
	30-Oct	1.677	28-Nov	1.688	-21.8	1.675	9.8	1.675	1.17	-7.66	-7.84	0.46	-6.68	-7.26	1.03	0.58
	30-Nov	1.688	30-Dec	1.657	-22.4	1.686	8.1	1.686	0.95	-0.22	-2.05	0.48	-1.10	-1.70	-0.88	-1.37
	2-Jan	1.648	29-Jan	1.64	-24.6	1.646	10	1.646	1.14	6.29	5.77	0.46	6.91	6.30	0.65	0.19
1998	30-Jan	1.634	27-Feb	1.645	-23.4	1.632	9.6	1.632	1.07	6.29	6.19	0.45	7.26	6.65	0.92	0.47
	27-Feb	1.645	1-Apr	1.673	-25.7	1.642	8.2	1.642	1.00	5.66	5.59	0.46	6.60	5.99	0.84	0.38
	31-Mar	1.674	30-Apr	1.671	-26.8	1.671	7.6	1.671	0.87	2.86	2.67	0.46	3.54	2.93	0.69	0.23
	30-Apr	1.671	2-Jun	1.639	-25.0	1.669	7	1.669	0.82	-0.07	-1.98	0.46	-1.16	-1.76	-1.09	-1.55
	29-May	1.634	30-Jun	1.67	-23.7	1.632	6.9	1.632	0.83	-0.97	-1.14	0.46	-0.31	-0.91	0.69	0.23
	30-Jun	1.67	30-Jul	1.64	-27.9	1.667	6.9	1.667	0.78	-0.65	-2.44	0.46	-1.66	-2.27	-1.02	-1.48
	31-Jul	1.633	2-Sep	1.669	-27.5	1.630	6.5	1.630	0.80	0.08	-0.09	0.46	0.70	0.09	0.62	0.16
	31-Aug	1.675	30-Sep	1.697	-27.5	1.672	8.1	1.672	0.94	-10.07	-10.37	0.46	-9.43	-10.04	0.77	0.31
	30-Sep	1.697	29-Oct	1.675	-28.0	1.694	9.6	1.694	1.07	-3.52	-4.77	0.44	-3.71	-4.31	-0.23	-0.67
	30-Oct	1.674	1-Dec	1.654	-27.8	1.671	9.3	1.671	1.09	7.38	6.10	0.43	7.19	6.59	-0.11	-0.54
	30-Nov	1.648	30-Dec	1.662	-21.5	1.646	7	1.646	0.79	5.62	5.53	0.46	6.33	5.77	0.66	0.20
	31-Dec	1.66	3-Feb	1.638	-16.5	1.658	9.1	1.658	1.09	2.41	1.06	0.41	2.15	1.64	-0.23	-0.64
1999	29-Jan	1.645	26-Feb	1.604	-12.5	1.644	7.1	1.644	0.76	0.23	-2.27	0.40	-1.51	-1.99	-1.73	-2.13
	26-Feb	1.604	31-Mar	1.615	-9.2	1.603	8.5	1.603	1.02	4.73	4.71	0.40	5.73	5.28	0.97	0.56
	31-Mar	1.615	29-Apr	1.608	-5.5	1.615	7.2	1.615	0.87	1.95	1.50	0.40	2.38	1.94	0.44	0.04
	30-Apr	1.608	2-Jun	1.604	-5.7	1.607	6.4	1.607	0.78	4.08	3.82	0.40	4.60	4.17	0.53	0.13
	31-May	1.603	30-Jun	1.576	-5.0	1.603	6.9	1.603	0.78	-4.98	-6.58	0.40	-5.80	-6.24	-0.91	-1.31
	30-Jun	1.576	29-Jul	1.618	2.3	1.576	7.1	1.576	0.82	1.48	1.54	0.43	2.36	1.94	0.83	0.41
	30-Jul	1.622	2-Sep	1.607	0.6	1.622	8.3	1.622	0.99	-1.37	-2.28	0.42	-1.30	-1.72	0.06	-0.36
	31-Aug	1.609	30-Sep	1.647	5.5	1.610	8.8	1.610	1.03	0.23	0.27	0.44	1.30	0.89	1.06	0.63
	30-Sep	1.647	2-Nov	1.646	0.8	1.647	8.5	1.647	1.02	-3.47	-3.53	0.44	-2.51	-2.95	0.96	0.52
	29-Oct	1.643	30-Nov	1.596	0.8	1.643	7.6	1.643	0.87	3.75	0.78	0.44	1.65	1.21	-1.99	-2.43
	30-Nov	1.596	29-Dec	1.619	8.8	1.597	8.3	1.597	0.95	5.46	5.59	0.52	6.54	6.09	1.00	0.48
	31-Dec	1.616	2-Feb	1.608	-0.9	1.616	7.3	1.616	0.88	5.05	4.53	0.47	5.41	4.97	0.39	-0.09
2000	31-Jan	1.614	29-Feb	1.58	-0.8	1.614	7.7	1.614	0.85	-9.55	-11.45	0.48	-10.61	-11.10	-1.26	-1.74
	29-Feb	1.58	30-Mar	1.593	-1.7	1.580	9.2	1.580	1.06	-0.57	-0.59	0.48	0.47	-0.03	1.05	0.57
	31-Mar	1.592	2-May	1.559	2.6	1.592	7.9	1.592	0.91	4.94	2.76	0.50	3.67	3.18	-1.16	-1.66

Japanese Yen Calls Strategy Returns

Year	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1994	31-Oct	96.97	30-Nov	98.87	-22.2	96.968	0.940	0.94	2.18	0.21	0.41	1.16	0.74	-0.98	-1.39
	30-Nov	98.87	29-Dec	99.6	-33.6	98.867	0.830	0.83	-4.57	-5.27	0.49	-4.44	-4.93	0.84	0.35
	30-Dec	99.58	1-Feb	99.38	-33.5	99.577	0.960	0.96	3.39	3.40	0.49	4.37	3.88	0.97	0.48
1995	31-Jan	99.45	28-Feb	96.54	-29.4	99.447	0.980	0.98	-5.44	-5.60	0.49	-4.62	-5.11	0.99	0.49
	28-Feb	96.54	30-Mar	89.53	-33.2	96.537	0.950	0.95	-8.56	-9.23	0.50	-8.27	-8.77	0.96	0.46
	31-Mar	86.55	2-May	83.65	-35.4	86.546	1.890	1.90	-5.36	-5.54	0.50	-3.64	-4.14	1.90	1.41
	28-Apr	84.33	31-May	84.44	-33.5	84.327	1.750	1.76	4.13	4.00	0.49	5.75	5.26	1.63	1.14
	31-May	84.44	29-Jun	84.72	-34.7	84.437	1.540	1.55	-8.15	-8.45	0.49	-6.91	-7.40	1.22	0.73
	30-Jun	84.63	2-Aug	90.88	-37.3	84.626	1.210	1.22	-5.96	-12.42	0.50	-11.21	-11.70	-5.66	-6.16
	31-Jul	88.26	31-Aug	97.71	-41.8	88.256	1.410	1.42	14.88	3.77	0.48	5.19	4.71	-8.25	-8.73
	31-Aug	97.71	2-Oct	100.54	-41.2	97.706	1.820	1.83	8.63	5.57	0.48	7.40	6.93	-0.99	-1.46
	29-Sep	99.72	1-Nov	103.1	-53.3	99.715	2.000	2.01	-1.13	-4.37	0.48	-2.36	-2.84	-1.27	-1.75
	31-Oct	102.07	30-Nov	102.07	-49.1	102.065	1.540	1.55	-1.44	-1.44	0.47	0.10	-0.37	1.55	1.08
	30-Nov	102.07	29-Dec	103.51	-48.6	102.065	1.420	1.43	6.17	4.70	0.48	6.12	5.64	1.43	0.95
	29-Dec	103.51	31-Jan	106.96	-46.8	103.505	1.400	1.41	6.00	2.58	0.46	3.98	3.52	-1.82	-2.28
1996	31-Jan	106.96	29-Feb	105.13	-44.7	106.956	1.110	1.11	4.75	4.84	0.44	5.96	5.51	1.12	0.68
	29-Feb	105.13	2-Apr	107.45	-41.8	105.126	1.220	1.23	-3.30	-5.39	0.43	-4.17	-4.60	-0.93	-1.37
	29-Mar	107.12	30-Apr	105.06	-49.3	107.115	1.040	1.04	6.37	6.50	0.44	7.54	7.10	1.05	0.61
	30-Apr	105.06	30-May	107.46	-57.5	105.054	1.180	1.19	2.96	0.66	0.44	1.85	1.41	-1.05	-1.49
	31-May	107.97	2-Jul	110.15	-45.5	107.965	1.030	1.03	-0.39	-2.36	0.44	-1.32	-1.77	-0.94	-1.39
	28-Jun	109.38	31-Jul	106.46	-47.5	109.375	0.860	0.86	2.62	2.69	0.45	3.56	3.11	0.87	0.42
	31-Jul	106.46	29-Aug	108.46	-48.0	106.455	1.050	1.05	-8.16	-9.85	0.44	-8.80	-9.24	-0.79	-1.23
	30-Aug	108.88	1-Oct	111.22	-39.0	108.876	0.730	0.73	-2.54	-4.59	0.44	-3.86	-4.30	-1.37	-1.81
	30-Sep	111.55	31-Oct	113.97	-52.5	111.545	0.790	0.79	6.89	4.62	0.44	5.41	4.97	-1.33	-1.77
	31-Oct	113.97	2-Dec	114.08	-46.0	113.965	0.950	0.95	-5.05	-5.15	0.44	-4.19	-4.63	0.86	0.42
	29-Nov	113.86	31-Dec	115.9	-55.2	113.854	0.730	0.73	2.70	0.90	0.45	1.63	1.18	-1.03	-1.48
	31-Dec	115.9	30-Jan	121.47	-55.8	115.894	1.010	1.01	-7.89	-12.12	0.45	-11.10	-11.55	-3.57	-4.02
1997	31-Jan	121.36	28-Feb	120.39	-47.0	121.355	1.090	1.09	-5.33	-5.37	0.44	-4.27	-4.71	1.10	0.66
	28-Feb	120.39	31-Mar	123.62	-51.3	120.385	1.220	1.23	1.24	-1.41	0.44	-0.18	-0.62	-1.39	-1.83
	31-Mar	124.05	30-Apr	127.14	-54.2	124.045	1.000	1.00	-2.98	-5.34	0.46	-4.34	-4.80	-1.43	-1.89
	30-Apr	127.14	29-May	115.9	-55.9	127.134	1.160	1.17	6.38	7.00	0.46	8.16	7.70	1.17	0.71
	30-May	116.4	1-Jul	114.53	-49.5	116.395	1.030	1.03	4.79	4.87	0.46	5.91	5.45	1.04	0.58
	30-Jun	114.53	31-Jul	118.47	-52.0	114.525	0.840	0.84	2.67	-0.74	0.46	0.10	-0.36	-2.48	-2.94
	31-Jul	118.47	29-Aug	120.93	-51.0	118.465	1.110	1.12	-1.33	-3.33	0.46	-2.22	-2.68	-0.92	-1.38
	29-Aug	120.93	30-Sep	120.47	-50.7	120.925	0.730	0.73	-10.34	-10.37	0.46	-9.64	-10.10	0.74	0.28
	30-Sep	120.47	29-Oct	120.94	-54.5	120.465	0.780	0.78	-1.87	-2.26	0.46	-1.47	-1.93	0.79	0.33
	30-Oct	120.05	28-Nov	127.74	-51.5	120.045	0.950	0.95	-7.99	-13.53	0.46	-12.57	-13.03	-5.07	-5.52
	30-Nov	127.74	30-Dec	130.1	-70.8	127.733	0.730	0.73	1.08	-0.76	0.48	-0.02	-0.51	-1.08	-1.56
	2-Jan	130.57	29-Jan	125.55	-58.5	130.564	0.990	0.99	-8.28	-8.61	0.46	-7.61	-8.08	1.00	0.53
1998	30-Jan	126.79	27-Feb	126.11	-50.0	126.785	1.340	1.35	8.98	9.03	0.45	10.38	9.92	1.35	0.90
	27-Feb	126.11	1-Apr	133.63	-54.9	126.105	1.360	1.37	1.22	-4.47	0.46	-3.11	-3.57	-4.26	-4.72
	31-Mar	133.3	30-Apr	132.76	-62.0	133.294	1.160	1.17	-1.81	-1.81	0.46	-0.65	-1.11	1.17	0.71
	30-Apr	132.76	2-Jun	138.9	-61.0	132.754	1.010	1.01	-5.36	-9.54	0.46	-8.53	-8.99	-3.41	-3.87
	29-May	138.57	30-Jun	137.98	-59.0	138.564	1.250	1.26	0.19	0.19	0.46	1.45	0.99	1.26	0.80
	30-Jun	137.98	30-Jul	143.36	-63.9	137.974	1.190	1.20	1.02	-2.77	0.46	-1.58	-2.04	-2.56	-3.02
	31-Jul	144.75	2-Sep	137.9	-63.5	144.744	1.320	1.33	3.47	3.64	0.46	4.97	4.51	1.33	0.87
	31-Aug	141.04	30-Sep	136.65	-60.7	141.034	1.460	1.46	-13.87	-14.31	0.46	-12.85	-13.31	1.46	1.00
	30-Sep	136.65	29-Oct	116.85	-59.4	136.644	1.440	1.45	-4.97	-5.81	0.44	-4.36	-4.80	1.45	1.01
	30-Oct	116.4	30-Nov	123.15	-49.5	116.395	1.400	1.41	1.18	-4.37	0.43	-2.96	-3.39	-4.08	-4.50
	30-Nov	123.15	30-Dec	114.92	-59.5	123.144	1.420	1.43	9.73	10.43	0.46	11.85	11.40	1.43	0.97
	31-Dec	113.6	3-Feb	112.97	-46.5	113.595	1.070	1.07	-7.00	-7.03	0.41	-5.96	-6.37	1.08	0.67
1999	29-Jan	116.24	26-Feb	119.09	-41.0	116.236	1.710	1.72	4.75	2.24	0.40	3.96	3.55	-0.68	-1.08
	26-Feb	119.09	31-Mar	118.47	-47.9	119.085	2.120	2.13	-0.91	-0.91	0.40	1.22	0.82	2.13	1.73
	31-Mar	118.47	29-Apr	119.1	-52.5	118.465	1.950	1.96	10.22	9.64	0.40	11.60	11.20	1.43	1.03
	30-Apr	119.29	2-Jun	121	-48.8	119.285	1.450	1.46	5.46	3.97	0.40	5.43	5.03	0.04	-0.36
	31-May	121.79	30-Jun	121.01	-49.2	121.785	1.320	1.33	-3.53	-3.55	0.40	-2.23	-2.63	1.33	0.93
	30-Jun	121.01	29-Jul	115.35	-53.0	121.005	1.180	1.19	8.80	9.24	0.43	10.42	10.00	1.19	0.76
	30-Jul	114.63	2-Sep	109.1	-50.5	114.625	1.580	1.59	1.89	2.00	0.42	3.58	3.16	1.59	1.17
	31-Aug	109.36	30-Sep	106.43	-52.0	109.355	1.630	1.64	-2.38	-2.44	0.44	-0.80	-1.24	1.64	1.20
	30-Sep	106.43	2-Nov	104.07	-48.9	106.425	1.960	1.97	0.97	1.00	0.44	2.96	2.52	1.97	1.53
	29-Oct	104.15	30-Nov	101.63	-49.9	104.145	1.590	1.60	1.91	1.96	0.44	3.56	3.12	1.60	1.16
	30-Nov	101.63	29-Dec	102.01	-48.0	101.625	1.730	1.74	3.43	3.05	0.52	4.79	4.26	1.37	0.84
	31-Dec	102.24	2-Feb	108.33	-53.5	102.235	1.630	1.64	2.03	-3.71	0.47	-2.07	-2.54	-3.98	-4.46
2000	31-Jan	107.37	29-Feb	109.96	-50.0	107.365	1.180	1.19	3.20	0.77	0.48	1.95	1.47	-1.17	-1.65
	29-Feb	109.96	30-Mar	105.51	-54.5	109.955	1.460	1.47	2.15	2.24	0.48	3.71	3.23	1.47	0.99
	31-Mar	102.64	2-May	108.44	-58.1	102.634	1.970	1.98	1.89	-3.56	0.50	-1.58	-2.07	-3.37	-3.87

APPENDIX 3D

RETURN RESULTS FOR ONE MONTH VOLATILITY SWAP STRATEGIES

Canadian Dollar Volatility Swap Strategy Returns

	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Vols(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	With Equity:				Without Equity:			
												Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1994	31-Oct	1.353	30-Nov	1.375	3.620	4.30	4.15	1102	-749.60	-584.25	-1.44	-3.09	-3.07	-3.50	-3.48	-1.67	-1.66	-2.09	-2.07
	30-Nov	1.375	30-Dec	1.402	3.290	4.20	4.05	1102	-1003.15	-837.79	-4.62	-6.56	-6.54	-7.05	-7.03	-2.10	-2.08	-2.59	-2.57
	30-Dec	1.402	2-Feb	1.406	4.590	5.70	5.55	1245	-1381.51	-1194.82	2.94	2.51	2.52	2.02	2.04	-0.63	-0.62	-1.12	-1.10
1995	31-Jan	1.408	28-Feb	1.393	4.290	6.70	6.45	1067	-2570.99	-2304.29	-4.65	-3.89	-3.86	-4.38	-4.35	-1.26	-1.23	-1.75	-1.73
	28-Feb	1.393	31-Mar	1.399	5.940	6.20	5.95	1138	-295.86	-11.38	2.67	2.20	2.23	1.71	1.73	-0.24	-0.22	-0.74	-0.71
	31-Mar	1.399	2-May	1.357	4.700	6.20	6.00	1102	-1653.54	-1433.07	4.58	7.65	7.67	7.15	7.17	3.08	3.10	2.59	2.61
	28-Apr	1.356	31-May	1.37	4.690	6.40	6.15	1138	-1945.84	-1661.36	-0.79	-2.00	-1.97	-2.49	-2.46	-1.51	-1.48	-2.00	-1.97
	31-May	1.37	30-Jun	1.372	3.840	6.20	6.05	1102	-2601.57	-2438.22	3.95	3.54	3.56	3.05	3.07	-0.19	-0.17	-0.68	-0.66
	30-Jun	1.372	2-Aug	1.356	5.100	5.80	5.45	1209	-846.33	-423.16	1.76	2.88	2.92	2.38	2.43	0.21	0.25	-0.29	-0.25
	31-Jul	1.368	31-Aug	1.343	5.080	6.10	5.90	1138	-1160.68	-933.09	1.94	3.72	3.75	3.25	3.27	1.67	1.69	1.19	1.22
	31-Aug	1.343	29-Sep	1.341	6.190	7.20	7.00	1067	-1077.47	-864.11	-2.13	-2.09	-2.07	-2.57	-2.55	0.27	0.29	-0.21	-0.19
	29-Sep	1.341	1-Nov	1.348	8.710	8.60	8.30	1138	125.17	466.55	0.29	-0.22	-0.19	-0.70	-0.66	-0.66	-0.62	-1.13	-1.10
	31-Oct	1.343	30-Nov	1.359	3.600	7.70	6.80	1102	-4519.68	-3527.55	-1.56	-3.17	-3.07	-3.64	-3.54	-1.70	-1.60	-2.17	-2.07
	30-Nov	1.359	29-Dec	1.365	4.510	5.00	4.75	1067	-522.73	-258.03	4.53	4.02	4.05	3.53	3.56	-0.05	-0.03	-0.54	-0.51
	29-Dec	1.365	1-Feb	1.374	4.260	5.60	5.25	1245	-1657.76	-1232.15	1.12	0.29	0.34	-0.17	-0.12	-0.82	-0.78	-1.28	-1.24
1996	31-Jan	1.376	29-Feb	1.372	3.770	5.00	4.85	1067	-1312.16	-1152.14	5.41	5.58	5.60	5.14	5.16	0.27	0.28	-0.17	-0.16
	29-Feb	1.372	29-Mar	1.363	2.360	4.90	4.70	1067	-2709.67	-2496.31	-0.70	-0.31	-0.29	-0.75	-0.72	1.33	1.35	0.90	0.92
	29-Mar	1.363	30-Apr	1.363	3.040	4.80	4.55	1102	-1940.15	-1664.56	0.75	0.56	0.59	0.12	0.14	-1.09	-1.07	-1.54	-1.51
	30-Apr	1.363	31-May	1.37	2.000	3.90	3.75	1102	-2162.05	-1991.36	3.53	2.79	2.81	2.35	2.36	-0.82	-0.80	-1.26	-1.24
	31-May	1.37	2-Jul	1.361	2.380	4.20	4.00	1102	-2008.30	-1785.82	1.94	2.42	2.44	1.97	2.00	0.40	0.42	-0.04	-0.02
	28-Jun	1.364	31-Jul	1.375	3.510	3.70	3.55	1138	-216.20	-45.52	-3.86	-4.65	-4.63	-5.09	-5.08	-0.82	-0.80	-1.27	-1.25
	31-Jul	1.375	30-Aug	1.368	2.210	3.70	3.55	1138	-1642.52	-1477.16	-2.28	-1.94	-1.93	-2.39	-2.37	0.04	0.05	-0.41	-0.39
	30-Aug	1.368	2-Oct	1.361	2.000	3.50	3.30	1138	-1708.68	-1479.30	4.35	4.71	4.74	4.27	4.29	0.53	0.55	0.09	0.11
	30-Sep	1.362	31-Oct	1.34	2.600	3.10	2.80	1138	-568.96	-227.58	2.87	4.50	4.54	4.06	4.09	2.74	2.78	2.30	2.34
	31-Oct	1.34	29-Nov	1.349	3.060	3.50	3.10	1176	-469.39	-42.67	5.82	5.06	5.11	4.63	4.67	-1.75	-1.70	-2.18	-2.14
	29-Nov	1.349	3-Jan	1.354	3.160	3.45	3.25	1280	-371.25	-115.21	7.46	7.03	7.05	6.58	6.60	-2.04	-2.01	-2.49	-2.46
	31-Dec	1.37	31-Jan	1.347	5.140	4.30	4.10	1138	955.85	1183.44	-1.49	0.29	0.31	-0.16	-0.14	2.90	2.92	2.45	2.47
1997	31-Jan	1.347	28-Feb	1.368	3.290	5.10	4.90	1031	-1866.54	-1660.30	3.08	1.31	1.33	0.87	0.89	-1.94	-1.92	-2.38	-2.36
	28-Feb	1.368	2-Apr	1.387	3.770	4.70	4.50	1138	-1058.27	-830.68	0.79	-0.70	-0.67	-1.14	-1.12	-1.48	-1.45	-1.92	-1.90
	31-Mar	1.381	30-Apr	1.396	2.810	4.50	4.30	1102	-1862.99	-1642.52	-5.00	-6.20	-6.18	-6.66	-6.64	-0.47	-0.45	-0.94	-0.91
	30-Apr	1.396	30-May	1.38	5.370	4.60	4.40	1102	848.62	1069.29	2.16	3.43	3.45	2.97	2.99	1.18	1.20	0.71	0.74
	30-May	1.38	1-Jul	1.38	5.090	5.50	5.25	1102	-451.97	-176.38	6.78	6.74	6.77	6.28	6.30	-0.41	-0.38	-0.87	-0.84
	30-Jun	1.381	31-Jul	1.378	3.310	4.90	4.75	1138	-1809.29	-1636.60	0.87	0.91	0.93	0.45	0.47	-0.18	-0.16	-0.64	-0.63
	31-Jul	1.378	29-Aug	1.388	3.440	4.80	4.60	1067	-1450.85	-1237.49	6.83	5.92	5.94	5.46	5.48	-0.65	-0.63	-1.11	-1.09
	29-Aug	1.388	1-Oct	1.378	3.100	4.60	4.40	1138	-1708.68	-1479.30	-3.87	-3.34	-3.32	-3.80	-3.78	0.48	0.51	0.02	0.05
	30-Sep	1.382	31-Oct	1.409	3.830	4.60	4.25	1138	-876.20	-477.93	6.48	4.35	4.39	3.89	3.93	-2.15	-2.11	-2.61	-2.57
	31-Oct	1.409	2-Dec	1.421	3.890	5.20	4.95	1138	-1490.68	-1208.20	-2.81	-3.78	-3.75	-4.24	-4.21	-1.41	-1.38	-1.87	-1.84
	28-Nov	1.424	31-Dec	1.43	5.200	5.50	5.35	1138	-341.38	-170.69	-4.82	-5.25	-5.23	-5.73	-5.72	-0.03	-0.02	-0.52	-0.50
1998	2-Jan	1.43	4-Feb	1.448	3.850	5.20	4.90	1102	-1488.19	-1157.48	2.87	1.44	1.47	0.97	1.01	-2.01	-1.98	-2.47	-2.44
	30-Jan	1.458	27-Feb	1.424	6.040	6.80	6.55	1102	-783.74	-525.93	0.01	2.32	2.35	1.87	1.89	2.32	2.35	1.86	1.89
	27-Feb	1.424	1-Apr	1.417	4.060	4.60	4.45	1138	-614.48	-443.79	5.85	6.32	6.33	5.85	5.87	0.01	0.03	-0.45	-0.44
	31-Mar	1.417	30-Apr	1.43	3.700	5.30	5.15	1102	-1763.78	-1598.42	6.57	5.43	5.44	4.96	4.98	-1.29	-1.28	-1.75	-1.74
	30-Apr	1.43	29-May	1.456	4.020	4.80	4.65	1067	-832.10	-672.08	1.41	-0.49	-0.47	-0.94	-0.93	-1.73	-1.71	-2.19	-2.17
	29-May	1.456	30-Jun	1.469	3.600	4.90	4.75	1102	-1433.07	-1267.71	-0.98	-2.00	-1.98	-2.46	-2.44	-0.55	-0.54	-1.01	-1.00
	30-Jun	1.469	31-Jul	1.512	3.920	4.80	4.65	1138	-1001.37	-830.68	-2.94	-5.80	-5.78	-6.26	-6.24	-3.53	-3.52	-3.99	-3.98
	31-Jul	1.512	2-Sep	1.544	8.150	6.60	6.35	1138	1763.78	2048.26	-5.91	-7.68	-7.66	-8.14	-8.12	-3.20	-3.18	-3.66	-3.63
	31-Aug	1.568	30-Sep	1.526	10.380	11.80	10.90	1102	-1565.35	-573.23	-20.21	-18.17	-18.07	-18.63	-18.53	0.69	0.79	0.23	0.33
	30-Sep	1.526	30-Oct	1.541	10.630	11.60	11.10	1176	-1140.72	-552.72	1.51	0.41	0.46	-0.03	0.03	0.21	0.27	-0.23	-0.17
	30-Oct	1.541	1-Dec	1.531	6.460	13.10	12.55	1176	-9455.04	-8806.24	10.58	10.36	10.42	9.93	10.00	-0.81	-0.75	-1.24	-1.18
	30-Nov	1.532	4-Jan	1.527	4.490	10.20	9.35	1228	-7011.88	-5966.06	2.18	1.82	1.92	1.36	1.47	-0.96	-0.86	-1.42	-1.31
	31-Dec	1.537	3-Feb	1.514	7.300	8.50	7.90	1210	-1452.00	-726.00	2.24	3.65	3.72	3.23	3.31	1.58	1.65	1.17	1.24
1999	29-Jan	1.511	26-Feb	1.509	7.860	8.50	8.10	1100	-704.00	-264.00	3.76	3.82	3.87	3.42	3.46	-1.12	-1.08	-1.52	-1.48
	26-Feb	1.509	31-Mar	1.509	5.960	8.40	7.95	1192	-2908.48	-2372.08	-6.19	-6.49	-6.43	-6.89	-6.84	1.04	1.09	0.63	0.69
	31-Mar	1.509	30-Apr	1.46	5.600	6.90	6.70	1136	-1478.60	-1249.60	4.52	7.88	7.90	7.47	7.50	3.50	3.53	3.10	3.12
	30-Apr	1.46	2-Jun	1.481	5.240	7.00	6.75	1194	-2101.44	-1802.94	6.32	4.60	4.63	4.20	4.23	-2.37	-2.34	-2.77	-2.74
	31-May	1.476	2-Jul	1.463	5.550	7.40	7.15	1154	-2134.90	-1846.40	-2.46	-1.81	-1.78	-2.21	-2.19	0.60	0.63	0.20	0.23
	30-Jun	1.474	2-Aug	1.503	4.890	6.90	6.75	1194	-2399.94	-2220.84	2.46	0.24	0.26	-0.18	-0.17	-2.30	-2.28	-2.73	-2.71
	30-Jul	1.505	1-Sep	1.495	6.590	7.50	7.30	1138	-1035.51	-807.92	1.01	1.58	1.61	1.16	1.18	0.97	1.00	0.55	0.57
	31-Aug	1.495	30-Sep	1.468	5.160	7.50	7.25	1138	-2662.92	-2378.42	-1.56	-0.01	0.02	-0.45	-0.42	0.68	0.71	0.25	0.28
	30-Sep	1.468	29-Oct	1.472	4.720	7.40	7.10	1118	-2996.24	-2660.84	-0.19	-0.76	-0.73	-1.20	-1.16	0.04	0.07	-0.40	-0.36
	29-Oct	1.472	30-Nov	1.475	4.340	6.00	5.80	1176	-1952.16	-1716.96	4.29	3.88	3.91	3.44	3.47	-0.60	-0.58	-1.04	-1.02
	30-Nov	1.475	3-Jan	1.446	4.490	6.30	6.00	1212	-2193.72	-1830.12	3.68	5.54	5.58	5.01	5.05	1.72	1.75	1.19	1.23
	31-Dec	1.447	2-Feb	1.442	4.800	6.10	5.85	1138	-1479.30	-1194.82	11.84	12.08	12.11	11.60	11.63	-0.15	-0.12	-0.62	-0.59
2000	31-Jan	1.45	29-Feb	1.452	5.200	6.60	6.35	1120	-1566.00	-1288.00	0.80	0.50	0.53	0.03	0.06	-0.16	-0.13	-0.63	-0.61
	29-Feb	1.452	31-Mar	1.454	5.340	6.80	6.60	1156	-1667.76	-1458.56	7.64	7.32	7.35	6.84	6.87	-0.72	-0.70	-1.20	-1.18
	31-Mar	1.454	2-May	1.487	5.620	5.50	5.25	1176	141.12	435.12	3.65	1.37	1.40	0.87	0.90	-1.68	-1.65	-2.17	-2.14

German Deutschemark Volatility Swap Strategy Returns

Year	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Vols(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	With Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Without Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1994	31-Oct	1.508	30-Nov	1.568	9.050	9.80	9.60	1236	-927.22	-679.96	2.98	-1.06	-1.03	-1.47	-1.44	-3.92	-3.89	-4.33	-4.31
	30-Nov	1.568	29-Dec	1.549	6.110	9.20	9.05	1169	-3612.15	-3436.61	-1.13	-0.28	-0.26	-0.77	-0.75	0.87	0.88	0.37	0.39
	30-Dec	1.55	1-Feb	1.523	8.590	9.60	9.45	1252	-1264.52	-1076.72	2.85	4.54	4.56	4.06	4.08	1.65	1.67	1.16	1.18
1995	31-Jan	1.523	28-Feb	1.456	7.440	10.10	9.90	1158	-3060.34	-2646.74	-4.05	0.06	0.08	-0.44	-0.41	4.29	4.32	3.80	3.82
	28-Feb	1.456	30-Mar	1.412	18.070	10.30	10.15	1201	9329.22	9509.32	4.00	8.18	8.19	7.68	7.70	4.05	4.07	3.55	3.57
	31-Mar	1.372	2-May	1.379	16.140	18.50	17.90	1271	-2999.24	-2236.72	-8.54	-9.31	-9.23	-9.80	-9.73	-0.81	-0.73	-1.30	-1.23
	28-Apr	1.389	31-May	1.412	17.470	15.10	14.70	1290	3058.25	3574.41	4.86	3.45	3.50	2.96	3.01	-1.32	-1.27	-1.81	-1.76
	31-May	1.412	29-Jun	1.384	8.480	15.70	15.40	1185	-6556.54	-6202.63	3.78	5.03	5.06	4.53	4.57	1.17	1.20	0.68	0.71
	30-Jun	1.381	2-Aug	1.397	8.280	13.20	12.55	1276	-6277.92	-5446.52	-0.39	-2.16	-2.08	-2.66	-2.58	-1.77	-1.69	-2.27	-2.19
	31-Jul	1.385	31-Aug	1.469	14.390	11.50	11.25	1230	3556.03	3863.64	6.47	0.74	0.77	0.26	0.29	-5.36	-5.33	-5.84	-5.81
	31-Aug	1.469	2-Oct	1.429	12.570	12.80	12.55	1215	-279.50	24.30	0.88	3.68	3.71	3.20	3.23	2.77	2.80	2.29	2.32
	29-Sep	1.428	1-Nov	1.414	9.480	14.70	14.25	1268	-6818.96	-6048.36	-2.29	-1.99	-1.93	-2.46	-2.40	0.33	0.39	-0.15	-0.09
	31-Oct	1.408	30-Nov	1.448	7.700	13.00	12.55	1199	-6355.53	-5815.91	-0.87	-4.25	-4.19	-4.72	-4.67	-3.40	-3.34	-3.87	-3.82
	30-Nov	1.448	29-Dec	1.438	5.980	11.90	11.65	1225	-7250.82	-6944.62	3.46	3.45	3.48	2.97	3.00	-0.03	0.00	-0.51	-0.48
	29-Dec	1.438	31-Jan	1.487	7.100	11.70	11.35	1240	-5704.00	-5270.00	0.49	-3.39	-3.35	-3.85	-3.81	-3.87	-3.82	-4.33	-4.28
1996	31-Jan	1.487	29-Feb	1.469	8.260	10.70	10.45	1130	-2757.66	-2475.12	9.60	10.66	10.69	10.22	10.25	0.95	0.98	0.51	0.54
	29-Feb	1.469	2-Apr	1.482	4.440	9.80	9.60	1226	-6509.22	-6324.10	0.14	-1.40	-1.37	-1.83	-1.81	-1.53	-1.51	-1.97	-1.94
	29-Mar	1.477	30-Apr	1.532	7.120	9.10	8.60	1197	-2370.39	-1771.81	0.50	-3.35	-3.29	-3.79	-3.73	-3.83	-3.77	-4.27	-4.21
	30-Apr	1.532	30-May	1.531	5.270	8.80	8.65	1140	-4024.31	-3853.31	0.78	0.44	0.46	0.00	0.02	-0.34	-0.32	-0.78	-0.76
	31-May	1.523	2-Jul	1.526	4.650	8.40	8.20	1215	-4557.00	-4313.96	1.50	0.84	0.87	0.40	0.43	-0.65	-0.63	-1.09	-1.07
	28-Jun	1.52	31-Jul	1.469	10.870	7.20	7.00	1242	4559.61	4808.09	0.73	4.68	4.71	4.24	4.26	3.93	3.95	3.48	3.51
	31-Jul	1.469	29-Aug	1.479	6.280	9.20	8.95	1161	-3389.47	-3099.27	-3.44	-4.43	-4.40	-4.87	-4.84	-1.02	-0.99	-1.46	-1.43
	30-Aug	1.48	1-Oct	1.526	5.800	7.00	6.80	1225	-1469.53	-1224.61	2.85	-0.40	-0.37	-0.84	-0.82	-3.16	-3.14	-3.60	-3.58
	30-Sep	1.526	31-Oct	1.517	5.230	7.10	6.90	1204	-2252.00	-2011.15	4.25	4.64	4.66	4.20	4.22	0.37	0.39	-0.07	-0.05
	31-Oct	1.517	2-Dec	1.546	7.400	8.00	7.75	1276	-785.61	-446.72	0.28	-1.68	-1.65	-2.12	-2.08	-1.95	-1.92	-2.39	-2.36
	29-Nov	1.538	31-Dec	1.539	7.900	6.80	6.60	1346	1480.16	1749.28	7.00	7.08	7.11	6.63	6.66	0.08	0.11	-0.37	-0.34
	31-Dec	1.539	30-Jan	1.641	9.900	9.20	8.85	1300	909.98	1364.97	1.52	-4.70	-4.66	-5.15	-5.10	-6.12	-6.08	-6.57	-6.53
1997	31-Jan	1.638	28-Feb	1.687	8.410	10.90	10.70	1170	-2914.47	-2680.37	5.07	1.73	1.75	1.28	1.31	-3.20	-3.17	-3.64	-3.61
	28-Feb	1.687	31-Mar	1.679	8.950	10.30	10.15	1302	-1758.24	-1562.88	7.40	7.73	7.75	7.29	7.31	0.30	0.32	-0.14	-0.12
	31-Mar	1.679	30-Apr	1.731	9.400	9.50	9.20	1236	-123.63	247.26	5.20	2.02	2.06	1.56	1.60	-3.02	-2.98	-3.48	-3.44
	30-Apr	1.731	29-May	1.695	9.380	8.60	8.45	1211	944.39	1126.00	0.26	2.49	2.51	2.02	2.04	2.22	2.24	1.76	1.77
	30-May	1.709	1-Jul	1.743	8.500	10.00	9.80	1285	-1927.46	-1670.47	3.19	0.99	1.01	0.53	0.55	-2.14	-2.12	-2.61	-2.58
	30-Jun	1.743	31-Jul	1.841	8.630	8.50	8.35	1283	166.77	359.19	6.71	1.04	1.06	0.58	0.60	-5.31	-5.29	-5.77	-5.75
	31-Jul	1.841	29-Aug	1.809	14.480	10.20	10.00	1311	5611.94	5874.18	17.25	19.89	19.91	19.43	19.46	2.33	2.36	1.87	1.90
	29-Aug	1.809	30-Sep	1.762	10.350	11.80	11.60	1270	-1841.82	-1587.60	-12.01	-9.84	-9.82	-10.30	-10.28	2.48	2.51	2.02	2.05
	30-Sep	1.762	29-Oct	1.733	10.350	10.80	10.55	1223	-550.54	-244.68	6.70	8.43	8.46	7.97	8.00	1.62	1.65	1.16	1.19
	30-Oct	1.725	28-Nov	1.766	6.290	12.10	11.65	1315	-7636.80	-7047.16	-10.58	-13.42	-13.37	-13.88	-13.82	-3.09	-3.03	-3.54	-3.49
	30-Nov	1.766	30-Dec	1.789	7.700	9.30	9.15	1350	-2160.64	-1958.06	5.97	4.39	4.41	3.91	3.93	-1.50	-1.48	-1.99	-1.97
	2-Jan	1.798	29-Jan	1.824	10.720	10.80	10.55	1249	-99.93	212.36	7.61	6.07	6.10	5.60	5.63	-1.44	-1.40	-1.90	-1.87
1998	30-Jan	1.83	27-Feb	1.817	10.970	11.30	11.10	1196	-394.71	-155.49	4.49	5.20	5.22	4.74	4.76	0.68	0.70	0.22	0.24
	27-Feb	1.817	1-Apr	1.853	5.540	9.50	9.30	1316	-5211.36	-4948.16	6.07	3.49	3.51	3.02	3.05	-2.46	-2.44	-2.93	-2.90
	31-Mar	1.849	30-Apr	1.796	8.170	9.00	8.80	1269	-1053.18	-799.40	8.33	11.43	11.45	10.96	10.99	2.85	2.87	2.38	2.41
	30-Apr	1.796	2-Jun	1.779	6.480	9.10	8.90	1337	-3502.42	-3235.06	0.10	0.71	0.73	0.25	0.27	0.61	0.63	0.15	0.17
	29-May	1.785	30-Jun	1.805	8.030	9.00	8.85	1281	-1242.62	-1050.47	9.04	7.71	7.73	7.25	7.27	-1.23	-1.21	-1.69	-1.67
	30-Jun	1.805	30-Jul	1.779	7.280	8.40	8.25	1266	-1417.76	-1227.83	5.90	7.30	7.32	6.84	6.86	1.32	1.34	0.86	0.88
	31-Jul	1.78	2-Sep	1.754	9.360	7.90	7.70	1306	1907.34	2168.62	-0.40	1.27	1.29	0.81	0.83	1.67	1.70	1.21	1.24
	31-Aug	1.76	30-Sep	1.671	10.460	11.70	11.25	1270	-1574.37	-1003.02	-17.71	-13.48	-13.42	-13.94	-13.88	5.17	5.23	4.71	4.77
	30-Sep	1.671	29-Oct	1.654	11.940	12.20	11.95	1266	-329.15	-12.66	-7.43	-6.52	-6.48	-6.95	-6.92	0.99	1.03	0.56	0.59
	30-Oct	1.657	1-Dec	1.682	8.760	10.60	10.20	1316	-2421.01	-1894.70	4.39	2.60	2.65	2.17	2.23	-1.73	-1.68	-2.15	-2.10
	30-Nov	1.696	30-Dec	1.682	7.720	8.80	8.50	1229	-1327.76	-958.94	7.53	8.29	8.33	7.83	7.87	0.70	0.74	0.24	0.28
	31-Dec	1.677	3-Feb	1.724	9.510	10.80	10.60	1341	-1730.25	-1462.00	-0.40	-3.29	-3.27	-3.71	-3.68	-2.90	-2.87	-3.31	-3.28
1999	29-Jan	1.722	26-Feb	1.776	7.780	8.60	8.40	1204	-987.39	-746.57	3.15	-0.09	-0.06	-0.49	-0.46	-3.14	-3.12	-3.54	-3.52
	26-Feb	1.776	31-Mar	1.81	8.560	9.50	9.30	1283	-1206.21	-949.57	-4.81	-6.72	-6.69	-7.12	-7.10	-2.00	-1.97	-2.40	-2.38
	31-Mar	1.81	29-Apr	1.846	7.540	9.90	9.75	1305	-3079.61	-2883.87	-0.56	-2.81	-2.79	-3.21	-3.19	-2.26	-2.24	-2.66	-2.64
	30-Apr	1.848	2-Jun	1.89	7.950	8.90	8.70	1296	-1231.25	-972.04	10.42	7.84	7.87	7.44	7.47	-2.35	-2.32	-2.74	-2.72
	31-May	1.873	30-Jun	1.897	9.930	9.50	9.30	1215	522.48	765.50	-5.99	-7.13	-7.11	-7.53	-7.51	-1.21	-1.19	-1.62	-1.59
	30-Jun	1.897	29-Jul	1.893	9.430	9.70	9.50	1176	-317.44	-62.30	6.09	6.28	6.30	5.85	5.88	0.18	0.20	-0.25	-0.22
	30-Jul	1.828	2-Sep	1.829	10.030	11.10	10.80	1298	-1388.43	-999.15	-5.14	-5.33	-5.30	-5.76	-5.72	-0.19	-0.15	-0.62	-0.58
	31-Aug	1.847	30-Sep	1.834	9.090	10.50	10.30	1220	-1719.67	-1475.74	3.31	3.87	3.90	3.43	3.46	0.54	0.56	0.10	0.12
	30-Sep	1.834	2-Nov	1.858	8.750	11.80	11.60	1318	-4018.68	-3755.16	-2.29	-3.96	-3.93	-4.40	-4.37	-1.69	-1.67	-2.13	-2.11
	29-Oct	1.858	30-Nov	1.942	9.140	10.10	9.95	1288	-1236.59	-1043.37	7.29	2.53	2.55	2.09	2.11	-4.45	-4.43	-4.89	-4.87
	30-Nov	1.942	29-Dec	1.946	9.730	11.70	11.45	1191	-2345.51	-2047.86	6.71	6.25	6.28	5.73	5.76	-0.44	-0.41	-0.96	-0.94
	31-Dec	1.943	2-Feb	2.003	10.700	12.00	11.75	1302	-1693.24	-1367.62	18.01	14.31	14.34	13.84	13.87	-3.16	-3.13	-3.64	-3.60
2000	31-Jan	2.012	29-Feb	2.023	12.550	13.20	12.35	1204	-782.63	240.81	-1.76	-2.37	-2.27	-2.85	-2.75	-0.62	-0.52	-1.10	-1.00
	29-Feb	2.023	30-Mar	2.038	9.440	15.70	15.35	1198	-7497.23	-7078.05	11.83	10.26	10.30	9.78	9.82	-1.49	-1.44	-1.97	-1.92
	31-Mar	2.043	2-May	2.162	11.470	12.80	12.55	1207	-1604.96	-1303.27	-0.59	-6.22	-6.19	-6.72	-6.69	-5.66	-5.63	-6.16	-6.13

British Pound Volatility Swap Strategy Returns

												With Equity:				Without Equity:			
	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Vols(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1994	31-Oct	1.631	30-Nov	1.567	7.520	8.90	8.60	1236	-1639.14	-1335.27	2.35	-1.83	-1.80	-2.28	-2.25	-4.09	-4.06	-4.54	-4.50
	30-Nov	1.567	29-Dec	1.56	5.180	8.30	8.15	1169	-3630.93	-3437.61	-0.52	-1.32	-1.30	-1.79	-1.77	-0.81	-0.79	-1.27	-1.25
	30-Dec	1.565	1-Feb	1.58	6.280	8.50	8.30	1252	-2806.08	-2529.18	-0.52	0.16	0.18	-0.33	-0.30	0.68	0.71	0.19	0.22
1995	31-Jan	1.582	28-Feb	1.584	6.930	8.30	8.05	1158	-1586.50	-1297.09	-2.41	-2.45	-2.42	-2.97	-2.94	-0.03	0.00	-0.55	-0.52
	28-Feb	1.584	30-Mar	1.599	14.550	8.70	8.45	1201	7090.45	7324.90	0.59	2.25	2.28	1.73	1.75	1.66	1.68	1.13	1.15
	31-Mar	1.621	2-May	1.613	10.360	14.50	14.00	1271	-5235.41	-4825.20	4.27	3.24	3.30	2.71	2.78	-1.02	-0.96	-1.54	-1.48
	28-Apr	1.613	31-May	1.589	11.120	11.20	10.70	1290	-101.70	542.00	2.51	0.98	1.04	0.44	0.51	-1.50	-1.43	-2.03	-1.96
	31-May	1.589	29-Jun	1.593	9.470	10.40	10.10	1185	-1105.19	-748.88	3.19	3.34	3.38	2.83	2.86	0.14	0.18	-0.38	-0.34
	30-Jun	1.595	2-Aug	1.6	4.060	10.50	9.80	1276	-6243.20	-7324.64	-0.14	-0.66	-0.56	-1.20	-1.10	-0.51	-0.42	-1.05	-0.96
	31-Jul	1.598	31-Aug	1.55	8.070	13.70	12.90	1230	-6719.41	-5943.77	4.49	0.68	0.75	0.12	0.20	-3.68	-3.60	-4.23	-4.15
	31-Aug	1.55	2-Oct	1.59	7.090	8.60	8.30	1215	-1882.31	-1470.47	0.42	2.82	2.86	2.28	2.32	2.39	2.43	1.85	1.89
	29-Sep	1.585	1-Nov	1.58	3.680	9.30	9.00	1268	-7103.68	-6746.13	0.87	-0.15	-0.12	-0.71	-0.67	-1.03	-0.99	-1.58	-1.54
	31-Oct	1.582	30-Nov	1.531	6.800	7.90	7.15	1199	-1276.55	-419.75	0.60	-2.77	-2.69	-3.32	-3.24	-3.35	-3.27	-3.90	-3.81
	30-Nov	1.531	29-Dec	1.55	6.000	9.90	9.60	1225	-4836.00	-4366.01	3.83	4.64	4.68	4.09	4.13	0.76	0.80	0.21	0.26
	29-Dec	1.55	31-Jan	1.515	5.610	8.20	7.80	1240	-3139.06	-2715.75	0.68	-1.91	-1.86	-2.44	-2.39	-2.57	-2.53	-3.10	-3.06
1996	31-Jan	1.515	29-Feb	1.532	5.890	8.20	7.90	1130	-2640.03	-2271.93	1.90	2.78	2.81	2.26	2.30	0.86	0.89	0.34	0.38
	29-Feb	1.532	2-Apr	1.525	4.720	6.70	6.40	1226	-2415.60	-2059.12	-0.84	-1.54	-1.50	-2.05	-2.01	-0.70	-0.66	-1.21	-1.17
	29-Mar	1.527	30-Apr	1.504	5.450	6.10	5.65	1197	-766.44	-239.45	-0.75	-2.32	-2.27	-2.81	-2.76	-1.58	-1.53	-2.08	-2.02
	30-Apr	1.504	30-May	1.537	6.320	7.00	6.50	1140	-792.23	-205.23	3.19	5.38	5.44	4.89	4.95	2.11	2.17	1.62	1.68
	31-May	1.55	2-Jul	1.558	4.350	6.30	6.15	1215	-2381.87	-2187.54	-1.84	-1.57	-1.55	-2.06	-2.04	0.28	0.30	-0.22	-0.20
	28-Jun	1.553	31-Jul	1.556	5.360	6.30	6.05	1242	-1170.11	-857.30	-0.98	-0.91	-0.88	-1.38	-1.35	0.08	0.11	-0.40	-0.37
	31-Jul	1.556	29-Aug	1.558	4.790	5.30	5.55	1161	-592.76	-682.29	-0.21	-0.14	-0.17	-0.61	-0.64	0.07	0.04	-0.40	-0.43
	30-Aug	1.562	1-Oct	1.565	3.790	5.30	4.90	1225	-1852.71	-1359.39	4.44	4.45	4.50	3.98	4.03	0.01	0.06	-0.47	-0.42
	30-Sep	1.564	31-Oct	1.628	6.210	4.80	4.65	1204	1767.52	1878.68	2.23	6.59	6.60	6.11	6.12	4.27	4.28	3.79	3.80
	31-Oct	1.628	2-Dec	1.682	5.910	7.90	7.65	1278	-2824.19	-2220.97	0.64	3.72	3.76	3.22	3.26	3.05	3.09	2.55	2.59
	29-Nov	1.682	31-Dec	1.715	12.090	7.50	7.25	1346	6297.48	6448.44	1.98	4.61	4.63	4.12	4.13	2.59	2.61	2.10	2.11
	31-Dec	1.715	30-Jan	1.614	9.940	10.70	10.20	1300	-929.79	-336.03	1.49	-4.58	-4.52	-5.09	-5.03	-5.98	-5.92	-6.49	-6.43
1997	31-Jan	1.599	28-Feb	1.628	8.500	11.10	10.90	1170	-3098.41	-2809.51	3.82	5.39	5.42	4.89	4.92	1.50	1.53	1.00	1.03
	28-Feb	1.628	31-Mar	1.645	7.640	9.90	9.70	1302	-2974.18	-2683.09	0.76	1.51	1.54	1.02	1.05	0.75	0.78	0.25	0.28
	31-Mar	1.631	30-Apr	1.623	5.610	8.50	8.25	1238	-3555.38	-3264.00	0.11	-0.74	-0.71	-1.24	-1.21	-0.85	-0.82	-1.34	-1.32
	30-Apr	1.623	29-May	1.641	8.020	7.90	7.65	1211	146.90	448.03	2.85	4.01	4.04	3.50	3.53	1.12	1.15	0.62	0.65
	30-May	1.639	1-Jul	1.659	5.050	8.60	8.40	1285	-4617.33	-4304.90	4.18	4.99	5.02	4.47	4.50	0.76	0.79	0.24	0.27
	30-Jun	1.666	31-Jul	1.639	9.090	7.90	7.65	1283	1501.82	1847.46	-0.36	-1.83	-1.79	-2.37	-2.33	-1.47	-1.44	-2.01	-1.98
	31-Jul	1.639	29-Aug	1.62	10.840	9.00	8.70	1311	2364.64	2806.27	6.58	5.58	5.62	5.02	5.06	-0.92	-0.88	-1.48	-1.44
	29-Aug	1.62	30-Sep	1.614	9.460	9.80	9.55	1270	-430.23	-114.31	-1.83	-2.24	-2.21	-2.82	-2.79	-0.41	-0.38	-1.00	-0.96
	30-Sep	1.614	29-Oct	1.672	7.380	9.90	9.45	1223	-3193.79	-2532.60	8.86	12.45	12.52	11.87	11.94	3.27	3.34	2.69	2.76
	30-Oct	1.677	28-Nov	1.688	6.300	10.50	10.15	1315	-5558.25	-5062.41	-7.66	-7.61	-7.56	-8.20	-8.15	0.10	0.15	-0.49	-0.44
	28-Nov	1.688	30-Dec	1.657	8.620	8.50	8.30	1350	159.07	427.91	-0.22	-2.03	-2.01	-2.64	-2.61	-1.82	-1.79	-2.43	-2.40
	2-Jan	1.648	29-Jan	1.64	8.560	10.40	10.20	1249	-2287.34	-2046.89	6.29	5.54	5.56	4.93	4.96	-0.71	-0.69	-1.32	-1.30
1998	30-Jan	1.634	27-Feb	1.645	7.350	10.00	9.80	1196	-3190.97	-2930.82	6.29	6.69	6.71	6.08	6.11	0.35	0.38	-0.25	-0.22
	27-Feb	1.645	1-Apr	1.673	5.670	8.60	8.40	1316	-3921.51	-3592.86	5.66	7.06	7.10	6.46	6.49	1.31	1.34	0.70	0.74
	31-Mar	1.674	30-Apr	1.671	6.040	8.00	7.80	1289	-2482.57	-2233.49	2.86	2.43	2.45	1.82	1.84	-0.43	-0.40	-1.04	-1.01
	30-Apr	1.671	2-Jun	1.639	5.290	7.30	7.15	1337	-2835.51	-2486.58	-0.07	-2.24	-2.23	-2.84	-2.83	-2.18	-2.16	-2.78	-2.76
	29-May	1.634	30-Jun	1.67	6.500	7.20	7.05	1281	-916.50	-704.62	-0.97	1.12	1.14	0.52	0.54	2.11	2.13	1.51	1.53
	30-Jun	1.67	30-Jul	1.64	5.980	7.30	7.10	1286	-1640.92	-1417.92	-0.65	-2.60	-2.58	-3.21	-3.19	-1.96	-1.94	-2.57	-2.55
	31-Jul	1.633	2-Sep	1.669	7.290	7.10	6.80	1306	253.69	640.17	0.08	2.31	2.35	1.69	1.73	2.23	2.27	1.62	1.65
	31-Aug	1.675	30-Sep	1.697	8.020	8.70	8.40	1270	-674.70	-482.49	-10.07	-8.97	-8.93	-9.58	-9.54	1.23	1.27	0.62	0.66
	30-Sep	1.697	29-Oct	1.675	10.400	10.00	9.80	1266	499.82	759.66	-3.52	-4.72	-4.70	-5.32	-5.30	-1.25	-1.22	-1.85	-1.82
	30-Oct	1.674	1-Dec	1.654	5.700	9.80	9.55	1316	-5330.18	-5065.97	7.38	5.57	5.60	4.97	5.00	-1.73	-1.70	-2.32	-2.30
	30-Nov	1.648	30-Dec	1.662	8.540	7.80	7.40	1229	917.49	1387.81	5.62	6.61	6.65	6.05	6.09	0.94	0.99	0.38	0.43
	31-Dec	1.66	3-Feb	1.638	5.760	10.00	9.55	1341	-5611.66	-5063.73	2.41	0.50	0.55	-0.02	0.04	-1.89	-1.83	-2.40	-2.35
1999	29-Jan	1.645	26-Feb	1.604	6.190	7.50	7.30	1204	-1538.11	-1330.78	0.23	-2.42	-2.40	-2.91	-2.89	-2.65	-2.63	-3.13	-3.11
	26-Feb	1.604	31-Mar	1.615	6.030	9.10	8.80	1283	-3966.44	-3554.66	4.73	5.06	5.10	4.60	4.64	0.29	0.33	-0.17	-0.13
	31-Mar	1.615	29-Apr	1.608	5.170	7.60	7.40	1305	-3157.21	-2910.29	1.95	1.19	1.21	0.75	0.77	-0.75	-0.72	-1.19	-1.16
	30-Apr	1.608	2-Jun	1.604	6.390	6.90	6.65	1296	-659.34	-336.99	4.08	3.76	3.79	3.32	3.35	-0.31	-0.28	-0.75	-0.72
	31-May	1.603	30-Jun	1.576	7.320	7.40	7.15	1215	-95.57	206.57	-4.98	-6.59	-6.56	-7.02	-6.99	-1.69	-1.66	-2.13	-2.10
	30-Jun	1.576	29-Jul	1.618	7.530	7.50	7.30	1178	38.21	270.44	1.48	4.19	4.21	3.77	3.80	2.67	2.69	2.25	2.27
	30-Jul	1.622	2-Sep	1.607	7.430	8.80	8.55	1298	-1781.27	-1453.47	-1.37	-2.46	-2.43	-2.89	-2.86	-1.10	-1.07	-1.53	-1.50
	31-Aug	1.609	30-Sep	1.647	7.080	9.20	9.00	1220	-2646.66	-2341.93	0.23	2.34	2.37	1.92	1.95	2.10	2.13	1.68	1.71
	30-Sep	1.647	2-Nov	1.646	6.800	8.90	8.70	1318	-2785.26	-2503.56	-3.47	-3.80	-3.78	-4.24	-4.22	-0.34	-0.31	-0.78	-0.75
	29-Oct	1.643	30-Nov	1.596	7.790	7.90	7.75	1288	-137.64	51.53	3.75	0.76	0.78	0.32	0.34	-2.87	-2.86	-3.32	-3.30
	30-Nov	1.596	29-Dec	1.619	6.380	9.00	8.65	1191	-3164.37	-2676.25	5.46	6.66	6.71	6.21	6.26	1.12	1.17	0.68	0.73
	31-Dec	1.616	2-Feb	1.608	7.450	7.80	7.55	1302	-453.62	-130.26	5.05	4.48	4.51	4.04	4.07	-0.54	-0.51	-0.98	-0.95
2000	31-Jan	1.614	29-Feb	1.58	9.170	8.20	7.95	1204	1143.32	1489.01	-9.55	-11.34	-11.31	-11.83	-11.80	-1.99	-1.96	-2.49	-2.45
	29-Feb	1.58	30-Mar	1.593	5.650	9.80	9.50	1196	-5011.10	-4611.42	-0.57	-0.26	-0.22	-0.75	-0.71	0.32	0.36	-0.18	-0.14
	31-Mar	1.592	2-May	1.559	6.290	8.20	8.05	1207	-2257.09	-2123.97	4.94	2.53	2.55	2.04	2.06	-2.30	-2.29	-2.79	-2.78

* Mar 1998 vol data extrapolated from Feb and Apr 98

Japanese Yen Volatility Swap Strategy Returns

	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Vols(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	With Equity:				Without Equity:			
												Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1994	31-Oct	96.97	30-Nov	98.87	6.750	8.70	8.45	1236	-2410.78	-2101.71	2.18	-0.03	0.00	-0.44	-0.41	-2.16	-2.13	-2.58	-2.54
	30-Nov	98.87	29-Dec	99.6	6.090	7.80	7.60	1169	-1998.96	-1785.16	-4.57	-5.47	-5.45	-5.96	-5.94	-0.93	-0.91	-1.42	-1.40
	30-Dec	99.58	1-Feb	99.38	9.350	8.40	8.20	1252	1189.40	1439.60	3.39	3.72	3.75	3.23	3.26	0.32	0.35	-0.17	-0.14
1995	31-Jan	99.45	28-Feb	96.54	5.110	9.30	9.10	1158	-4852.12	-4620.52	-5.44	-3.08	-3.05	-3.57	-3.55	2.53	2.55	2.03	2.06
	28-Feb	96.54	30-Mar	89.53	14.680	8.60	8.45	1201	7300.09	7480.19	-8.56	-0.67	-0.65	-1.17	-1.15	8.56	8.58	8.06	8.08
	31-Mar	86.55	2-May	83.65	18.500	17.00	16.50	1271	1906.30	2541.73	-5.36	-1.88	-1.82	-2.38	-2.32	3.66	3.72	3.16	3.22
	28-Apr	84.33	31-May	84.44	16.770	15.10	14.85	1290	2154.97	2477.57	4.13	4.21	4.24	3.72	3.75	0.09	0.12	-0.41	-0.37
	31-May	84.44	29-Jun	84.72	9.020	14.30	14.00	1185	-6258.66	-5903.26	-8.15	-9.08	-9.05	-9.57	-9.54	-0.96	-0.92	-1.45	-1.41
	30-Jun	84.63	2-Aug	90.88	13.720	11.30	10.70	1276	3087.92	3853.52	-5.96	-12.11	-12.04	-12.61	-12.53	-6.57	-6.49	-7.07	-6.99
	31-Jul	88.26	31-Aug	97.71	19.270	13.70	12.90	1230	6853.66	7838.03	14.88	4.45	4.55	3.98	4.08	-8.99	-8.89	-9.46	-9.36
	31-Aug	97.71	2-Oct	100.54	16.760	15.90	15.65	1215	1045.07	1348.67	8.63	5.68	5.71	5.20	5.23	-2.71	-2.68	-3.19	-3.16
	29-Sep	99.72	1-Nov	103.1	9.610	17.40	17.05	1268	-9877.72	-9433.92	-1.13	-5.36	-5.31	-5.83	-5.79	-4.27	-4.22	-4.74	-4.70
	31-Oct	102.07	30-Nov	102.07	11.220	14.40	13.95	1199	-3613.32	-3273.70	-1.44	-1.82	-1.77	-2.30	-2.24	-0.38	-0.33	-0.85	-0.80
	30-Nov	102.07	29-Dec	103.51	5.940	12.30	12.05	1225	-7789.73	-7463.53	6.17	3.92	3.95	3.43	3.46	-2.17	-2.14	-2.66	-2.62
	29-Dec	103.51	31-Jan	106.96	12.560	12.20	11.65	1240	446.40	1128.40	6.00	2.62	2.69	2.16	2.23	-3.18	-3.11	-3.64	-3.57
1996	31-Jan	106.96	29-Feb	105.13	11.210	10.60	10.25	1130	689.42	1064.98	4.75	6.65	6.69	6.20	6.24	1.81	1.85	1.37	1.41
	29-Feb	105.13	2-Apr	107.45	4.660	10.80	10.50	1226	-7525.18	-7157.50	-3.30	-6.14	-6.11	-6.58	-6.54	-2.91	-2.87	-3.34	-3.31
	29-Mar	107.12	30-Apr	105.06	8.360	9.80	9.30	1197	-1723.92	-1125.34	6.37	8.28	8.34	7.84	7.90	1.79	1.85	1.35	1.41
	30-Apr	105.06	30-May	107.46	8.130	11.20	10.75	1140	-3499.90	-2986.88	2.96	0.31	0.37	-0.13	-0.08	-2.58	-2.53	-3.03	-2.97
	31-May	107.97	2-Jul	110.15	6.860	9.90	9.30	1215	-3694.21	-2965.09	-0.39	-2.73	-2.65	-3.17	-3.10	-2.35	-2.28	-2.79	-2.72
	28-Jun	109.38	31-Jul	106.46	8.730	7.70	7.45	1242	1279.67	1590.27	2.62	5.56	5.59	5.11	5.14	2.87	2.90	2.42	2.45
	31-Jul	106.46	29-Aug	108.46	5.380	9.70	9.50	1161	-5014.55	-4782.40	-8.16	-10.35	-10.33	-10.80	-10.77	-2.35	-2.32	-2.79	-2.77
	30-Aug	108.88	1-Oct	111.22	6.230	6.70	6.45	1225	-575.57	-269.41	-2.54	-4.65	-4.62	-5.09	-5.06	-2.16	-2.13	-2.60	-2.57
	30-Sep	111.55	31-Oct	113.97	4.830	7.30	7.05	1204	-2974.57	-2673.50	6.89	4.32	4.35	3.88	3.91	-2.42	-2.39	-2.86	-2.83
	31-Oct	113.97	2-Dec	114.08	9.470	8.40	8.20	1276	1365.70	1620.97	-5.05	-5.01	-4.98	-5.45	-5.42	0.04	0.07	-0.40	-0.37
	29-Nov	113.86	31-Dec	115.9	6.240	6.50	6.30	1346	-349.86	-60.74	2.70	0.86	0.89	0.41	0.44	-1.80	-1.77	-2.25	-2.22
	31-Dec	115.9	30-Jan	121.47	9.420	9.40	9.10	1300	28.00	415.99	-7.89	-12.11	-12.07	-12.56	-12.52	-4.58	-4.54	-5.03	-4.99
1997	31-Jan	121.36	28-Feb	120.39	9.810	12.40	12.25	1170	-3031.51	-2855.94	-5.33	-4.87	-4.85	-5.31	-5.29	0.50	0.52	0.06	0.08
	28-Feb	120.39	31-Mar	123.62	8.910	11.60	11.45	1302	-3503.46	-3308.10	1.24	-1.76	-1.74	-2.20	-2.18	-2.96	-2.94	-3.41	-3.39
	31-Mar	123.62	30-Apr	127.14	8.460	10.60	10.40	1236	-2645.68	-2398.42	-2.98	-5.93	-5.91	-6.40	-6.37	-3.03	-3.01	-3.50	-3.47
	30-Apr	127.14	29-May	115.9	17.730	8.80	8.60	1211	10812.07	11054.22	6.38	17.77	17.80	17.31	17.33	10.78	10.80	10.32	10.34
	30-May	116.4	1-Jul	114.53	14.630	11.00	10.80	1285	4664.46	4921.45	4.79	6.97	6.99	6.51	6.53	2.10	2.12	1.64	1.66
	30-Jun	114.53	31-Jul	118.47	9.820	10.90	10.65	1283	-1385.45	-1064.74	2.67	-0.88	-0.85	-1.34	-1.31	-3.46	-3.43	-3.93	-3.89
	31-Jul	118.47	29-Aug	120.93	16.110	11.40	11.20	1311	6175.75	6437.99	-1.33	-2.72	-2.69	-3.17	-3.15	-1.42	-1.39	-1.87	-1.85
	29-Aug	120.93	30-Sep	120.47	10.030	13.10	12.90	1270	-3899.15	-3645.13	-10.34	-10.39	-10.36	-10.85	-10.82	-0.01	0.02	-0.47	-0.44
	30-Sep	120.47	29-Oct	120.94	10.460	13.40	13.10	1223	-3596.63	-3229.81	-1.87	-2.62	-2.58	-3.08	-3.04	-0.75	-0.71	-1.21	-1.17
	30-Oct	120.43	28-Nov	127.74	9.600	12.30	12.05	1315	-3549.97	-3221.16	-7.99	-13.61	-13.58	-14.07	-14.03	-6.08	-6.04	-6.54	-6.50
	30-Nov	127.74	30-Dec	130.1	13.470	14.00	13.10	1350	-715.71	364.61	1.03	-0.83	-0.72	-1.31	-1.20	-1.89	-1.78	-2.37	-2.26
	2-Jan	132.4	29-Jan	125.55	13.300	14.70	14.40	1249	-1746.86	-1374.10	-8.28	-3.45	-3.41	-3.92	-3.88	5.28	5.32	4.82	4.85
1998	30-Jan	126.79	27-Feb	126.11	11.060	13.70	13.50	1196	-3157.67	-2918.45	8.98	9.25	9.27	8.79	8.82	0.22	0.25	-0.23	-0.21
	27-Feb	126.11	31-Mar	133.63	11.760	13.00	12.85	1316	-1631.84	-1434.44	1.22	-4.64	-4.62	-5.10	-5.08	-5.79	-5.77	-6.25	-6.23
	31-Mar	133.3	30-Apr	132.76	11.660	14.10	13.95	1269	-3096.10	-2905.78	-1.81	-1.72	-1.70	-2.18	-2.16	0.10	0.12	-0.36	-0.35
	30-Apr	132.76	2-Jun	138.9	9.100	12.00	11.85	1337	-3876.72	-3676.20	-5.36	-9.93	-9.91	-10.39	-10.37	-4.81	-4.79	-5.27	-5.25
	29-May	138.57	30-Jun	137.98	25.250	12.90	12.70	1281	15621.04	16077.25	0.19	2.20	2.22	1.74	1.77	2.01	2.04	1.55	1.58
	30-Jun	137.98	30-Jul	143.36	13.250	18.30	18.05	1266	-6392.59	-6076.13	1.02	-3.41	-3.38	-3.87	-3.84	-4.39	-4.36	-4.85	-4.82
	31-Jul	144.75	2-Sep	137.9	16.170	15.50	15.15	1306	875.29	1332.53	3.47	8.69	8.74	8.23	8.28	5.05	5.10	4.60	4.64
	31-Aug	141.04	30-Sep	136.65	25.180	18.10	17.30	1270	8989.12	10004.84	-13.87	-10.20	-10.10	-10.66	-10.56	4.11	4.21	3.65	3.75
	30-Sep	136.65	29-Oct	116.85	31.020	19.20	18.95	1266	14963.67	15280.16	-4.97	12.63	12.66	12.19	12.22	18.44	18.47	18.00	18.04
	30-Oct	116.4	30-Nov	123.15	15.930	20.00	19.35	1316	-5355.16	-4499.91	1.18	-4.90	-4.82	-5.33	-5.24	-6.02	-5.93	-6.44	-6.36
	30-Nov	123.15	30-Dec	114.92	12.490	16.40	16.05	1229	-4806.99	-4376.69	9.73	17.10	17.15	16.65	16.69	6.68	6.72	6.22	6.27
	31-Dec	113.6	3-Feb	112.97	20.010	22.00	21.25	1341	-2669.15	-1663.19	-7.00	-6.75	-6.65	-7.16	-7.06	0.29	0.39	-0.12	-0.02
1999	29-Jan	116.24	26-Feb	119.09	17.010	16.10	15.80	1204	1095.77	1457.01	4.75	2.35	2.39	1.95	1.98	-2.28	-2.25	-2.69	-2.65
	26-Feb	119.09	31-Mar	118.47	12.420	18.60	18.15	1283	-7930.18	-7352.74	-0.91	-1.18	-1.13	-1.59	-1.53	-0.27	-0.21	-0.67	-0.62
	31-Mar	118.47	29-Apr	119.1	10.950	17.90	17.60	1305	-9068.19	-8677.72	10.22	8.73	8.77	8.33	8.37	-1.44	-1.40	-1.84	-1.80
	30-Apr	119.29	2-Jun	121	8.070	12.60	12.25	1296	-5871.10	-5417.48	5.46	3.38	3.43	2.98	3.03	-2.00	-1.95	-2.40	-2.35
	31-May	121.79	30-Jun	121.01	13.380	12.00	11.75	1215	1676.80	1960.57	-3.53	-2.74	-2.71	-3.15	-3.11	0.81	0.84	0.41	0.44
	30-Jun	121.01	29-Jul	115.35	10.070	10.90	10.70	1176	-975.83	-740.69	8.80	14.04	14.07	13.62	13.64	4.81	4.83	4.38	4.41
	30-Jul	114.63	2-Sep	109.1	10.520	14.00	13.60	1298	-4515.65	-3996.61	1.89	6.61	6.66	6.18	6.24	4.62	4.67	4.19	4.25
	31-Aug	141.04	30-Sep	106.43	18.250	14.10	14.50	1220	4329.56	4573.58	-2.38	0.74	0.76	0.30	0.33	3.19	3.21	2.75	2.77
	30-Sep	106.43	2-Nov	104.07	11.370	17.50	17.05	1318	-8076.89	-7463.97	0.97	2.45	2.51	2.01	2.07	1.46	1.52	1.02	1.08
	29-Oct	104.15	30-Nov	101.63	13.310	13.90	13.65	1288	-758.99	-437.96	1.91	4.36	4.40	3.92	3.96	2.40	2.44	1.96	2.00
	30-Nov	101.63	29-Dec	102.01	8.560	16.70	16.05	1191	-9691.61	-8917.71	3.43	2.08	2.16	1.55	1.63	-1.34	-1.26	-1.87	-1.79
	31-Dec	102.24	2-Feb	108.33	11.580	14.40	13.90	1302	-3673.04	-3021.79	2.03	-4.08	-4.01	-4.55	-4.48	-5.99	-5.92	-6.46	-6.40
2000	31-Jan	107.37	29-Feb	109.96	8.730	11.20	10.95	1204	-2973.99	-2672.96	3.20	0.47	0.50	-0.01	0.02	-2.65	-2.62	-3.13	-3.10
	29-Feb	109.96	30-Mar	105.51	12.590	12.80	12.50	1198	-251.50	107.79	2.15	6.43	6.47	5.95	5.99	4.19	4.23	3.71	3.75
	31-Mar	102.64	2-May	108.44	12.060	18.60	18.05	1207	-7892.05	-7228.35	1.89	-4.35	-4.28	-4.84	-4.78	-6.14	-6.07	-6.63	-6.57

Currency Returns From Unhedged Currency Positions (in US dollars) with Equity Returns

		CAD		DEM		GBP		JPY	
		Usd amnt	Return	Usd amnt	Return	Usd amnt	Return	Usd amnt	Return
1994	31-Oct	-$30,131	-3.01	-$9,639	-0.96	-$16,668	-1.67	$2,129	0.21
	30-Nov	-$64,561	-6.46	$847	0.08	-$9,610	-0.96	-$52,717	-5.27
	30-Dec	$26,436	2.64	$46,706	4.67	$4,375	0.44	$36,021	3.60
1995	31-Jan	-$36,280	-3.63	$3,656	0.37	-$22,873	-2.29	-$25,913	-2.59
	28-Feb	$22,312	2.23	$72,438	7.24	$15,442	1.54	-$14,003	-1.40
	31-Mar	$78,139	7.81	-$90,073	-9.01	$37,588	3.76	-$20,755	-2.08
	28-Apr	-$18,053	-1.81	$31,474	3.15	$9,860	0.99	$39,957	4.00
	31-May	$38,015	3.80	$58,810	5.88	$34,525	3.45	-$84,548	-8.45
	30-Jun	$29,656	2.97	-$15,347	-1.53	$1,684	0.17	-$124,234	-12.42
	31-Jul	$38,393	3.84	$3,809	0.38	$13,477	1.35	$37,690	3.77
	31-Aug	-$19,851	-1.99	$37,059	3.71	$30,101	3.01	$55,747	5.57
	29-Sep	-$2,319	-0.23	-$13,231	-1.32	$5,559	0.56	-$43,683	-4.37
	31-Oct	-$27,174	-2.72	-$36,130	-3.61	-$26,472	-2.65	-$14,426	-1.44
	30-Nov	$40,710	4.07	$41,753	4.18	$51,196	5.12	$46,957	4.70
	29-Dec	$4,609	0.46	-$28,188	-2.82	-$15,912	-1.59	$25,761	2.58
1996	31-Jan	$57,149	5.71	$109,379	10.94	$30,408	3.04	$65,778	6.58
	29-Feb	-$429	-0.04	-$7,404	-0.74	-$12,963	-1.30	-$53,905	-5.39
	29-Mar	$7,522	0.75	-$31,099	-3.11	-$22,434	-2.24	$84,531	8.45
	30-Apr	$30,044	3.00	$8,454	0.85	$54,591	5.46	$6,642	0.66
	31-May	$26,158	2.62	$12,993	1.30	-$13,294	-1.33	-$23,576	-2.36
	28-Jun	-$46,257	-4.63	$42,282	4.23	-$7,906	-0.79	$54,314	5.43
	31-Jul	-$17,783	-1.78	-$40,901	-4.09	-$819	-0.08	-$98,510	-9.85
	30-Aug	$48,839	4.88	-$2,507	-0.25	$46,400	4.64	-$45,921	-4.59
	30-Sep	$45,594	4.56	$48,648	4.86	$64,094	6.41	$46,203	4.62
	31-Oct	$51,104	5.11	-$16,020	-1.60	$39,807	3.98	-$51,459	-5.15
	29-Nov	$70,663	7.07	$69,351	6.94	$39,837	3.98	$8,966	0.90
	31-Dec	$1,922	0.19	-$47,929	-4.79	-$44,861	-4.49	-$121,160	-12.12
1997	31-Jan	$14,976	1.50	$20,183	2.02	$57,023	5.70	-$45,640	-4.56
	28-Feb	-$5,908	-0.59	$79,081	7.91	$18,123	1.81	-$14,069	-1.41
	31-Mar	-$60,164	-6.02	$20,370	2.04	-$3,842	-0.38	-$56,692	-5.67
	30-Apr	$33,452	3.35	$23,925	2.39	$39,949	3.99	$166,913	16.69
	30-May	$67,846	6.78	$11,798	1.18	$54,484	5.45	$65,028	6.50
	30-Jun	$10,911	1.09	$10,261	1.03	-$19,762	-1.98	-$7,430	-0.74
	31-Jul	$60,641	6.06	$193,272	19.33	$53,427	5.34	-$33,347	-3.33
	29-Aug	-$31,683	-3.17	-$96,580	-9.66	-$21,975	-2.20	-$99,964	-10.00
	30-Sep	$44,395	4.44	$84,885	8.49	$127,691	12.77	-$22,558	-2.26
	31-Oct	-$36,313	-3.63	-$126,607	-12.66	-$70,580	-7.06	-$132,529	-13.25
	28-Nov	-$52,161	-5.22	$46,067	4.61	-$20,493	-2.05	-$7,562	-0.76
	2-Jan	$15,873	1.59	$60,766	6.08	$57,695	5.77	-$32,760	-3.28
1998	30-Jan	$23,993	2.40	$52,347	5.23	$70,051	7.01	$95,643	9.56
	27-Feb	$63,778	6.38	$40,075	4.01	$74,557	7.46	-$44,742	-4.47
	31-Mar	$56,016	5.60	$115,310	11.53	$26,749	2.67	-$14,097	-1.41
	30-Apr	-$4,020	-0.40	$10,563	1.06	-$19,795	-1.98	-$95,438	-9.54
	29-May	-$18,575	-1.86	$78,304	7.83	$12,102	1.21	$6,171	0.62
	30-Jun	-$56,971	-5.70	$74,438	7.44	-$24,354	-2.44	-$27,732	-2.77
	31-Jul	-$78,611	-7.86	$10,776	1.08	$22,834	2.28	$86,057	8.61
	31-Aug	-$180,121	-18.01	-$133,228	-13.32	-$88,856	-8.89	-$110,987	-11.10
	30-Sep	$5,201	0.52	-$64,832	-6.48	-$47,749	-4.77	$111,298	11.13
	30-Oct	$113,056	11.31	$28,424	2.84	$61,019	6.10	-$43,663	-4.37
	30-Nov	$25,186	2.52	$84,217	8.42	$65,147	6.51	$175,833	17.58
	31-Dec	$37,927	3.79	-$31,196	-3.12	$10,574	1.06	-$64,791	-6.48
1999	29-Jan	$38,936	3.89	$136	0.01	-$22,703	-2.27	$22,402	2.24
	26-Feb	-$61,946	-6.19	-$65,973	-6.60	$54,520	5.45	-$3,898	-0.39
	31-Mar	$80,240	8.02	-$25,013	-2.50	$15,047	1.50	$96,417	9.64
	30-Apr	$48,114	4.81	$79,657	7.97	$38,219	3.82	$39,712	3.97
	31-May	-$15,981	-1.60	-$71,836	-7.18	-$65,760	-6.58	-$29,101	-2.91
	30-Jun	$4,825	0.48	$63,129	6.31	$41,869	4.19	$141,403	14.14
	30-Jul	$16,879	1.69	-$51,955	-5.20	-$22,827	-2.28	$70,594	7.06
	31-Aug	$2,541	0.25	$40,429	4.04	$25,999	2.60	$3,064	0.31
	30-Sep	-$4,590	-0.46	-$35,566	-3.56	-$35,262	-3.53	$32,583	3.26
	29-Oct	$40,781	4.08	$26,520	2.65	$7,786	0.78	$44,390	4.44
	30-Nov	$57,591	5.76	$64,886	6.49	$69,788	6.98	$30,488	3.05
	31-Dec	$122,247	12.22	$144,787	14.48	$45,276	4.53	-$37,090	-3.71
2000	31-Jan	$6,618	0.66	-$22,953	-2.30	-$114,535	-11.45	$7,664	0.77
	29-Feb	$74,910	7.49	$110,112	11.01	$2,454	0.25	$64,568	6.46
	31-Mar	$13,518	1.35	-$60,624	-6.06	$27,602	2.76	-$35,570	-3.56

APPENDIX 4

RETURN RESULTS FOR SIX MONTH STRATEGIES

Canadian Dollar Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Outright	Eq Ret	Rf	With Equity:		Without Equity	
									Return	Excess Return	Return	Excess Return
1995	31-Jan	1.408	1-Aug	1.368	111	1.3791	0.00	2.60	2.11	-0.49	2.11	-0.49
	31-Jul	1.368	1-Feb	1.376	77	1.3817	14.87	2.90	13.81	10.92	-1.14	-4.04
1996	31-Jan	1.376	1-Aug	1.375	2	1.3712	7.66	2.60	8.04	5.44	0.06	-2.54
	31-Jul	1.375	3-Feb	1.347	-69	1.3361	-0.79	2.90	2.09	-0.81	2.59	-0.31
1997	31-Jan	1.347	4-Aug	1.38	-153	1.3637	23.95	2.80	22.18	19.38	-1.28	-4.09
	31-Jul	1.378	2-Feb	1.458	-132	1.4388	12.57	2.86	7.74	4.88	-4.58	-7.44
1998	30-Jan	1.458	3-Aug	1.512	-35	1.5115	-2.58	2.77	-6.01	-8.79	-3.34	-6.11
	31-Jul	1.512	3-Feb	1.515	-34	1.5106	3.45	2.83	3.54	0.70	0.03	-2.81
1999	29-Jan	1.511	2-Aug	1.505	-6	1.5024	-2.91	2.46	-2.36	-4.81	0.44	-2.02
	30-Jul	1.505	2-Feb	1.445	-34	1.4386	5.22	2.81	10.06	7.24	4.39	1.57
							Ann Sharpe		1.06	0.59	-0.04	-1.46

German Deutschemark Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Outright	Eq Ret	Rf	With Equity:		Without Equity	
									Return	Excess Return	Return	Excess Return
1995	31-Jan	1.523	2-Aug	1.376	-102	1.5128	0.0000	2.60	0.74	-1.86	0.74	-1.86
	31-Jul	1.385	2-Feb	1.49	-92	1.3758	9.7696	2.90	9.70	6.80	0.62	-2.28
1996	31-Jan	1.487	2-Aug	1.475	-141	1.4729	11.3308	2.60	12.38	9.78	0.96	-1.64
	31-Jul	1.469	3-Feb	1.642	-181	1.4509	0.1300	2.90	1.22	-1.68	1.10	-1.80
1997	31-Jan	1.638	4-Aug	1.868	-196	1.6184	22.7141	2.80	20.97	18.16	1.05	-1.76
	31-Jul	1.841	4-Feb	1.819	-223	1.8187	46.2508	2.86	48.04	45.18	1.23	-1.63
1998	30-Jan	1.83	3-Aug	1.784	-177	1.8123	0.0327	2.77	1.03	-1.75	0.99	-1.78
	31-Jul	1.78	4-Feb	1.724	-185	1.7615	32.2842	2.83	34.41	31.57	1.07	-1.76
							Ann Sharpe		1.31	1.08	6.89	-12.68

British Pound Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Outright	Eq Ret	Rf	With Equity:		Without Equity	
									Return	Excess Return	Return	Excess Return
1995	31-Jan	1.582	2-Aug	1.598	-40	1.5780	0.00	2.60	-0.22	-2.82	-0.26	-2.86
	31-Jul	1.598	2-Feb	1.515	-80	1.5900	15.77	2.90	13.12	10.23	-0.48	-3.37
1996	31-Jan	1.515	2-Aug	1.556	-63	1.5087	8.55	2.60	7.36	4.76	-0.43	-3.03
	31-Jul	1.556	3-Feb	1.614	3	1.5563	-1.49	2.90	-1.27	-4.17	0.02	-2.88
1997	31-Jan	1.599	4-Aug	1.639	-60	1.5930	15.46	2.80	13.01	10.21	-0.39	-3.19
	31-Jul	1.639	4-Feb	1.637	-120	1.6270	14.77	2.86	12.43	9.58	-0.74	-3.60
1998	30-Jan	1.634	3-Aug	1.64	-145	1.6195	11.23	2.77	9.58	6.81	-0.90	-3.67
	31-Jul	1.633	4-Feb	1.642	-158	1.6172	6.93	2.83	5.52	2.69	-0.98	-3.82
1999	29-Jan	1.645	2-Aug	1.618	-48	1.6402	1.01	2.46	0.66	-1.80	-0.29	-2.75
	36737	1.622	3-Feb	1.611	22	1.6242	5.69708	2.81	5.19	2.37	0.13	-2.68
							Ann Sharpe		1.68	0.98	-1.67	-10.95

Japanese Yen Forward Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Outright	Eq Ret	Rf	With Equity:		Without Equity	
									Return	Excess Return	Return	Excess Return
1995	31-Jan	99.45	2-Aug	90.88	-207	97.38	0.00	2.60	2.28	-0.32	2.28	-0.32
	31-Jul	88.26	2-Feb	106.38	-226	86.00	-10.58	2.90	-6.65	-9.55	2.12	-0.77
1996	31-Jan	106.96	2-Aug	106.93	-248	104.48	24.80	2.60	27.12	24.52	2.32	-0.28
	31-Jul	106.46	3-Feb	121.74	-273	103.73	-0.58	2.90	1.74	-1.16	2.24	-0.66
1997	31-Jan	121.36	4-Aug	118.42	-308	118.28	-11.42	2.80	-9.10	-11.91	2.60	-0.20
	31-Jul	118.47	4-Feb	123.63	-304	115.43	10.92	2.86	12.92	10.06	2.46	-0.40
1998	30-Jan	126.79	3-Aug	145.71	-318	123.61	-18.21	2.77	-13.67	-16.44	2.18	-0.59
	31-Jul	144.75	4-Feb	112.15	-381	140.94	-1.50	2.83	1.46	-1.37	3.40	0.56
1999	29-Jan	116.24	2-Aug	114.29	-295	113.29	-11.48	2.46	-9.09	-11.55	2.58	0.12
	30-Jul	114.63	3-Feb	107.63	-480	109.83	23.1916	2.81	29.16	26.35	4.46	1.65
							Ann Sharpe		0.34	0.08	5.17	-0.17

Canadian Dollar Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	1.408	1-Aug	1.368	111	1.4191	6.7	1.828	-1.8755	0.00	0.00	2.60	1.05	-1.55	1.05	-1.55
	31-Jul	1.368	1-Feb	1.376	77	1.3757	6.5	1.788	-1.8398	14.87	14.87	2.90	12.53	9.64	-2.42	-5.32
1996	31-Jan	1.376	1-Aug	1.375	2	1.3762	5.8	1.587	-1.6282	7.66	7.66	2.60	6.42	3.82	-1.56	-4.15
	31-Jul	1.375	3-Feb	1.347	-69	1.3681	4.3	1.182	-1.2163	-0.79	-0.79	2.90	0.36	-2.54	0.86	-2.04
1997	31-Jan	1.347	4-Aug	1.38	-153	1.3317	4.9	1.341	-1.3786	23.95	23.95	2.80	23.12	20.32	-0.27	-3.07
	31-Jul	1.378	2-Feb	1.458	-132	1.3648	4.7	1.289	-1.3259	12.57	12.57	2.86	11.51	8.66	-0.42	-3.28
1998	30-Jan	1.458	3-Aug	1.512	-35	1.4545	6	1.642	-1.6875	-2.58	-2.58	2.77	-3.94	-6.71	-1.46	-4.23
	31-Jul	1.512	3-Feb	1.515	-34	1.5086	5.8	1.604	-1.6495	3.45	3.45	2.83	2.02	-0.81	-1.43	-4.26
1999	29-Jan	1.511	2-Aug	1.505	-6	1.5104	8.3	2.289	-2.3453	-2.91	-2.91	2.46	-4.74	-7.20	-1.95	-4.40
	30-Jul	1.505	2-Feb	1.445	-34	1.5016	7	1.941	-1.9956	5.22	5.22	2.81	7.82	5.01	2.16	-0.66
											Ann Sharpe		0.93	0.48	-0.51	-3.17

German Deutschemark Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	1.3760	4-Jul	1.3760	-102	1.5128	11.1	3.040	-3.12	0.00	10.68	2.60	7.56	4.97	7.56	4.97
	31-Jul	1.385	2-Jan	1.4900	-92	1.3758	12.9	3.340	-3.44	9.77	9.70	2.90	6.26	3.37	-2.82	-5.71
1996	31-Jan	1.487	2-Jul	1.4750	-141	1.4729	12.7	3.185	-3.27	11.33	12.38	2.60	9.11	6.51	-2.31	-4.91
	31-Jul	1.469	2-Jan	1.6420	-181	1.4509	8.7	2.560	-2.63	0.13	1.22	2.90	-1.42	-4.32	-1.53	-4.43
1997	31-Jan	1.638	2-Jul	1.8680	-196	1.6184	9.2	2.766	-2.84	22.71	20.97	2.80	18.12	15.32	-1.79	-4.60
	31-Jul	1.841	5-Jan	1.8190	-223	1.8187	10.9	2.941	-3.03	46.25	48.04	2.86	45.01	42.15	-1.80	-4.66
1998	30-Jan	1.83	2-Jul	1.7840	-177	1.8123	10.9	3.013	-3.10	0.03	2.61	2.77	-0.48	-3.26	-0.52	-3.29
	31-Jul	1.78	4-Jan	1.7240	-185	1.7615	9	2.387	-2.45	32.28	36.58	2.83	34.13	31.29	0.79	-2.04
											Ann Sharpe		1.25	1.02	-0.13	-1.27

British Pound Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	1.5820	31-Jul	1.5980	-40.0	1.5780	10.0	2.716	-2.7772	0.00	1.01	2.60	-1.77	-4.36	-1.77	-4.36
	31-Jul	1.5980	31-Jan	1.5150	-80.0	1.5900	9.8	2.687	-2.7459	15.77	9.75	2.90	7.01	4.11	-3.22	-6.12
1996	31-Jan	1.5150	31-Jul	1.5560	-63.0	1.5087	10.0	2.723	-2.7791	8.55	11.48	2.60	8.71	6.11	-0.07	-2.67
	31-Jul	1.5560	30-Jan	1.6140	3.0	1.5563	6.8	1.856	-1.891	-1.49	2.18	2.90	0.29	-2.61	1.84	-1.06
1997	31-Jan	1.5990	31-Jul	1.6390	-60.0	1.5930	10.1	2.745	-2.8005	15.46	18.35	2.80	15.55	12.75	-0.30	-3.10
	31-Jul	1.6390	2-Feb	1.6370	-120.0	1.6270	9.4	2.587	-2.6447	14.77	14.63	2.86	11.99	9.13	-2.77	-5.63
1998	30-Jan	1.6340	30-Jul	1.6400	-145.0	1.6195	10.0	2.716	-2.7786	11.23	11.64	2.77	8.86	6.08	-2.41	-5.19
	31-Jul	1.6330	2-Feb	1.6420	-158.0	1.6172	7.8	2.147	-2.1984	6.93	7.52	2.83	5.33	2.49	-1.65	-4.48
1999	29-Jan	1.6450	29-Jul	1.6180	-48.0	1.6402	8.0	2.173	-2.2102	1.01	-0.65	2.46	-2.86	-5.32	-3.85	-6.31
	30-Jul	1.6220	1-Feb	1.6110	22.0	1.6242	8.5	2.330	-2.3699	5.70	4.98	2.81	7.82	-0.20	-3.05	-5.88
											Ann Sharpe		1.45	0.67	-1.39	-3.68

Japanese Yen Put Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	99.45	31-Jul	88.26	-207	97.38	10.6	2.854	-2.93	0.00	12.68	2.60	9.75	7.15	9.75	7.15
	31-Jul	88.26	31-Jan	106.96	-226	86.00	13.4	3.911	-4.02	-10.58	-6.61	2.90	-10.64	-13.53	-1.91	-4.81
1996	31-Jan	106.96	31-Jul	106.46	-248	104.48	12.1	3.515	-3.61	24.80	27.24	2.60	23.63	21.04	-1.28	-3.88
	31-Jul	106.46	31-Jan	121.47	-273	103.73	10.2	2.918	-3.00	-0.58	1.74	2.90	-1.26	-4.16	-0.76	-3.65
1997	31-Jan	121.36	1-Aug	118.47	-308	118.28	11.3	3.17	-3.26	-11.42	-9.10	2.80	-12.36	-15.16	-0.66	-3.46
	31-Jul	118.47	2-Feb	126.6	-304	115.43	11.7	3.23	-3.32	10.92	12.62	2.86	9.30	6.44	-0.92	-3.78
1998	30-Jan	126.79	30-Jul	143.36	-318	123.61	13.5	3.77	-3.87	-18.21	-13.89	2.77	-17.76	-20.54	-1.66	-4.43
	31-Jul	144.75	2-Feb	112.26	-381	140.94	15.2	4.34	-4.46	-1.50	27.01	2.83	22.54	19.71	24.48	21.64
1999	29-Jan	116.24	29-Jul	115.35	-295	113.29	17.2	4.77	-4.89	-11.48	-9.01	2.46	-13.89	-16.35	-2.33	-4.79
	30-Jul	114.63	1-Feb	107.85	-480	109.83	12.9	3.65	-3.75	23.19	30.94	2.81	27.18	24.37	2.53	-0.28
											Ann Sharpe		0.30	0.07	0.46	0.00

Canadian Dollar Call Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	1.408	1-Aug	1.368	111	1.4191	6.4	1.75	1.80	0.00	-0.81	2.60	0.98	-1.61	0.98	-1.61
	31-Jul	1.368	1-Feb	1.376	77	1.3757	6.2	1.705	1.75	14.87	14.25	2.90	16.00	13.11	1.17	-1.72
1996	31-Jan	1.376	1-Aug	1.375	2	1.3762	5.5	1.505	1.54	7.66	7.67	2.60	9.21	6.62	1.53	-1.07
	31-Jul	1.375	3-Feb	1.347	-69	1.3681	4	1.1	1.13	-0.79	-0.30	2.90	0.84	-2.06	1.64	-1.26
1997	31-Jan	1.347	4-Aug	1.38	-153	1.3317	4.6	1.259	1.29	23.95	21.07	2.80	22.37	19.56	-1.10	-3.90
	31-Jul	1.378	2-Feb	1.458	-132	1.3648	4.4	1.207	1.24	12.57	6.83	2.86	8.08	5.22	-4.25	-7.10
1998	30-Jan	1.458	3-Aug	1.512	-35	1.4545	5.5	1.505	1.55	-2.58	-6.25	2.77	-4.70	-7.47	-2.02	-4.80
	31-Jul	1.512	3-Feb	1.515	-34	1.5086	5.3	1.466	1.51	3.45	3.31	2.83	4.82	1.99	1.31	-1.53
1999	29-Jan	1.511	2-Aug	1.505	-6	1.5104	7.8	2.151	2.20	-2.91	-2.89	2.46	-0.68	-3.14	2.24	-0.21
	30-Jul	1.505	2-Feb	1.445	-34	1.5016	6.7	1.858	1.91	5.22	5.69	2.81	7.60	4.78	2.15	-0.67
											Ann Sharpe		1.12	0.65	0.24	-1.55

German Deutschemark Call Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	1.523	4-Jul	1.3760	-102	1.5128	11.1	2.931	3.01	0.00	0.74	2.60	3.75	1.15	3.75	1.15
	31-Jul	1.385	2-Jan	1.4900	-92	1.3758	12.9	3.285	3.38	9.77	2.03	2.90	5.41	2.52	-3.67	-6.56
1996	31-Jan	1.487	2-Jul	1.4750	-141	1.4729	12.7	3.131	3.21	11.33	12.24	2.60	15.45	12.85	4.03	1.43
	31-Jul	1.469	2-Jan	1.6420	-181	1.4509	8.7	2.477	2.55	0.13	-10.42	2.90	-7.87	-10.77	-7.99	-10.89
1997	31-Jan	1.638	2-Jul	1.8680	-196	1.6184	9.2	2.684	2.76	22.71	7.60	2.80	10.36	7.56	-9.55	-12.36
	31-Jul	1.841	5-Jan	1.8190	-223	1.8187	10.9	2.831	2.91	46.25	48.02	2.86	50.93	48.07	4.12	1.26
1998	30-Jan	1.83	2-Jul	1.7840	-177	1.8123	10.9	2.958	3.04	0.03	1.03	2.77	4.07	1.29	4.03	1.26
	31-Jul	1.78	4-Jan	1.7240	-185	1.7615	9.0	2.332	2.40	32.28	34.41	2.83	36.80	33.97	3.47	0.64
											Ann Sharpe		1.08	0.88	-0.05	-0.71

British Pound Call Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	1.5820	31-Jul	1.5980	-40.0	1.5780	10.0	2.608	2.66673	0.00	-0.26	2.60	2.41	-0.19	2.41	-0.19
	31-Jul	1.5980	31-Jan	1.5150	-80.0	1.5900	9.8	2.518	2.57315	15.77	9.75	2.90	12.33	9.43	-2.62	-5.52
1996	31-Jan	1.5150	31-Jul	1.5560	-63.0	1.5087	10.0	2.451	2.50149	8.55	8.35	2.60	10.85	8.25	2.07	-0.53
	31-Jul	1.5560	30-Jan	1.6140	3.0	1.5563	6.8	1.747	1.77998	-1.49	-1.53	2.90	0.25	-2.65	1.80	-1.10
1997	31-Jan	1.5990	31-Jul	1.6390	-60.0	1.5930	10.1	2.635	2.6883	15.46	15.46	2.80	18.15	15.35	2.30	-0.50
	31-Jul	1.6390	2-Feb	1.6370	-120.0	1.6270	9.4	2.477	2.53226	14.77	14.02	2.86	16.55	13.69	1.80	-1.06
1998	30-Jan	1.6340	30-Jul	1.6400	-145.0	1.6195	10.0	2.635	2.69576	11.23	10.37	2.77	13.07	10.29	1.80	-0.98
	31-Jul	1.6330	2-Feb	1.6420	-158.0	1.6172	7.8	2.037	2.08573	6.93	5.99	2.83	8.08	5.24	1.10	-1.73
1999	29-Jan	1.6450	29-Jul	1.6180	-48.0	1.6402	8.0	2.037	2.07185	1.01	-0.65	2.46	1.42	-1.03	1.78	-0.67
	30-Jul	1.6220	1-Feb	1.6110	22.0	1.6242	8.5	2.257	2.29562	5.70	4.98	2.81	7.28	4.46	2.43	-0.38
											Ann Sharpe		2.04	1.43	1.41	-1.15

Japanese Yen Call Strategy Returns

	Price Date	Spot	Maturity	Mat. Spot	Fwd	Strike	Vols (o)	Premium	Op'n Ret	Eq Ret	Curr Ret	Rf	With Equity: Return	Excess Return	Without Equity Return	Excess Return
1995	31-Jan	99.45	31-Jul	88.26	-207	97.38	10.6	2.776	2.85	0.00	2.35	2.60	5.19	2.59	5.19	2.59
	31-Jul	88.26	31-Jan	106.96	-226	86.00	13.4	3.69	3.80	-10.58	-26.21	2.90	-22.41	-25.31	-13.69	-16.58
1996	31-Jan	106.96	31-Jul	106.46	-248	104.48	12.1	3.323	3.41	24.80	25.38	2.60	28.79	26.19	3.88	1.28
	31-Jul	106.46	31-Jan	121.47	-273	103.73	10.2	2.808	2.89	-0.58	-12.86	2.90	-9.97	-12.87	-9.47	-12.37
1997	31-Jan	121.36	1-Aug	118.47	-308	118.28	11.3	3.09	3.18	-11.42	-9.26	2.80	-6.08	-8.89	5.62	2.81
	31-Jul	118.47	2-Feb	126.6	-304	115.43	11.7	3.24	3.33	10.92	3.80	2.86	7.13	4.27	-3.09	-5.95
1998	30-Jan	126.79	30-Jul	143.36	-318	123.61	13.5	3.69	3.79	-18.21	-27.67	2.77	-23.87	-26.65	-7.77	-10.54
	31-Jul	144.75	2-Feb	112.26	-381	140.94	15.2	4.2	4.32	-1.50	1.46	2.83	5.78	2.94	7.71	4.88
1999	29-Jan	116.24	29-Jul	115.35	-295	113.29	17.2	4.7	4.82	-11.48	-10.79	2.46	-5.98	-8.44	5.59	3.13
	30-Jul	114.63	1-Feb	107.85	-480	109.83	12.9	3.51	3.61	23.19	29.10	2.81	32.71	29.90	8.06	5.25
											Ann Sharpe		0.08	-0.12	0.04	-0.45

Canadian Dollar Volatility Swap Strategy Returns

	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Volss(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	Rf	With Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Without Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1995	31-Jan	1.408	31-Jul	1.368	4.750	6.70	+6.55	2728	-5319.60	-4501.20	0.00	2.60	2.39	2.47	-0.21	-0.13	2.39	2.47	-0.21	-0.13
	31-Jul	1.368	31-Jan	1.376	5.670	6.50	+6.35	2728	-2264.24	-1445.84	14.87	2.90	13.98	14.06	11.08	11.17	-0.81	-0.73	-3.70	-3.62
1996	31-Jan	1.376	31-Jul	1.375	2.920	5.80	+5.65	2736	-7879.68	-7058.88	7.66	2.60	6.95	7.03	4.35	4.43	-0.72	-0.63	-3.31	-3.23
	31-Jul	1.375	31-Jan	1.347	3.250	4.30	+4.15	2748	-2885.40	-2061.00	-0.79	2.90	0.96	1.07	-1.92	-1.83	1.79	1.87	-1.11	-1.03
1997	31-Jan	1.347	1-Aug	1.38	4.090	4.90	+4.75	2736	-2216.16	-1395.36	23.95	2.80	20.76	20.84	17.96	18.04	-2.61	-2.53	-5.42	-5.34
	31-Jul	1.378	30-Jan	1.458	3.920	4.70	+4.55	2742	-2138.76	-1316.16	12.57	2.86	6.18	6.26	3.32	3.40	-5.70	-5.62	-8.56	-8.48
1998	30-Jan	1.458	31-Jul	1.512	4.290	6.00	+5.75	2740	-4685.40	-3315.40	-2.58	2.77	-6.53	-6.39	-9.30	-9.17	-4.04	-3.90	-6.81	-6.68
	31-Jul	1.512	2-Feb	1.515	7.900	5.80	+5.55	2764	5904.40	7186.40	3.45	2.83	3.83	3.96	0.99	1.13	0.38	0.52	-2.45	-2.31
1999	29-Jan	1.511	30-Jul	1.505	5.870	8.30	+8.05	2756	-6697.08	-5319.08	-2.91	2.46	-3.20	-3.06	-5.65	-5.52	-0.27	-0.13	-2.73	-2.59
	30-Jul	1.505	1-Feb	1.445	5.070	7.00	+6.85	2772	-5349.96	-4518.36	5.22	2.81	9.06	9.14	6.24	6.33	3.62	3.70	0.80	0.89
										Ann Sharpe		0.96	0.98	0.48	0.50	-0.29	-0.24	-1.62	-1.58

German Deutschemark Volatility Swap Strategy Returns :

	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Volss(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	Rf	With Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Without Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1995	30-Dec	1.523	4-Jul	1.376	14.090	11.10	10.95	2738	8186.82	8597.32	0.00	2.60	11.50	11.54	8.90	8.94	11.50	11.54	8.90	8.94
	30-Jun	1.385	2-Jan	1.49	10.080	12.90	12.45	2758	-7777.58	-4536.45	9.77	2.90	1.26	1.38	-1.64	-1.52	-7.82	-7.70	-10.72	-10.60
1996	29-Dec	1.487	2-Jul	1.475	6.380	12.70	12.50	2744	-17342.08	-16793.28	11.33	2.60	10.50	10.56	7.90	7.96	-0.92	-0.87	-3.52	-3.46
	28-Jun	1.469	2-Jan	1.642	7.550	8.70	+8.55	2752	-3164.80	-2752.00	0.13	2.90	-10.74	-10.69	-13.64	-13.59	-10.85	-10.81	-13.75	-13.71
1997	31-Dec	1.638	2-Jul	1.868	9.190	9.20	+8.90	2738	-27.38	794.02	22.71	2.80	7.60	7.68	4.80	4.88	-12.32	-12.23	-15.12	-15.04
	30-Jun	1.841	5-Jan	1.819	10.110	10.90	10.75	2768	-2186.72	-1771.52	46.25	2.86	47.80	47.84	44.94	44.98	0.99	1.03	-1.87	-1.83
1998	31-Dec	1.83	2-Jul	1.784	8.270	10.90	10.75	2738	-7200.94	-6790.24	0.03	2.77	1.89	1.93	-0.88	-0.84	1.86	1.90	-0.92	-0.87
	30-Jun	1.78	4-Jan	1.724	9.380	9.00	+8.90	2774	1054.12	1331.52	32.28	2.83	36.69	36.71	33.85	33.88	3.35	3.38	0.52	0.55
										Ann Sharpe		0.97	0.98	0.77	0.77	-0.31	-0.30	-0.79	-0.78

British Pound Volatility Swap Strategy Returns

	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Volss(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	Rf	With Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Without Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1995	31-Jan	1.582	31-Jul	1.598	10.230	10.00	+9.80	2749	632.27	1731.87	0.00	2.60	1.07	1.18	-1.52	-1.41	1.07	1.18	-1.52	-1.41
	31-Jul	1.598	31-Jan	1.515	6.380	9.80	+9.50	2606	-8912.52	-7348.92	15.77	2.90	8.86	9.02	5.97	6.12	-6.09	-5.93	-8.98	-8.82
1996	31-Jan	1.515	31-Jul	1.556	5.550	10.00	+9.50	2679	-11921.55	-8242.55	8.55	2.60	10.29	10.56	7.69	7.96	1.51	1.78	-1.08	-0.82
	31-Jul	1.556	31-Jan	1.614	7.740	6.80	+6.60	2786	2618.84	5733.24	-1.49	2.90	2.44	2.55	-0.46	-0.35	3.99	4.10	1.09	1.20
1997	31-Jan	1.599	1-Aug	1.639	7.430	10.10	+9.90	2816	-7518.72	-6392.32	15.46	2.80	17.60	17.71	14.79	14.91	1.75	1.86	-1.05	-0.94
	31-Jul	1.639	30-Jan	1.637	8.630	9.40	+9.20	2848	-2192.98	-1053.78	14.77	2.86	14.41	14.53	11.55	11.67	-0.34	-0.23	-3.20	-3.09
1998	30-Jan	1.634	31-Jul	1.64	6.190	10.00	+9.85	2821	-10748.01	-9901.71	11.23	2.77	10.56	10.65	7.79	7.87	-0.71	-0.62	-3.48	-3.40
	31-Jul	1.633	2-Feb	1.642	7.750	7.80	+7.60	2860	-143.00	1001.00	6.93	2.83	7.51	7.62	4.67	4.79	0.54	0.65	-2.30	-2.18
1999	29-Jan	1.645	30-Jul	1.618	6.430	8.00	+7.75	2783	-4369.31	-2977.81	1.01	2.46	-1.08	-0.94	-3.54	-3.40	-2.08	-1.94	-4.54	-4.40
	30-Jul	1.622	1-Feb	1.611	7.240	8.50	+8.35	2806	-3535.56	-2693.76	5.70	2.81	4.63	4.71	1.81	1.90	-1.03	-0.95	-3.84	-3.76
										Ann Sharpe		1.82	1.85	1.17	1.20	-0.07	0.00	-1.51	-1.44

Japanese Yen Volatility Swap Strategy Returns

	Start	Spot	Exp date	Exp Spot	RHV	Vols(O)	Volss(m)	vega	Pvol(O)	Pvol(m)	Eq Ret	Rf	With Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)	Without Equity: Ret(o)	Ret(m)	Excess Ret (o)	Excess Ret (m)
1995	31-Jan	99.45	31-Jul	88.26	14.030	10.90	10.75	2744	8588.72	9411.92	0.00	2.60	13.54	13.62	10.94	11.02	13.54	13.62	10.94	11.02
	31-Jul	88.26	31-Jan	106.96	13.360	14.20	13.60	2728	-2291.52	-109.12	-10.58	2.90	-26.44	-26.22	-29.33	-29.12	-17.71	-17.49	-20.61	-20.39
1996	31-Jan	106.96	31-Jul	106.46	8.260	12.80	12.45	2744	-12457.76	-10535.96	24.80	2.60	24.14	24.33	21.54	21.73	-0.78	-0.58	-3.38	-3.18
	31-Jul	106.46	31-Jan	121.47	7.200	10.60	10.40	2744	-8329.60	-8232.00	-0.58	2.90	-13.79	-13.69	-16.69	-16.58	-13.29	-13.18	-16.19	-16.08
1997	31-Jan	121.36	1-Aug	118.47	11.980	11.60	11.45	2722	1034.36	1850.96	-11.42	2.80	-9.15	-9.07	-11.96	-11.88	2.54	2.62	-0.26	-0.18
	31-Jul	118.47	2-Feb	126.6	12.360	12.00	11.85	2766	895.76	1825.56	10.92	2.86	3.90	3.98	1.04	1.12	-6.32	-6.24	-9.18	-9.10
1998	30-Jan	126.79	30-Jul	143.36	14.780	13.80	13.55	2730	2675.40	3494.40	-18.21	2.77	-27.40	-27.32	-30.17	-30.09	-11.29	-11.21	-14.06	-13.98
	31-Jul	144.75	2-Feb	112.26	20.570	16.20	15.70	2780	12148.80	14928.80	-1.50	2.83	28.22	28.50	25.39	25.67	30.16	30.43	27.32	27.60
1999	29-Jan	116.24	29-Jul	115.35	12.160	17.70	17.45	2728	-15113.12	-13749.12	-11.48	2.46	-12.30	-12.17	-14.76	-14.63	-0.74	-0.60	-3.20	-3.06
	30-Jul	114.63	1-Feb	107.85	12.760	13.40	13.15	2720	-1740.80	-380.80	23.19	2.81	30.76	30.90	27.95	28.09	6.11	6.25	3.30	3.44
										Ann Sharpe		0.07	0.08	-0.10	-0.09	0.02	0.04	-0.25	-0.24

Currency Returns from Unhedged Currency Positions (for a US investor) with Equity Returns

		CAD		DEM		GBP		JPY	
		Usd amnt	*Return*	*Usd amnt*	*Return*	*Usd amnt*	*Return*	*Usd amnt*	*Return*
1995	31-Jan	$29,239.77	2.92	$106,831.40	10.68	$10,113.78	1.01	$126,784.50	12.68
	31-Jul	$142,063.76	14.21	$20,341.59	2.03	$97,545.28	9.75	-$262,096.42	-26.21
1996	31-Jan	$77,354.18	7.74	$122,364.97	12.24	$114,843.31	11.48	$253,812.11	25.38
	31-Jul	$12,716.68	1.27	-$104,196.71	-10.42	$21,795.82	2.18	-$128,619.05	-12.86
1997	31-Jan	$209,839.70	20.98	$76,047.91	7.60	$183,506.66	18.35	-$92,576.56	-9.26
	31-Jul	$63,952.66	6.40	$480,196.00	48.02	$146,337.90	14.63	$37,958.30	3.80
1998	30-Jan	-$60,597.88	-6.06	$26,119.83	2.61	$116,361.38	11.64	-$276,661.84	-27.67
	31-Jul	$32,462.37	3.25	$365,811.08	36.58	$75,234.89	7.52	$270,070.51	27.01
1999	29-Jan	-$25,253.26	-2.53	na	na	-$6,471.35	-0.65	-$107,934.07	-10.79
	30-Jul	$95,918.90	9.59	na	na	$49,802.71	4.98	$309,360.65	30.94

APPENDIX 5

CURRENCY TREND ANALYSIS

We have already discussed the existence of foreign currency risk inherent in a foreign equity investment for a US investor. Earlier in Section 4.4 we discussed how the currency risk management strategies might react in different exchange rate environments. Indeed the performance of each strategy depends greatly on the underlying currency return distributions. Therefore this study analyzes such distributions, so as to enable us to determine if there have been any trends in the Canadian dollar, German deutschemark, British pound and Japanese yen.

I examine two time periods: February 1971, to April 2000, as well as the sub-period October 1994, to March 2000. The latter period is analyzed because that is the time period over which we compare our currency risk management strategies. The former time period gives us a broader perspective for each currency studied.

(i) *Annual Returns*

Table 18 shows the yearly returns to the four currencies from 1971 to 1999. It gives us a general overview of the return to a US investor for an investment in one of these foreign currencies. A negative annual return means that for a US investor, had they bought the foreign currency and then sold it after a year, they would receive less US

dollars for every unit of foreign currency sold than they had paid initially, (i.e. the foreign

currency had depreciated against the US dollar).

Table 18: Annual Returns to Currencies, 1971 - 1999.

	Canadian Dollar	German Deutschemark	British Pound	Japanese Yen
1971	-0.56	-11.08	5.27	-13.56
1972	-1.00	-0.25	-10.46	-2.95
1973	-0.49	-16.63	-2.55	-7.54
1974	0.32	-14.17	2.60	0.75
1975	1.70	10.70	-17.74	2.36
1976	0.82	-9.68	-19.31	-3.61
1977	6.82	-14.75	10.54	-20.19
1978	6.65	-16.04	4.60	-24.34
1979	-2.74	-8.52	10.32	15.86
1980	3.01	11.64	5.12	-17.84
1981	-0.67	4.74	-23.52	5.96
1982	2.68	2.59	-16.13	2.73
1983	0.63	9.54	-4.73	-3.52
1984	5.48	10.73	-21.00	6.73
1985	5.10	-29.26	21.76	-27.24
1986	-3.06	-24.15	4.76	-21.48
1987	-2.98	-16.69	19.72	-26.72
1988	-6.98	5.36	2.31	-2.16
1989	-2.20	-11.19	-8.65	9.25
1990	-2.18	-12.76	13.06	-6.48
1991	-0.61	2.73	-5.15	-5.24
1992	7.49	0.85	-18.34	-0.55
1993	4.38	7.35	-0.58	-11.52
1994	5.15	-11.94	3.69	-8.95
1995	-3.11	-6.01	-1.93	3.83
1996	-0.27	3.44	11.69	7.48
1997	5.77	8.96	2.60	7.11
1998	5.51	-9.14	1.69	-11.84
1999	-4.45	11.45	-1.65	-13.48
Mean*	1.04 (1.43)	-4.21 (-0.54)	-1.10 (2.68)	-5.76 (-2.64)
Standard Dev'n*	3.86 (4.6)	11.64 (9.84)	11.97 (4.96)	11.51 (9.81)
Max*	7.49 (5.77)	11.64 (11.45)	21.76 (11.69)	15.86 (7.48)
Min*	-6.98 (-4.45)	-29.26 (-11.94)	-23.52 (-1.93)	-27.24 (-13.48)

* The values in brackets represent the statistical measures for the 1994 to 1999 time period.

For a US investor, an investment in these currencies returned a negative annual rate of return quite often. On average, over the broader period of 1971 to 1999, only the Canadian dollar had a positive return. Over the shorter 1994 to 1999 period, the British pound also offered a positive return. It is obvious from the above results that positive returns are dependent on the investment period. Further analysis allows us to determine if there were any discernible trends in these currencies over the periods studied.

(ii) Distributional Characteristics

The following tables examine the distributional characteristics of monthly foreign exchange returns for each currency to determine if any of them approximate the normal return distribution.

Table 19: Distributional characteristics of monthly foreign exchange returns from February 1971 to April 2000.

	Canadian Dollar	German Deutschemark	British Pound	Japanese Yen
Observations	352	352	352	352
Mean (%)	11.71	-9.61	-7.96	-28.19
Standard Deviation	1.270	3.27	3.04	3.36
(Annualized)	4.39	11.33	10.54	11.65
Skewness	0.6804	0.1633	0.0045	-0.4407
Kurtosis	2.54	0.96	2.10	1.61
t-stat for Mean	1.73	-0.55	-0.49	-1.57
Jacque-Bera statistic	33.77	31.47	13.26	31.85

For a normal distribution, the Kurtosis value should be close to 3. When the tails are thicker (thinner) then the value will be greater (less than) 3. A symmetrical distribution has a skewness value of 0. When this value is positive it implies an upper

tail which is thicker than the lower tail. A negative value implies that the lower tail is thicker. The Jacque-Bera statistic is a more formal test of normality. It follows a Chi-square distribution with two degrees of freedom. If the Jacque-Bera statistic is greater than the critical value, the assumption of normality is rejected.

From the above table we can see that the means are all non-zero but the returns are statistically insignificant.[114] The Canadian dollar and German deutschemark both showed positive skewness, which implies that the upper tail of the distribution is thicker than the lower tail. This indicates that large increases are more probable than large declines. The Japanese yen however, showed negative skewness, implying that large declines are more probable than large increases. The British pound's skewness value was very close to zero. Only the Canadian dollar had a Kurtosis value close to 3. Further analysis using the Jacque-Bera statistic shows that all the currencies had values that were substantially higher than the critical value of 5.99 (at 5% level of significance). Hence none of the above currency return distributions approximate the normal, over the February 1971, to April 2000 time period.

---

[114] None of the t-statistics for the mean are greater than the 99% critical level of 2.326.

Table 20: Distributional characteristics of monthly foreign exchange returns from October 1994 to March 2000.

	Canadian Dollar	German Deutschemark	British Pound	Japanese Yen
Observations	69	69	69	69
Mean (%)	12.42	47.55	3.66	19.50
Standard Deviation	1.368	2.598	2.029	4.014
(Annualized)	4.74	9.00	7.03	13.90
Skewness	-0.0975	0.0037	-0.3856	-1.0260
Kurtosis	0.33	-0.25	0.51	2.84
t-stat for Mean	0.75	1.52	0.15	0.40
Jacque-Bera statistic	20.49	9.35	8.84	12.58

From the above table we can see that the means are all non-zero, and the returns are statistically insignificant. All of the return distributions show negative skewness except for the German deutschemark. For the Kurtosis measure, only the Japanese Yen had a value close to 3. Once again all return distributions had Jacque-Bera statistics above the critical value of 5.99, therefore rejecting the assumption that any of them approximate the normal.

(iii) Autocorrelation Coefficients

The distributional characteristics of returns to currencies allow us to determine the existence of trends. Since none of the above return distributions approximated the normal distribution, autocorrelation coefficients were calculated. This was done since the "analysis of autocorrelations in currency returns data can be used to confirm or negate the existence of such trends."[115]

---

[115] Ramaswami (93) p.98

The autocorrelation coefficients appear in tables 21 and 22. During the February 1971, to April 2000 period, the Canadian dollar showed significant 1, 2 and 3 month lagged negative autocorrelations, or reversals. The German deutschemark and the Japanese yen both showed 6 month lagged reversals. The Canadian dollar and the British pound showed a significant positive correlation on a monthly basis lagged 11 periods. The British pound also had reversals for lag 14. Only the Canadian dollar had any Q-statistic greater than the critical level. This was true for lags 1 through 8, and for lags 1 through 16. This means that we can be 95% confident that not all the autocorrelation coefficients are zero.

During the October 1994, to March 2000 period, only the German deutschemark and the British pound had any significant autocorrelation coefficients. They had significant negative autocorrelations on a monthly basis lagged 2 and 1 periods respectively. None of the currency return distributions had Q-statistics greater than the 10% critical level.

Table 21: Autocorrelation Coefficients, Monthly Currency Returns from February 1971, to April 2000.

Lags	Canadian Dollar	German Deutschemark	British Pound	Japanese Yen
1	-0.1862630*	-0.0130142	0.0002051	-0.0059466
2	-0.3516010*	-0.0067656	-0.0001475	-0.0068982
3	0.0191550	0.0159770	-0.0262956	0.0346646
4	0.0593620	-0.0197957	0.0027845	0.0307533
5	-0.0083930	0.0201700	0.0370272	-0.0202903
6	-0.0898417	-0.1242943*	-0.0943079	-0.1131584*
7	-0.0218519	0.0602603	-0.0104884	-0.0001791
8	0.0839869	0.0282444	0.0307427	0.0746070
9	-0.0126209	0.0239146	0.0284956	0.0350015
10	0.0282144	0.0232676	-0.0419728	-0.0390989
11	0.1361682*	0.0558725	0.116104*	0.0970320
12	-0.0845184	-0.0053798	-0.0108968	0.0822100
13	-0.1509844*	0.0604192	0.0403716	-0.0589549
14	0.0380633	-0.0199878	-0.1475812*	-0.0270313
15	0.0272437	-0.0637404	-0.0765498	0.0290936
16	0.0693157	0.0491429	0.0554057	-0.0367887
Q-stat: Lags 1 through 8	62.85**	7.56	4.29	7.51
10% critical level: 13.36				
Q-stat Lags 1 through 16	83.39**	12.95	21.99	17.09
10% critical level: 23.54				

* significant at the 95% level.[116]
** Q-stat > critical 10% level.[117]

---

[116] To test whether a particular autocorrelation coefficient is equal to zero, I followed the process outlined in Pindyck and Rubinfeld (97) p. 496. For the first period covered (349 observations) we attach a standard error of $1 / \sqrt{T}$ (where T is the number of observations in the series), therefore 0.0535, to each autocorrelation coefficient. If the coefficient is greater than 0.1071 (2 times 0.0535) then we can be 95% sure that the true autocorrelation coefficient is not zero.

[117] To test if all the autocorrelation coefficients are zero, I used the Q statistic again outlined in Pindyck and Rubinfeld (97) p. 496. If the calculated value of Q is greater than the 10% critical level, then we can be 95% sure that the true autocorrelation coefficients are not all zero.

Table 22: Autocorrelation Coefficients, Monthly Currency Returns from October 1994, to March 2000.

Lags	Canadian Dollar	German Deutschemark	British Pound	Japanese Yen
1	0.1668322	-0.0696153	-.3889120*	0.0216847
2	-0.0184535	-0.2802778*	-0.1027717	0.0255653
3	-0.0354673	-0.2228171	-0.1086143	-0.0190293
4	-0.0777635	0.0545696	0.1204001	-0.0084874
5	-0.1736196	0.1118146	-0.0584332	-0.2115073
6	-0.0898647	-0.0656574	0.1871707	-0.1146116
7	0.1263839	-0.0960028	-0.1660417	-0.0186648
8	-0.0370267	0.038377	0.0949516	0.1804675
9	0.0215638	-0.0048083	-0.1255032	0.0531686
10	-0.0362953	0.0573327	0.0308004	0.0433206
11	0.0883820	-0.0533943	-0.0289370	0.0729157
12	-0.0386402	0.1284567	0.1669447	0.0235855
13	0.0177790	-0.0585803	-0.0997305	-0.0132977
14	0.016970	-0.0045972	0.0076887	0.0231041
15	-0.1182254	-0.0263659	-0.0784229	0.0184299
16	0.0094527	-0.0053552	0.0766954	-0.0989960
Q-stat: Lags 1 through 8	6.62	11.65	18.74	6.93
10% critical level: 13.36				
Q-stat Lags 1 through 16	8.81	13.88	24.36	8.75
10% critical level: 23.54				

* significant at the 95% level[118]

** Q-stat > critical 10% level

(iv) *Variance Ratio Tests*

To estimate the horizon over which significant trends/reversals occur, Variance Ratio tests are performed.[119] They test whether the series is a random walk over the

---

[118] Since this series contained only 66 observations for each currency return distribution, I used a standard error of 0.1231. Hence if any of the coefficients are greater than 0.2462, then we can be 95% sure that the true autocorrelation coefficient is not zero.

[119] The variance Ratio, Ramaswami (93), is:

period studied. For example, the variance of a six month buy-and-hold strategy was computed for each return series. This variance was then divided by the variance of the monthly returns. If the ratio was equivalent to 1, then the series is a random walk. If the ratio was greater than 1, then this is indicative of trends. A ratio of less than 1, indicates reversals. The results are shown below for different investment horizons.

Table 23: Variance Ratios for Monthly Currency Returns, February 1971, to April 2000.

Holding Period	Canadian Dollar	German Deutschemark	British Pound	Japanese Yen
3 months	0.6834	0.6945	0.6112	0.7235
6 months	0.7695	1.0069	1.0794	1.1022
12 months	0.8122	0.8961	1.2783	0.7813
18 months	1.0106	1.1562	0.6997	0.5209
24 months	1.4197	1.1892	1.8175	0.8320

Table 24: Variance Ratios for Monthly Currency Returns, October 1994, to March 2000.

Holding Period	Canadian Dollar	German Deutschemark	British Pound	Japanese Yen
3 months	0.5283	0.6555	0.5011	0.6768
6 months	0.6783	1.1304	0.2633	0.7967
12 months*	1.0836	1.0295	0.0590	0.3275
18 months*	0.4050	0.5456	0.7097	0.2105

*For the 12 and 18 month holding periods the monthly variances were calculated from October 1994 to September 1999 and March 1999 respectively.

$$VR(K) = \frac{Var(R_t^K)/K}{Var(R_t)}$$

where $R_t^K = \sum_{i=0}^{k-1} R_{t-i}$ and R_t = return in month t

For the February 1971 to April 2000 time period, none of the series had every variance ratio greater (less) than 1, which would have suggested trends (reversals) in monthly returns for that currency. The Canadian dollar returns had reversals up to the 12 month horizon and then switched to trends. The European currencies and the Japanese yen tended to have either trends or reversals depending on the investment horizon. For the shorter period over which we applied our currency risk management strategies, the Canadian dollar showed reversals up to the 12 month horizon. The German deutschemark showed mixed results, while the British pound and the Japanese yen both demonstrated variance ratios of less than 1. This indicates monthly reversals over this time period.

(v) *Summary*

Summarizing the above results for the October 1994, to March 2000 time period, I found that for the Canadian dollar, on average, it returned positive annual results. The monthly currency return distribution did not approximate the normal, and there were no significant trends or reversals. The German deutschemark had on average, negative annual returns. The monthly currency return distribution did not approximate the normal. It did have significant negative autocorrelation on a monthly basis lagged two periods. Variance ratio tests however showed mixed results over the holding period studied. The British pound had on average, negative annual returns. The monthly currency return

distribution did not approximate the normal. It did have significant negative autocorrelation on a monthly basis lagged one period. Variance ratio tests showed all variance ratios less than 1 over the holding periods studied which indicates monthly reversals. The Japanese yen had on average, negative annual returns. The monthly currency return distribution did not approximate the normal. It had no significant autocorrelations. Variance ratio tests were also all less than 1 over the holding periods studied. Examining the broader period of February 1971, to April 2000 concludes relatively similar results.

In general then we cannot conclude any significant or discernible monthly trends in these currencies over the October 1994, to March 2000 time period. The existence of trends aids one in the forecasting of future exchange rates. If one could forecast such rates with precision then they would be able to determine which of the currency risk management strategies to use.

BIBLIOGRAPHY

Adler, M. and Prasad, B., (1992) "On Universal Currency Hedges", *Journal of Financial and Quantitative Analysis,* Vol. 27, no. 1, March, p. 19-38.

Armstrong, M., "A Few Home Truths About Volatility", *Forex and Global Markets,* Princeton Economic Institute, NJ, USA.

Bates, D., (1996) "Dollar Jump Fears, 1984-1992: Distributional Abnormalities Implicit in Currency Future Options," *Journal of International Money and Finance,* Vol. 15, #1, p. 65-93.

Baxter, M., and Jermann, U., (1995) "The International Diversification Puzzle Is Worse Than You Think", *National Bureau of Economics,* Working Paper #5019.

Bekaert, G. and Hodrick, R., (1992) "Characterizing predictable components in Excess Returns on Equity and Foreign Exchange Markets", *Journal of Finance,* Vol. 47 #2, p. 445-479.

Bekaert, G., and Urias, M., (1995) "Diversification, Integration and Emerging Market Closed-end Funds", *National Bureau of Economics,* Working Paper #4990.

Bessembidder, H., and Kaufman, H., (1997) "A Comparison of Trade Execution costs for NYSE and NASDAQ-listed Stocks", *Journal of Financial and Quantitative Analysis,* Vol. 32 #3, Sept., p. 287-310.

Black, F., (1989) "Universal Hedging: Optimizing Currency Risk and Reward in International Equity Portfolios", *Financial Analysts Journal,* July-August, p. 16-22.

Bohn H., and Tesar L., (1996) "U.S. Equity Investment in Foreign Markets: Portfolio Rebalancing or Return Chasing?" *American Economic Review,* Vol. 86, p. 77-81.

Brennan, M., and Cao, H., (1997) "International Portfolio Investment Flows", *Journal of Finance,* Vol. LII, #5, p. 1851-1880.

Carr, P., and Madan, D., (1997) "Towards a Theory of Volatility Trading", Robert H. Smith School of Business, University of Maryland, MD, USA, http://www.rhsmith.umd.edu/default.asp.

Chen C., (1999) "Currency Hedging, Currency Overlay Strategy and the Performance of Closed-End Country and International Equity Funds", *Journal of Alternative Investments,* Vol. 2, #2 (Fall), p. 42-55, resume found In: *CFA Digest, Spring 2000,* Charlottesville, Va.: Association for Investment Management and Research, p. 90.

Choey, M., and Weigend, A., (1997) "Nonlinear Trading Models Through Sharpe Ratio Maximization", *International Journal of Neural Systems(Special Issue on Data Mining in Finance,* Vol. 8, #4, p. 417-431.

Chris, N., and Morokoff, W., (1999) "Market Risk of Variance Swaps", *Risk,* October.

Clarke, R., and Kritzman, M. (1995) *Currency Management: Concepts and Practices.* Charlottesville, Va.: Association for Investment Management and Research, p. 113-120.

Clewlow, L., (1995) "Black-Scholes Family", In: *Learning Curves: The Guide to Understanding Derivatives,* Institutional Investor, Inc., New York, NY., p. 93-95.

Constantinides, G., (1997) "Transaction Costs and the Pricing of Assets", *Multinational Finance Journal,* Vol. 1, #2, p. 93-99.

Davidson, C., (1995) "Developments in the FX Markets" Olsen and Associates Research Group, http://www.olsen.ch/library/prof/dev_fx.htm.

Dehnad, K., (1992) "Volatility", In: *Derivatives Week,* Institutional Investor, UK, October 9, p. 9.

Demeterfi, K., Derman, E., Kamal M., and Zou, J., (1999) "A Guide to Volatility and Variance Swaps", *Journal of Derivatives,* Vol. 6, #4, p. 9-32.

Demeterfi, K., Derman, E., Kamal M., and Zou, J., (1999) "More Than You Ever Wanted to Know About Volatility Swaps", *Goldman Sachs Quantitative Research Notes,* March.

Demeterfi, K., Derman, E., Kamal M., and Zou, J., (1999) "A Guide to Volatility and Variance Swaps", *Risk,* June, p. 54-59.

Derman, E., Kamal M., and Kani, I., (1996) "Trading and Hedging Local Volatility", *Goldman Sachs Quantitative Analysis Research Notes,* August.

Derman, E., and Kani, I., (1994) "The Volatility Smile and It's Implied Tree", *Goldman Sachs Quantitative Analysis Research Notes,* January.

Derman, E., and Kani, I., (1994) "Riding On A Smile", *Risk,* February, Vol. 7, #2, p. 32-39.

DeSantis, G., and Gerard, B., (1998) "How Big is the Premium for currency Risk?" *Journal of Financial Economics,* Vol. 49, #3, p. 375-412.

Dumas, R., Fleming, J., and Whaley, R., (1998) "Implied Volatility Functions", *Journal of Finance,* December, Vol. 53, #6.

Dumas, B., and Solnik, B., (1995) "The World Price Foreign Exchange Risk". *Journal of Finance,* Vol. 50, #2, p. 445-479.

Dupire, B., (1994) "Pricing With A Smile", *Risk,* January, Vol. 7, #1, p. 18-20.

Errunza, V., Hogan, K., and Hung., M., (1999) "Can the Gains From International Diversification be Achieved Without Trading Abroad?", *Journal of Finance,* Vol. 54, #6, December, p. 2075-2107.

Eun C., and Resnick B., (1988) "Exchange Rate Uncertainty, Forward Contracts and International Portfolio Selection", *Journal of Finance,* Vol. 43, p. 197-215.

Eun C., and Resnick B., (1997) "International Equity Investing With Selective Hedging Strategies", *Journal of International Financial Markets, Institutions and Money,* Vol. 7, p. 21-42.

French K., and Poterba, J., (1991) " Investor Diversification and International Equity Markets", *American Economic Review,* Vol. 81, May, p. 222-226.

Froot, K., O'Connell, P., and Seasholes, M., (1998) "The Portfolio Flows of International Investors", *National Bureau of Economics,* Working Paper #6687, August.

Glen, J., and Jorion P., (1993) "Currency Hedging for International Portfolios", *Journal of Finance,* December, Vol. XLVIII, p. 1865-1885.

Guo, D., (1998) "The Risk Premium of Volatility Implicit In Currency Options", *Journal of Business and Economic Statistics*, Vol. 16, #4, p. 498-507.

Hill J., (1997) "Derivatives in Equity Portfolios", In: *Derivatives In Portfolio Management*. Charlottesville, Va.: Association for Investment Management and Research, p. 4-27.

Hore, J., (1999) "Derivatives Update: News From Recent Conferences", *Canadian Treasurer*, Vol. 15, #1, p. 20-22.

Hsieh, D., (1993) "Assessing the Market and Credit Risks of Long-Term Interest Rate and Foreign Currency Products", *Financial Analysts Journal*, July-August, p. 75-79.

Hull, J., and White, A., (1987) "The Pricing of Options on Assets with Stochastic Volatilities", *Journal of Finance*, Vol. XLII, #2, p. 281-300.

Jorion P., (1985) "International Portfolio Analysis," *Journal of Business*, Vol. 58, p. 259-278.

Jorion P., (1986) "Bayes-Stein Estimation for Portfolio Analysis," *Journal of Financial and Quantitative Analysis*, Vol. 21, p. 279-292.

Lavelle, G., (1992) "Volatility", In: *Derivatives Week*, Institutional Investor, UK, October 9, p. 9.

Layard-Liesching, R., (1997) "The Role of Currency Overlay Managers", *Managing Currency Risk*. Charlottesville, Va.: Association for Investment Management and Research, p. 50-59.

Lee, A., (1989) "Hedging Decisions Within the Overall Asset Allocation Strategy", In: *Managing Currency Risk*. Charlottesville, Va.: Association for Investment Management and Research, p. 13-20.

Levich, R., (1998) *International Financial Markets*, Irwin McGraw-Hill, New York, NY.

Levich, R., and Thomas, L., (1993) "The Merits of Active Currency Risk Management: Evidence From International Bond Portfolios", *Financial Analysts Journal*, September-October, p. 63-70.

Lundin, M., (1997) "To Hedge or Not to Hedge", In: *Managing Currency Risk.* Charlottesville, Va.: Association for Investment Management and Research, p. 17-26.

Melino, A., and Turnbull, S., (1995) "Misspecification and the Pricing and Hedging of Long-term Foreign Currency Options", *Journal of International Money and Finance,* Vol. 14, #3, p. 373-393.

Miyamoto, A., (1999) "Why Hedge?" *Canadian Treasurer,* Vol. 15, #1, p. 9-12.

Muller, U., (1995) "Hedging Currency Risks - Dynamic Hedging Strategies Based on O&A Trading Models", O&A Research Group (http://www.olsen.ch/library/prof/dev_fx.htm).

Neuberger, A., (1994) "The Log Contract", *Journal of Portfolio Management,* Winter, p. 74-80.

Neuberger, A., and Britten-Jones, M., (2000) "Option Prices, Implied Price Processes and Stock Volatility" *Journal of Finance,* April 2000.

O'Keefe, P., (1993) "Term Structure of Volatility", In: *Derivatives week,* Institutional Investor, UK, February 15, p. 9.

Perold, A., and Schulman, L., (1988) "The Free Lunch in Currency Hedging: Implications for Investment Policy and Performance Standards", *Financial Analysts Journal,* May-June, p. 45-50.

Pilipovic, D., (1995) "Trading Volatilities" In: *Learning Curves: The Guide to Understanding Derivatives,* Institutional Investor, Inc., New York, NY., p. 144-147.

Pindyck, R., and Rubinfeld, D., (1998) *Econometric Models and Economic Forecasts,* fourth edition, Irwin McGraw-Hill, USA.

Quan D., and Titman, S., (1999) "Do Real Estate Prices and Stock Prices Move Together? An International Analysis", *Real Estate Economics,* Vol. 27, #2, p. 183-207.

Ramaswami, M., (1997) "Using Derivatives to Manage Currency Risk", In: *Derivatives In Portfolio Management.* Charlottesville, Va.: Association for Investment Management and Research, p. 98-104.

Rhodes, J., (1989) "To Hedge or Not To Hedge?", In: *Managing Currency Risk*. Charlottesville, Va.: Association for Investment Management and Research, p. 4-9.

Rowland, P., and Tesar, L., (1998) "Multinationals and the gains From International Diversification", *National Bureau of Economics*, Working Paper # 6733, September.

Sharpe, F., (1994) "The Sharpe Ratio", *Journal of Portfolio Management*. Fall, 1994.

Shimko, D., (1997) "Applying Value-at-Risk Measures to Derivatives", In: *Derivatives in Portfolio Management*, Charlottesville, Va.: Association for Investment Management and Research, p. 66-72.

Solnik, B., (1997) " Integrating Global Asset Allocation and Currency Management", In: *Managing Currency Risk* Charlottesville, Va.: Association for Investment Management and Research, p. 60-69.

Tesar, L., and Werner, I., (1994) "International Equity Transactions and U.S. Portfolio Choice", In: *The Internationalization of Equity Markets*, University of Chicago Press, p. 185-220.

Zerolis , J., (1997) "Picturing Volatility and Correlation", In: *Derivatives In Portfolio Management*. Charlottesville, Va.: Association for Investment Management and Research, p. 49-64.

Zhang, P., (1995) "A Few Moments on Option Prices" In: *Learning Curves: The Guide to Understanding Derivatives*, Institutional Investor, Inc., New York, NY., p. 111-113.

Zhu, Y., and Avellaneda, M., (1998) "A Risk-Neutral Stochastic Volatility Model", *International Journal of Theoretical and Applied Finance*, Vol. 1, #2, p. 289-310.