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# Derivative Products & Currency Technical Trading Rules

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## APPENDIX

## PROPOSAL

### 1. MOTIVATION

One of the most critical issues in financial markets is efficiency. A capital market is said to be efficient when prices “fully reflect” all available information. When a market is efficient, investors cannot earn any unusual profit by exploiting available information. Consequently, the profitability of technical trading rules rests upon the presence of efficiency in these markets. This, of course, applies to foreign exchange market as well.

Market efficiency is a major theme that has motivated numerous empirical studies of international financial markets. Tests of asset market efficiency, focusing on domestic equity and bond markets, began in the 1950s and gained increasing popularity and significance during 1960s. With the establishment of floating exchange rates in the early 1970s (presumably dominated by free-market behavior), it was natural to begin the investigation of foreign exchange market efficiency.

Many studies have stated this issue, but none of them led to definite results. This reflects, among other difficulties, that they test a joint hypothesis: that market equilibrium prices or expected returns are some function of the information set ( $\Phi_t$ ), and that economic agents can set actual prices or returns to conform to their expected values. Mathematically speaking, these two hypothesis imply that the excess market return on asset  $j$  is given by:

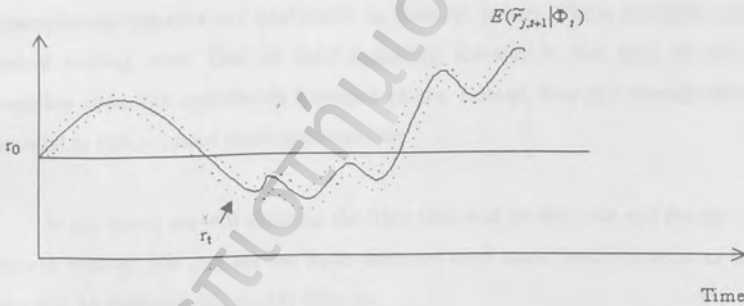
$$Z_{j,t+1} = r_{j,t+1} - E(\tilde{r}_{j,t+1} | \Phi_t)$$

where  $r_{j,t+1}$  is the actual one period percentage return and  $\Phi_t$  represents the information set that is assumed to be fully reflected in the price at time  $t$ . The market is efficient when expected excess market return  $E(Z_{j,t+1})$  equals zero and when  $Z_{j,t}$  is uncorrelated with  $Z_{j,t+k}$  for any value of  $k$ . These two properties together imply that the sequence  $\{Z_t\}$  is a fair game with respect to  $\Phi_t$ . In words, the market is efficient if, on average, errors follow no pattern that might be exploited to produce profits.

A major difficulty applies to choosing an appropriate model of equilibrium prices. In many cases, the equilibrium expected return is assumed to be constant at  $r_0$ . The figure below illustrates the case of efficient market behavior when the expected equilibrium return is constant at  $r_0$ . So, if actual returns fluctuate randomly around  $r_0$ , the market is efficient. Generalizing, the market is efficient if actual returns follow a random walk.



On the other hand, the equilibrium expected returns may be assumed to vary systematically.



According to the efficiency hypothesis, if actual returns fluctuate randomly about the equilibrium, the market is efficient. In this case however, equilibrium expected returns are serially correlated about their mean values and do not follow a random walk with zero drift, or a random walk with constant drift, or a random walk with any obvious pattern of deterministic drift. This means that the market can be efficient even if actual returns do not follow a random walk.

So the most important presupposition in order to test market efficiency is to define the equilibrium expected return or price. But, in the case of foreign exchange market owing to changes in macroeconomic policies, there is no general agreement on the

appropriate model of equilibrium pricing comparable, for instance, to that for equity markets. Simply put, it is difficult to test whether investors efficiently set actual spot exchange rate equal to its equilibrium value unless there is some agreement on what the equilibrium value is. Similarly, it is difficult to test whether risk-bearing is efficiently rewarded if there is no agreement on the fundamental nature of foreign exchange risk, no adequate measure of it, and no model that determines the equilibrium fair return for bearing it.

Equity markets and foreign exchange markets differ in another important respect. Firms might be characterized by their consistency – in terms of directors, product lines, financial strategy, customers, etc. This suggests that investors can learn, with some certainty, the risk/return properties of equities. However, in the foreign market, our confidence that underlying economic policies will be maintained is considerably less. The operation of monetary and fiscal policy is subject to sharp changes. Furthermore, under a managed floating system, the government may enter the market in a non-profit-maximizing and non-stationary manner. So in the absence of any agreement on the equilibrium exchange rate, it is difficult to prove the efficiency hypothesis in the foreign exchange market.

**The absence of tests that prove with certainty the existence of efficiency in the foreign market encourage the usage of many diverse methods that might take advantage of unexploited information contained in historic prices.** These methods are known as technical trading rules. One of their appealing features is that they do not make any assumption about the equilibrium expected values. Instead, they test directly the availability of unusual or risk-adjusted profit opportunities.

In our thesis we will examine the filter technical trading rule and the moving average crossover trading rule that are the most common used ones. Both methods as well as their results will be analyzed thoroughly later on.

What distinguishes, however, this study from existing ones is **the usage of information from currency options to enhance the buy/sell signals from technical trading rules.** The motivation comes from the fact that, although the aforementioned rules have been shown to be profitable in several instances (Levich and Thomas [The Significance of Technical Trading-Rule Profits in the Foreign Exchange Market: A Bootstrap Approach], Silber [Technical Trading: When It Works and When It Doesn't]), they frequently generate false buy/sell signals that lead to substantial losses.

In principle, therefore, this thesis examines whether there is more unused information, contained in currency options prices, in addition to the unexploited information the technical trading rules are supposed to exploit.

## 2. LITERATURE REVIEW

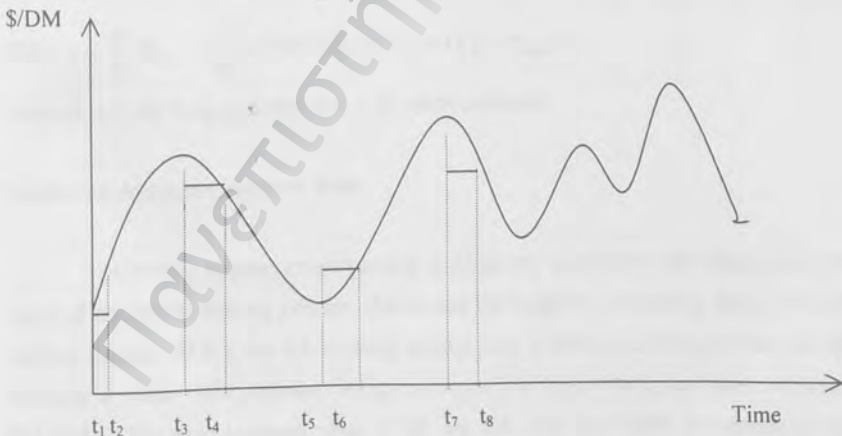
### 2.1 Technical Trading Rules: Descriptions

As already mentioned, the lack of convincing evidence about foreign market efficiency has encouraged the use of technical trading rules. Trading rules use past series of prices and try to identify trading behavior in these prices that might generate unusual returns. The technical trading rules can be used to spot market as well as to future one. Although in our study we will apply these strategies to future market, we will firstly examine their usage in the spot market and then make the correspondence with the future market.

We will describe the two technical trading rules that are mostly employed in the practice- the filter rule and the moving average crossover rule.

#### a) Filter rule

A filter rule is defined by a single parameter ( $f$ ), the filter size. An  $f$  percent filter rule identifies trends and generates buy and sell signals according to the following design: buy a currency whenever it rises  $f$  percent above its most recent trough; sell the currency and take a short position whenever the currency falls  $f$  percent below its most recent peak. Typically,  $f$  is chosen to be small number (such as 1 percent, 2 percent, 3 percent etc.)



Assume we use a 1 percent filter rule on a hypothetical series of \$/DM exchange rate. At the start of the process ( $t_1$ ); the speculator has a net worth that allows him to execute transactions, but he holds no foreign exchange positions. At time  $t_2$ , the DM is assumed to have risen by 1 percent. The filter rule signals an upward trend in the DM. So, the speculator

takes a long position in DM by borrowing US\$ and buying DM in the spot market. At time  $t_2$ , the expected return on the currency position is  $R = [\ln(E(S_{t_3})/S_{t_2}) - (r_{t_2,S} - r_{t_2,DM})]$ , where  $r_{DM}$  represents the interest earned on the long foreign currency position (DM),  $r_S$  is the interest expense of the short \$ position and  $S$  is the spot exchange rate in \$/DM. The interest differential ( $r_{t_2,S} - r_{t_2,DM}$ ) is the cost of taking on the long position in DM. The cost of holding this position for  $m$  days is  $C = \sum_{t_2}^{t_2+m} (r_{t,S} - r_{t,DM})$ . The expected return on the currency position is  $\ln(E(S_{t_2+m})/S_{t_2})$  which would be positive if  $E(S_{t_2+m}) > S_{t_2}$ . Over a period  $(t, t+1)$ , the return from a long position is measured by

$$R_{t,t+1} = [\ln(E(S_{t+1})/S_t) - (r_{t,S} - r_{t,DM})]$$

By time  $t_3$ , the DM has hit its peak. But the filter rule does not signal a change until time  $t_4$ . At time  $t_4$ , a sell signal causes the speculator to sell his DM holdings and take a short in DM by borrowing DM and buying US\$ in the spot market. By analogy the return from a short foreign currency position is measured by

$R = -[\ln(E(S_{t_5})/S_{t_4}) - (r_{t_4,DM} - r_{t_4,S})]$ . The cost of the short position is  $(r_{t_4,DM} - r_{t_4,S})$  and the cost of holding this position for  $n$  days is  $C = \sum_{t_4}^{t_4+n} (r_{t,DM} - r_{t,S})$ . The expected return on the currency position is  $\ln(S_{t_4}/E(S_{t_4+n}))$  which would be positive if  $S_{t_4} > E(S_{t_4+n})$ . Over a period  $(t, t+1)$ , the return from a short position is measured by  $R_{t,t+1} = -[\ln(E(S_{t+1})/S_t) - (r_{t,S} - r_{t,DM})]$

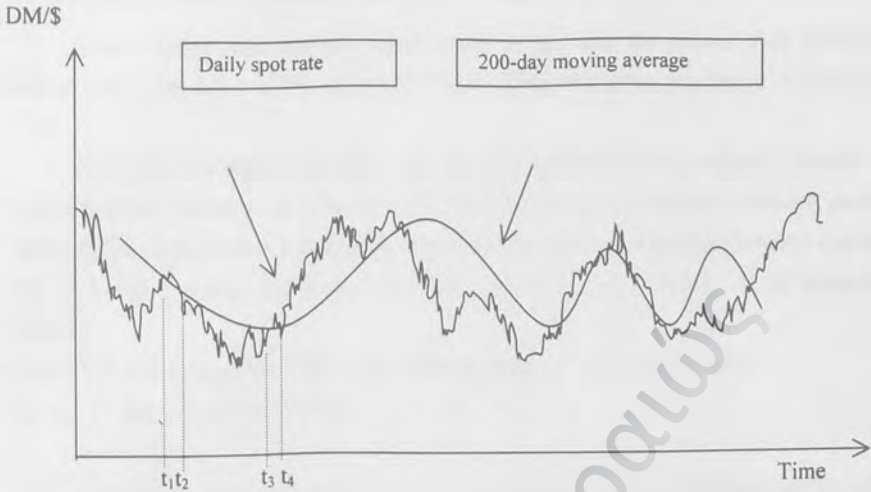
By following the buy/sell signals generated by the filter rule, the total return (TR) is calculated by:

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t [\ln(E(S_{t+1})/S_t) - (r_{t,S} - r_{t,DM})]$$

where  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.

### b) Moving Average Crossover Rule

The moving average crossover rule requires two parameters: the length ( $S$ , in trading days) of the shorter moving average (MAs) and the length ( $L$ , in trading days) of the longer moving average ( $MA_L$ ). An  $S/L$  moving average rule is defined as follows: buy the foreign currency if  $MAS > MA_L$ , sell the foreign currency if  $MAS < MA_L$  and take no position if  $MAS = MA_L$ . The most common value of  $S/L$  are  $1/5$ ,  $5/20$  and  $1/200$ .  $1/5$  represents today's price relative to the last week,  $5/20$  represents this week's price relative to the last month and  $1/200$  represents today's price relative to the last 200 trading days. When  $MAS > MA_L$ , the currency's value in the recent past exceeds its value in the more distant past, which in moving average models signals that an upward trend is developing.



Suppose we use the 1/200 moving average crossover rule by using a hypothetical series of DM/\$ exchange rate. As before, we assume that the speculator has no initial foreign exchange positions, but he has capital that permits him entry into the transactions that follow. At time  $t_1$ , when spot rate (MAS) exceeds the 200-day moving average ( $MA_L$ ), speculator takes a long position in \$, since this exchange rate is quoted as DM/\$. The speculator borrows an amount of DM and uses it to purchase US\$ placing the funds in an interest-bearing account. At time  $t_2$ , spot rate (MAS) falls below the 200-day moving average ( $MA_L$ ), so the speculator closes his position and takes a short one in US\$. Analogously to the filter rule, the return (R) from a long position in US\$ over a period (t, t+1) is measured by

$$R_{t,t+1} = [\ln(E(S_{t+1})/S_t) - (r_{DM} - r_s)]$$

where  $r_s$  represents the interest earned on the long foreign currency position (US\$),  $r_{DM}$  is the interest expense of the short DM position and S is the spot exchange rate in DM/\$.

The return from a short foreign currency position over the period (t, t+1) is measured by

$$R_{t,t+1} = -[\ln(E(S_{t+1})/S_t) - (r_{DM} - r_s)]$$

The total return (TR) earned from moving average crossover rule are computed in an identical manner to the filter rule:

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t [\ln(E(S_{t+1})/S_t) - (r_{t,DM} - r_{t,s})]$$

where  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.



## 2.2 Combining Currency Returns with Future Prices

Later studies used currency future prices to calculate the returns from technical trading rules. The virtue of this approach will be illustrated using the basics of currency prices.

Suppose the markets are perfect and efficient and an investor, at time  $t$ , deposits  $A$  units of domestic currency and at time  $t+s$  will receive  $A(1+r_{t,t+s})$  of domestic currency, on the other hand he could convert  $A$  units of domestic currency to  $A/S_t$  of foreign currency, deposit  $A/S_t$  of foreign currency and expect to receive  $[(1+r_{t,t+s}^*)A/S_t] E(S_{t+s})$  of domestic currency.

In equilibrium the proceeds of the two investment strategies should be the same:

$$A(1+r_{t,t+s}) = [(1+r_{t,t+s}^*)A/S_t] E(S_{t+s}).$$

Yet, there is some risk arising from the fact that  $S_{t+s} \neq E(S_{t+s})$ . To eliminate this risk, one can use a forward contract  $F$  with maturity at period  $t+s$  to hedge the foreign currency position in the second strategy  $(1+r_{t,t+s}) = (1+r_{t,t+s}^*) F_{t,t+s}/S_t$

That is the covered interest rate parity which equates the domestic-currency return with a fully hedged foreign-currency return:  $(1+r_{t,t+s}) = (1+r_{t,t+s}^*) F_{t,t+s}/S_t$

where  $r_{t,t+s}$  is the domestic currency rate of return from period  $t,t+s$ ,  $r_{t,t+s}^*$  the foreign currency rate of return over the same period,  $S_t$  is the domestic currency price of a foreign currency unit at period  $t$ , and  $F_{t,t+s}$  is the forward exchange rate constructed at period  $t$  for exchange at period  $t+s$ .

At period  $t+s$  the forward contract expires so  $F_{t,t+s}$  equals the spot rate  $S_{t+s}$  that prevails at that period. In a different case, there would be place for arbitrage opportunities. So from the covered interest rate parity we have:

$$\begin{aligned} F_{t,t+s} &= [(1+r_{t,t+s})/(1+r_{t,t+s}^*)] \times S_t \Leftrightarrow \\ F_{t+s}/F_t &= S_{t+s}/[(1+r_{t,t+s})/(1+r_{t,t+s}^*)] \times S_t \Leftrightarrow \\ F_{t+s}/F_t &= (S_{t+s}/S_t)[(1+r_{t,t+s}^*)/(1+r_{t,t+s})] \Leftrightarrow \\ \ln(F_{t+s}/F_t) &= \ln F_{t+s} - \ln F_t = \ln(S_{t+s}/S_t) + \ln(1+r_{t,t+s}^*) - \ln(1+r_{t,t+s}) \Leftrightarrow \\ \ln(F_{t+s}/F_t) &= \ln(S_{t+s}/S_t) + \ln(1+r_{t,t+s}^*) - \ln(1+r_{t,t+s}) \Leftrightarrow \\ \ln(F_{t+s}/F_t) &= \ln(S_{t+s}/S_t) + \ln r_{t,t+s}^* - \ln r_{t,t+s} \Rightarrow \\ \ln(F_{t+s}/F_t) &\approx \ln(S_{t+s}/S_t) + r_{t,t+s}^* - r_{t,t+s} \end{aligned} \quad (1)$$

Yet, the right hand side of equation (1) is equal to the profits from technical trading rules. That is, by using future prices with the technical trading rules, one takes into account automatically the interest cost of any short position or interest earned on any long position. This essentially eliminates the need for overnight interest rates on spot interbank deposits.

In addition to the fact that future prices embed financial costs, the future closing prices represent actual transaction prices as well. Another advantage from using future contracts is the fact that purchases and sales of future contracts do not require exchanges of cash.

So, when the signal from a technical trading rule is to take a long position on a foreign currency, it will automatically imply to buy foreign currency future contracts and when the signal is to sell foreign currency, it will imply to take short position on foreign currency future contracts.

As mentioned before, the realized return from following a technical trading rule is:

$$R_{t,t+1} = d_t [\ln(S_{t+1} / S_t) - (r_{t,t+1} - r^*_{t,t+1})]$$

where  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.

Additionally, the futures prices reflect the contemporaneous interest differential between the foreign currency and the domestic currency and we have proved that

$$\ln(F_{t+1} / F_t) = \ln(S_{t+1} / S_t) + r^*_{t,t+1} - r_{t,t+1}$$

So, price trends and returns can be measured simply by:  $R_{t,t+1} = \ln(F_{t+1} / F_t)$

The total return (TR) from following a technical trading strategy is measured by:

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t \ln(F_{t+1} / F_t)$$

where  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.

There exist some subtle issues, however. Apart from just reporting these issues, we present the methods that will help us cope with these during our analysis. One of them is the **rollover transaction**. It arises from the need to rollover positions when the contracts expire. Implementing buy/sell decisions in future markets according to the filter and moving average rules require that we choose from among outstanding contracts with different maturities. We simulate the buy/sell decisions in the nearest contract because it is usually the most liquid contract. So in order to maintain an existing position, we must close out the position in the near contract and open a position in the next-nearest contract. Buy/sell transactions, therefore

occur not only following on moving average and filter signals, but also on rolling over existing positions.

In addition, as Samuelson has pointed, futures that are near their maturity have more variability than those ones with distant maturity. Hence, there is some possibility that return variances may be rising as our contracts move towards maturity and then falling abruptly as we rollover into the next contract. In addition, Samuelson has shown that for some stationary price generating processes, variance may rise over some intervals as time to maturity rises, even though in the limit, variance of futures price changes is zero as  $T \rightarrow \infty$ . **However, in our process, we accept that there is no significant difference between volatility for 'far' maturities ( $80 < T < 110$ ) and 'near' maturities' ( $20 < T < 50$ ).**

Another subtle issue concerns the existence of a **risk premium**. So far, it has been implicitly assumed that there is no risk premium. If a risk premium is present, total returns will overstate the true excess return from following the trading rule, especially if there is a prolonged trend in the currency over the sample period. To correct this effect, we will estimate the risk premium as a constant over the sample period and equal to the returns from the buy and hold strategy

$$RP_{1,N+1} = \sum_{t=1}^N \ln(F_{t+1} / F_t)$$

The benchmark for assessing unusual performance over a period is then the constant RP. Since our trading rules earn the RP over the fraction of days  $(1-f)$  long foreign currency and give up the RP over the fraction of days  $(f)$  short foreign currency, the benchmark expected profit from the trading rule should be adjusted:  $R^* = (1-f) RP - fRP$

In the case where the fraction of days that long position on a foreign currency is near 50 per cent or risk premium is small,  $R^*$  will approach zero. Studies have shown that the estimated risk premia are small relative to the size of trading rule profits and none are significant, so we did not include them in our calculations.

Lastly, one has to account for the **transaction costs**. There are two ways in order to adjust returns for transaction costs. The first one is to express the bid-ask spread as a percent of price and then multiply the spread by the average number of trades per year, including the number of transactions due to rollovers. This product is then subtracted from the sum of the annual returns calculated in the way referred above. The other way is to consider that the likely cost of transacting in the currency futures market is about 2.5 basis point per transaction for a large institution. A more conservative estimate would be roughly 4.0 basis points.

### 2.3 Previous Studies

Many empirical studies have examined the profitability of filter and moving average trading rules. One of the first was undertaken by Dooley and Shafer. They reported excess returns from filter trading profits for nine currencies, using daily spot rates over 1973-1981 period. Their calculations are adjusted to reflect the interest expense and income of short and long positions, and transaction costs are incorporated by using bid and asked foreign exchange quotation. Their results indicate that small filters ( $x=1,3,5$  per cent) would have been profitable for all currencies over the entire sample period. The authors also reported results for 10, 15, 20 and 25 per cent filters. These filters were profitable in more than one-half of the sub-periods but the results were more variable than for the smaller filters.

However, even with the small filters there appears to be some element of riskiness in these trading rules since each filter would have generated losses in at least one currency during at least one sub-period. Even so, for three currencies (Yen, Guilder and Pound sterling) every small filter was profitable in every sub-period. The authors did not report any measures of statistical or economic significance of these profits.

An early study by Poole reports filter rule profits for the Canadian dollar during the floating rate period, 1950-1962, and for nine other series of flexible exchange rates in the post-First World War period. Poole finds evidence of statistically significant first-order serial correlation in exchange rate changes. In such circumstances, filter rule strategies tend to make large profits relative to a buy-and-hold strategy.

A recent paper by Goodman examines the performance of professional foreign exchange advisors that issue buy and sell signals based on technical analysis. Goodman reports that large profits in excess of the risk-free rate are generally available to users of these professional signals. There are also risks; the largest individual loss on one buy/sell signal was 2.4 times the initial 5 percent margin, and the largest stream of losses was 2.9 times the initial margin. Goodman suggests that these risks are small for investors who have enough capital to withstand intermittent losses and who use professional signals on a regular basis. Goodman reports that if investors use a composite signal based on two or more advisors, the risk/return trade-off improves.

A study by Sweeney used similar filter rule technique on daily exchange rates for ten currencies over April 1973-December 1980 sample period and reached similar conclusions. Filters of 0.5, 1, 2, 3, 4, 5 and 10 per cent led to trading profits in more than 80 percent of the cases. The profits from the smaller filters (0.5, 1 and 2 per cent) were again superior. Sweeney divided his sample into a 2.5-year estimation period followed by a 5-year post-sample period. Filter rules that were profitable in the first period tended to be profitable in the second one as well. Under the assumption of constant exchange rate volatility, Sweeney calculated that in

about one third of the cases, the profits from filter trading were statistically significant. Again, the results were more pronounced for the smaller filters.

Schulmeister tested the moving average crossover rule using the 3 day-10 day, 5 day-10 day, 4 day-16 day combinations. He used the \$/DM rate over the April 1973-September 1986. His results suggested that most of these technical models would have resulted in profitable trading strategies even after adjusting for interest expense and transaction costs. In particular, the moving average rules were profitable in each of the 10 sub-periods analyzed. He attributed these results to the fact that exchange rate changes and speculative profits appear to be non-normally distributed. He suggested that there are too many small exchange rate changes (relative to a normal distribution) but also too many large exchange swings (also relative to the normal). So, once an exchange rate move has started, it is likely to proceed more or less uninterrupted, which allows market technicians time to identify a profitable investment opportunity.

Two papers that analyze the statistical properties of exchange rates are also worth noting. In an analysis of daily spot exchange rates over the period 1974-1983, Hsieh rejects the hypothesis that exchange rates are independently drawn from a fat-tailed distribution that remains fixed over time. While the usual tests do reveal the presence of serial correlation in exchange rates, Hsieh argues that this may be the result of heteroscedasticity. Once heteroscedasticity is removed from the data, very little serial correlation remains. Exchange rates appear more accurately characterized as drawings from distributions that vary over time with changing means and variances.

Our thesis will be based on two studies, the one presented by Silber and the other one by Levich and Thomas. These two studies will be presented below analytically. During the analysis we are going to point out some issues and explain in details the way the authors cope with them as many of them will be met in our calculations as well. We considered this necessary since a great part of our thesis is based on the calculations done by these studies.

Both studies use foreign currency future contracts. The total return (TR) from following a technical trading strategy is measured by:

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t \ln(F_{t+1} / F_t)$$

where  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.

In addition, both studies examine the profitability of the moving average crossover rule and the filter rule despite they use different methods. Silber grounds his tests on out-of-sample simulations while Levich on the bootstrap method.

**Silber's study** relies on out-of-sample simulation and uses only the moving average crossover rule. Of course, the same study can be implemented using the filter rule as well. He begins by choosing the best moving average. Some practitioners test for the best moving average by simulating the profitability of hundreds of alternative combinations during a particular historical period and on choosing the one that has generated more profits. The problem with this approach is, of course, selection bias: if enough combinations of moving averages are tried, at least one is likely to work simply by chance. Out-of-sample simulations are required to determine whether the trading rule works in general and to identify which combination works best in particular.

For each future contract, he follows a two-step procedure for selecting optimal moving averages and for simulating their profitability. Daily futures closing prices are used as the raw data. He starts by searching for the most profitable moving average rule for Year1 of his sample. He then uses this rule to simulate returns for Year2. The next step is to search for the most profitable moving average for Years1 and Years2 combined and uses this new combination to simulate returns for Year3. This sequential optimization and simulation is continued through the end of the sample period. If there are  $n$  years of data (including 200 observations prior to what he has labeled Year 1), he has  $n-1$  years of out-of-sample daily returns simulations from following a moving average trading strategy.

**We present below, analytically, the way the results have been calculated; in sequel, the same procedure will be implemented for the estimation of our results.** Based on the signal from the technical rule in use for a particular period, he gets a short or a long position on a particular future contract. He assumes one day  $t$ , the signal is to buy a future contract, then he takes a long position on it and his return will depend on the future price of the next day  $R_{t,t+1} = \ln(F_{t+1} / F_t)$ . Analogously, if the signal is to sell a future contract, then he gets a short position and his return will be  $R_{t,t+1} = -\ln(F_{t+1} / F_t)$ . The returns have to be calculated every day, following this particular method.

Whenever the signal he gets from the trading rule is different from the one of the previous day, he has to close the existing position, and gets the one that is ordered by the technical trading rule. In this case, again, he follows the previous method and calculates the generated returns. This process is followed through the end of the data he has chosen to examine.

Of course, buy/sell transactions occur not only following the moving average signals, but also to rollover existing positions. The future contracts on the foreign currencies that he uses have delivery months on March, June, September and December, and he has to rollover the future contracts since they expire. The date where the rollover transaction takes place will be at the last trading day of the previous month when the contract he holds expires. At that

day, he rollovers this contract with the nearest to expire future contract. For example, suppose he is short on a future contract that expires in December. The nearest contract to expire is the one that expires in March. So, at the last trading day of November he will have to close the short position on the future of December and simultaneously gets again a short position at the future contract that expires in March. Similar procedure has to be followed in the case of the others future contracts that he uses.

By following the buy/sell signals and calculating the returns, he produces the average annual returns, assuming that there are 250 trading days per year, and the standard deviation of returns. Although the returns data are based on closing prices in each of the markets, the average annual returns do not take account of the bid-ask spread encountered when trading. One problem is that the relevant bid-ask spread varies with the number of contracts that must be bought and sold.

In order to have some more representative returns he includes the corresponding transaction costs. He first expresses the bid-ask spread as a percent of price. The calculation of transaction costs is based on the product of the bid-ask spread and the number of trades per year, which is then subtracted from the initial returns.

In order to determine whether the returns after transaction costs are statistically significant positive, he forms a t-statistic on the mean returns by dividing the average annual returns after transaction costs by  $\sigma/\sqrt{t}$ , where  $\sigma$  is the standard deviation and  $t$  the number of years of the data used. Finally, Silber tests the hypothesis that the means calculated are all different from zero. He assumes that the moving average returns follow jointly normal distribution, which permits him to perform a Hotelling  $T^2$  test.

To evaluate the performance of the technical trading rule that he follows, he also compares these results with those from a buy and hold strategy. With the buy and hold strategy, he acquires a long position on a future contract and the only transaction that takes place is the rollover transaction at the last trading day of the previous month when the contract expires. The process for calculating the returns is exactly the same with the previous one.

The basis for comparison is the Sharpe ratio, which measures the excess return per unit of risk. Sharpe ratio equals the return over and above the risk free- rate divided by the standard deviation of returns,  $r_p - r_f / \sigma_p$

where  $r_p$  signifies the returns generated by following the technical trading rule for a particular future contract,  $\sigma_p$  is the standard deviation of  $r_p$ , and  $r_f$  is the risk-free rate.

Since the transactions with futures contracts require no cash outlay, the returns are all in excess of the risk-free rate, so the total returns to the moving average trading position are  $r_p + r_f$ . Therefore, the relevant Sharpe ratio is simply  $r_p / \sigma_p$ , or the return divided by its standard deviation.

Silber has chosen 12 actively traded futures contracts. He includes the major foreign currencies traded on Chicago Mercantile Exchange (CME) i.e the German mark, Swiss franc, Japanese yen, British pound and Canadian dollar. He also includes two actively traded short-term interest rate contracts: Eurodollar time deposits from the CME and three-month sterling from the London International Financial Futures Exchange (LIFFE). Finally, he has chosen gold and silver from the Comex, U.S. Treasury bonds from the Chicago Board of Trade, crude oil from the New York Mercantile Exchange and the S&P 500 from the CME.

Most contracts have twelve years of simulations, with 1979 providing the first optimization year, and 1980 through 1991 available for simulation. For S&P 500, three-month sterling, and three-month Eurodollar contracts, simulations were performed over eight years, and for crude oil simulations were done over seven years.

From average annual return produced by following the moving average rules, it occurs that technical trading rules have generated unusual profits for all contracts except for silver, gold and S&P 500. The same results come from the average annual returns included transaction costs. As t-values are concerned, four of the seven returns on currencies and short-term interest rate futures (German Mark, Swiss Franc, Japanese Yen, 3-Month Eurodollar) are significantly positive at the 5% level. In addition, after performing a Hotelling  $T^2$  test, he accepts the fact that all seven means are significantly different from zero.

The positive returns generated from moving average strategy are higher than those ones from a simple buy/hold strategy except for three-month Eurodollar. **Thus the moving average rule seems to add value over and above the naïve buy and roll over strategy.**

Finally, to determine whether the moving average rule generates excess returns relative to the risk incurred, Silber uses the Sharpe ratio. The German mark has the highest Sharpe ratio, three-month Eurodollar the next highest. The Sharpe ratio is higher for currencies and short interest rates, next highest for crude oil and Treasury bonds and lowest for gold, silver, and the S&P 500.

Levich's study relies on the bootstrap method. He collected data on future prices for 5 currencies, the German mark, Swiss franc, Japanese yen, British pound and Canadian dollar for the period January 1, 1976 through December 31, 1990. He assumes that there are no changes in the variance of future prices as time to maturity rises.



He uses both the filter and the moving average crossover rule. He utilizes filter rules of size of 0.5 per cent, 1 per cent, 2 per cent, 3 per cent, 4 per cent, and 5 per cent and three moving average crossover rules: 1 day/5 day, 5 day/20 day, and 1 day/200 day. Based on the signal he gets from each of the technical trading rules, he takes a short or a long position on the foreign future contracts. The returns generated from the signals are calculating in the same method as in the study of Silber. Of course we have to keep in mind the rollover transactions as well. The total return (TR) from following a technical trading strategy is equal to:

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t \ln(F_{t+1} / F_t)$$

where  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.

In case risk premium is present, he estimates it as equal to the returns from a buy and hold strategy  $RP_{1,N+1} = \sum_{t=1}^N \ln(F_{t+1} / F_t)$

and so the expected profits from the trading rule, with risk premium is  $R^* = (1-f)RP - fRP$ , where  $(1-f)$  the fraction of days of long position and  $f$  the fraction of days short position.

However, Levich did not include in his following test any risk premium since it was very small relative to the profits. Furthermore, he considered that transaction costs would not affect profits and so he did not include them as well.

In order to evaluate the returns from following the technical trading rules, Levich used the bootstrap method. According to this method, each series of future prices has  $N+1$  observations, which correspond to  $N$  log price changes. These  $N$  observations can be arranged to  $M=N!$  separate sequences, each of them corresponds to a unique profit measure ( $X[m,r]$ ) under the trading rule he follows. For each currency, he generates a new comparison series by making a random rearrangement of price changes in the original series and keeping the starting and the ending price levels the same. By following this process, he generates one of the many paths that the exchange rate might have followed from its level on the starting day of the sample until the ending day holding constant the original distribution of price changes. He rearranges the original series 10000 times and so he gets for each currency 10000 i.i.d.

Each of the 10000 notional paths have the same properties as the original ones but random time series properties. He applies the trading rules to each series and gets the profits  $X[m,r]$ . The next step is to compare the profits generated from the original series to the ones that are generated from the random series. If the returns from the original series and the randomly generated one are almost the same, then the null hypothesis that there is no information in the original sequence should be accepted.

Levich, also calculates the mean daily return for all currencies as well as the standard deviation. He estimates the skewness, the kurtosis and the autocorrelation of daily returns for lags 1-10. Finally, he reports the profits associated with the buy and sell signals generated from the technical trading rules. At the end of his study, he splits the sample period into three, five-year sub periods and repeats his analysis.

Turning to his finding, as far as the original time series of future price returns is concerned, the mean daily return of all currencies is small, near zero. The largest (absolute) mean return is negative four basis points per day for the BP during the period 1981-85. The daily standard deviation varies from 0.27 per cent for the CD to 0.79 per cent for the SF.

Positive skewness of daily returns is apparent in four of the sampled currencies except for the case of the Canadian Dollar, while positive kurtosis in all of them. The tests also result in significant autocorrelation that may exist due to heteroscedasticity.

**The profits generated from both the filter and the moving average rules are positive, especially in the case of small filters and short-term moving average respectively.** More specifically, over the entire 15-year period every size filter results in positive profits for every currency. Average profit in the Canadian dollar across all filters is 1.8 per cent, substantially less than the average for other currencies where results range between 6.6 per cent and 8.1 per cent. The results are much the same for the moving average rule that led to average profits of 2.6 per cent for the CD and between 6.9 per cent and 9.0 per cent for the other currencies.

On the contrary the average filter rule profits from the generated series are small and insignificantly different from zero. The average profit is positive for a sample of 10000 simulated series in only three cases. In fifteen of the cases, the profits of the actual series rank in the top 1 per cent of all the simulated series. In ten further cases, the rank is in the top 5 per cent. The results are the same for the moving average rules. In twelve cases the profits of the actual series rank in the top 1 per cent of all of the simulated series and in two additional cases the profits are significant at the 5 per cent level.

The other sample statistics for the simulated series suggest that average profits are normally distributed without skewness and kurtosis. These results imply a strong rejection of the hypothesis that there is no information in the original series that can be exploited for profit by technical trading rules.

Furthermore, in the case where he splits the sample period into three, five-year sub-periods, he finds that small filter appears to be more profitable. Finally, in both filter and average moving rules he observed a decrease in their profitability over time.

### 3. PROPOSAL

As already, the thesis main idea (and contribution) is to enhance the buy/sell signals from technical trading rules with information from currency option prices. This information is based on the interpretation of the risk reversal prices, which will turn attention to next.

#### 3.1 Currency Options Basics

Before delving into any of the substantive issues, it is important to lay out the essential terminology. Maybe for most of us the following information below is already known. Nevertheless, we consider essential to state options basics in order to associate them with the concept of risk reversal.

A foreign exchange or currency option contract gives the buyer the right, but not the obligation, to buy (or sell) a specified amount of one currency for another at a specified price on (in some cases, on or before) a specified date. Options are unique in that the right to execute will be exercised only if it is in the holder's interest to do so. That differs from a forward contract, in which the parties are obligated to execute the transaction on the maturity date, and it differs from a futures contract, in which the parties are obligated, in principle to transact at maturity, but that obligation easily can be—and normally is—bought out and liquidated before the maturity or delivery date.

A **call option** is the right, but not the obligation, to buy the underlying currency, and a **put option** is the right, but not the obligation, to sell the underlying currency. All currency option trades involve two sides—the purchase of one currency and the sale of another—so that a put to sell pounds sterling for dollars at a certain price is also a call to buy dollars for pounds sterling at that price. The purchased currency is the call side of the trade, and the sold currency is the put side of the trade. The party who purchases the option is the holder or buyer, and the party who creates the option is the seller or writer. The price at which the underlying currency may be bought or sold is the exercise, or strike, price ( $K$ ). The option premium is the price of the option that the buyer pays to the writer ( $P$  put premium,  $C$  call premium). In exchange for paying the option premium upfront, the buyer gains insurance against adverse movements in the underlying spot exchange rate while retaining the opportunity to benefit from favorable movements. The option writer, on the other hand, is exposed to unbounded risk—although the writer can (and typically does) seek to protect himself through hedging or offsetting transactions.

In general, options are written either “European style,” which may be exercised only on the expiration date, or “American style,” which may be exercised at any time prior to, and including, the expiration date. The American option is at least as valuable as the European

option, since it provides the buyer with more opportunities, but is analytically more complex. American calls on the higher interest rate currency are likely to be more valuable than the equivalent European option. The bulk of trading in the OTC interbank market consists of European options, while American options are standard on some of the exchanges.

Two main factors that are important in using and understanding risk reversal are volatility and delta. **Volatility** is a statistical measure of the tendency of a market price—in this case, the spot exchange rate—to vary over. Volatility is the annualized percentage change in an exchange rate, in terms of standard deviation (which is the most widely used statistical measurement of variation about a mean). The greater the forecast volatility, the greater the expected future movement potential in the exchange rate during the life of the option—i.e., the higher the likelihood the option will move “in-the-money,” and so, the greater the value (and the cost) of the option, be it a put or a call. (With zero volatility, the option should cost nothing.) If the one-year forward dollar-Swiss franc exchange rate is CHF 1.6000 = \$1, and the volatility of a one-year European option price is forecast at 10 percent, there is implied the expectation, with a 68 percent probability, that one year hence, the exchange rate will be within CHF 1.6000 per dollar plus or minus 10 percent—that is, between CHF 1.4400 and CHF 1.7600 per dollar.

There are different measurements of volatility:

- Historical volatility is the actual volatility, or variance, of an exchange rate that occurred during some defined past time frame. This can be used as an indication or guide to future movements in the exchange rate.
- Future volatility is the expected variance in the exchange rate over the life of the option, and must be forecast.
- Implied volatility is the variance in an exchange rate that is implied by or built into the present market price of an option—thus, it is the market’s current estimate of future movement potential as determined by supply and demand for the option in the market.

Finally, an important parameter for assessing options risk, calculated from the Black-Scholes equation, is the **delta**, which measures how much the price of an option changes with a small (e.g., one percent) change in the value of the underlying currency. In addition hedge ratio tells an option writer or a holder at any particular moment just how much spot foreign exchange he must be long or short to hedge an option position and eliminate (at least for that moment) the spot position risk.

However, the delta, or hedge ratio, will change continually, not only with each significant change in the exchange rate, but also with changes in volatility, or changes in interest rates, and, very importantly, delta will change with the passage of time. An option with a longer time to run is more valuable than an option with a shorter time to run. Thus, new calculations will continually be required as conditions change, to determine the new delta and the change in spot or forward foreign exchange position needed to maintain a neutral hedge position.

### 3.2 Put-Call Parity

Assume we buy a European call and sell a European put, this means that we pay an amount equal to  $C$  for the call and earn an amount equal to  $P$  for the put option. We focus only on European options that cannot be exercised prior to their expiration date. Thus, they have identical values today. Both call and put options have the same maturity ( $T$ ) and the same exercise price ( $K$ ). At maturity, either the call is in the money (and worth  $S_T - K$ ) or the put is in the money (and also worth  $S_T - K$ ). So the option portfolio always returns  $S_T - K$ . On the other hand, the combination of the put and call positions gives the same payoff profile as a forward position established at the strike price. So, being long a call and short a put (at the same exercise price) must be equivalent to holding a long forward position. Analogously, being short a call and long a put (at the same exercise price) must be equivalent to holding a short forward position.

A long forward foreign exchange position can be replicated by borrowing the domestic currency and lending the foreign currency. Thus, in the initial period, we borrow the present value of the option strike price [ $K \exp(-r_d T)$ ]. At maturity, we must repay an amount equal to the strike price ( $-K$ ). To complete the forward position, we invest an amount of foreign currency equal to the present value of the currency spot rate [ $S_1 \exp(-r_f T)$ ]. At maturity, this investment returns an amount of foreign currency now valued at  $S_t$ . Thus, the forward contract always returns an amount  $S_t - K$ . By the law of financial arbitrage, it must be the case that holds for European options:

$$-C + P = K \exp(-r_d T) - S_1 \exp(-r_f T)$$

If we divide each side of this equation by  $\exp(-r_d T)$  and recall that based on interest rate parity the  $T$ -period forward rate  $F_{1,t}$  equals the  $S_1 \exp(r_d T - r_f T)$ , the put-call parity becomes:

$$C - P = (F_{1,t} - K) / \exp(r_d T)$$

which refers as put-call-forward parity and applies only to European options that have identical values today.

Undoubtedly, there is a link between put prices, call prices and market sentiment. If we have puts and calls written at a strike price equal to the currency forward rate, then the put-call-forward parity implies that the put and call prices should be identical, that is,  $C=P$ . So, if investors pay the same amount for a call as they would pay for a put, intuitively, the forward rate must lie at the center of the distribution of the expected future spot rates.

### 3.3 Extracting Information from Put/Call Prices – The Concept of Risk Reversal

The main part of our study relies on the inferences that derive from risk reversal combination. Combinations of options are used among the professionals for many purposes, including taking directional views on currencies—anticipating that a particular currency will move up or down—as well as taking volatility views on currencies—anticipating that a particular exchange rate will vary by more or by less than the market expects.

In recent years, the OTC market for currency derivatives has seen the development of “risk reversals”, instruments that specifically price the “skewness of tail risk”. This skewness refers to the asymmetry between the risk of large price movements in one direction and that of equivalently large movements in the other direction. Risk reversals can be used to trade skewness in the same way that options can be used to trade volatility. Indeed, a risk reversal simply combines opposite positions in two options. **Buying a risk reversal is equivalent to buying a call and selling a put where both options are deeply and equally out-of-the-money. In the foreign exchange market, risk reversal prices are particularly useful indicators of whether market participants are more concerned about an extraordinary movement in one direction than in the other.**

Interpreting risk reversals requires a grasp of the peculiar language of the OTC market for currency options. Quotes in this market reflect two conventions. First, options prices are quoted in terms of volatility, the most critical factor in option valuation. Although a currency option’s price also depends on the spot exchange rate and on interest rates in the two currencies involved, these other factors are determined largely outside the options market. In the specific case of risk reversals, prices are quoted in terms of the difference between the volatilities of the embedded call and put options. Second, strike prices are specified in terms of “delta”, which measures the sensitivity of an option’s value to the price of the underlying asset and depends on how close the option is to the money. An at-the-money option would

have a delta of 0.5, a deeply out-of-the-money option a delta close to zero, and a deeply in-the-money option a delta close to one. Market participants are able to communicate effectively in these terms because they use a common translation device – the Garman-Kohlhagen equation, a well-known pricing formula for currency options.

The Reuters British Bankers' Association page for currency options on 16 June 1999, for example, shows a one-month risk reversal for the yen/dollar quoted at "0.46 for 25 delta". Here, "0.46" is the difference between the volatilities of the call and put options that form the risk reversal. **The fact that 0.46 is positive means the call is more valuable than the put. In other words, it is more expensive to hedge against a strong appreciation of the yen against the dollar than to hedge against the opposite movement.** The "25 delta" in the quote leaves out a decimal point and specifies a strike price equivalent to a delta of 0.25.

To translate risk reversal quotes into actual prices requires information on the "strangle" strategy. As already known, buying this instrument is equivalent to buying both a call and put, rather than buying one and selling the other as in the case of a risk reversal. Strangles are typically traded at the same deltas as risk reversals. The price of a strangle is quoted in terms of the average of call and put volatilities (often expressed as a spread over the at-the-money volatility) rather than the difference between the two volatilities. Both this average and the difference allow the calculation of two separate volatilities, one for the call and one for the put. The individual volatilities, the delta and information on the forward exchange rate and interest rate can then be translated into options prices through the Garman-Kohlhagen equation.

Under certain conditions, risk reversals allow the extraction of probabilities attached by market participants to large price movements. In fact, the entire probability distribution can be extracted assuming risk neutrality (that is, that options are priced as fair bets) and given sufficient assumptions about the shape of the distribution. McCauley and Melick (1996), for example, assume that this distribution has the shape of a mixture of two lognormal distributions. Since risk neutrality means options prices would correspond to their expected exercise values, McCauley and Melick then find the mixture of lognormals that makes these expected values approximate actual options prices most closely.

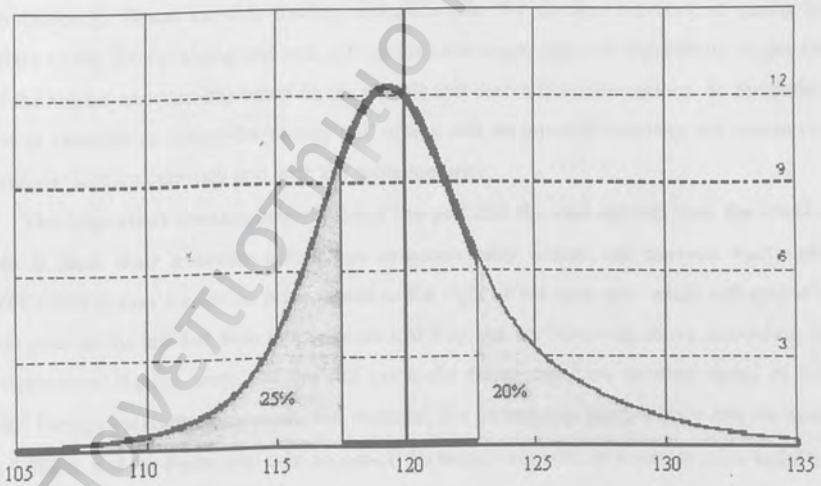
Applying a similar methodology to yen/dollar options on 16 June 1999 gives us the chart below. The area under the curve between any two points reflects the probability that the spot exchange rate will fall within that range. The horizontal axis represents possible outcomes for the spot rate at the maturity of the contract, and the vertical axis represents probability. However, in order to infer the probability for any particular movement, it is necessary to be able to estimate the area under the curve. For example, the strike prices for 25 delta puts and calls on 16 June 1999 were 122.8 and 117.4 respectively. The probability associated with a rise in the yen to 117.4 or above, according to the estimate of the risk-

neutral density function, was 25%. Conversely, the probability of a fall in the yen to below 122.8 was 20%.

The difference in probabilities for the 25 delta risk reversal shows that market participants were biased towards a possible dramatic appreciation of the yen. This bias in expectations was typical of the three-month period leading up to 16 June, during which the actual exchange rate did not show a clear trend. Such a bias in expectations represents a break from the usual pattern documented by McCauley and Melick (1996) and Campa, Chang and Reider (1997), who find that the currency market tends to form expectations of large movements by extrapolating the recent trend in the exchange rate.

One month ahead probability distribution for the yen/dollar on 16 June 1999

In JPY per USD and % probability



Source: Reuters; HJS calculations.



### 3.3 Using "Risk Reversal" to Enhance Buy/Sell Signals from Technical Trading Rules

We have examined, so far, some trading strategies. We have seen the filter rule, the moving average crossover rule as well as the currency options signals. Several studies have shown that the filter and moving average rules have led to profits that are highly unusual. On the other hand we cannot ignore the cases where technical trading rules have generated little gains or even losses in comparison with the simple buy and hold method. Here is that the use of the currency option signals comes. In the previous section we had examined them theoretically. **Now, we are going to explain the way we will use the risk reversal prices in combination with the technical trading rules.** By this way we can reinforce the technical trading rules with the signals derived from the currency options. This is the main scope of this thesis. We have to examine each signal separately and then try to combine all of them.

For example, a trader uses a moving average rule, in the way mentioned before, in order to take a long or short position on a particular foreign currency (FC) for example on the euro. Suppose that the moving average crossover rule gives the trader the signal to sell the foreign currency. Based on this trading technical rule the foreign currency is going to depreciate in the future. Using put and call options the trader has the opportunity to get an idea of the market expectations based on the signals that derive from the options. So the trader chooses to examine an out-of-the-money call option and an out-of-the-money put option on the particular foreign currency and with the same maturity.

**The important presupposition about the put and the call options that the trader chooses is that their exercise prices are symmetrically about the current spot rate  $S(\text{DC}/\text{FC})$ .** Put option's exercise price stands to the right of the spot rate, while call option's exercise price to the left and both in a symmetrical way. As we have said above, according to the difference in the put price and the call price, the trader can have another signal of the expected foreign currency movement. For instance, the underlying asset is Euro and the spot rate is  $0.86\$/\text{€}$  and the trader will take an out-of-the money put with an exercise price equal to  $0.84\$/\text{€}$  and an out-of-the money call with an exercise price equal to  $0.88\$/\text{€}$ . The put premium is  $2.5c/\text{€}$  and the call price equals  $2c/\text{€}$ . So the risk reversal, which is the difference between put and call prices, is positive and equals  $0.5c/\text{€}$ . This means that market participants are willing to pay more for the right to sell a currency at a given strike price than they are willing to pay for the right to buy a currency at a symmetric strike price. This means that it is more expensive to hedge against a depreciation of the euro against US dollar than to hedge against the opposite movement. **So, whenever we have a positive risk reversal, which is defined as the put price minus the call price may, the trader will take a short position**

since the market anticipates currency depreciation. In addition, **whenever we have a negative risk reversal, the trader will have a long position** due to anticipation of a currency appreciation.

In this particular example, if put premium is higher than the call premium, then the market expects the particular currency to depreciate, which is the same expectation as it was in the case of the technical trading rule. In this case the trader follows the signals and gets a short position on the foreign currency. In a difference case, that is if the difference between the put and call options is negative, the trader ignores the signal from the technical trading rule.

		Technical Trading Rules Signal	
Currency		BUY Currency ↑	SELL Currency ↓
Options Signals	BUY Currency ↑	BUY	
	SELL Currency ↓		SELL

The only difference from the process followed in the case of the simple technical trading rules is that the signals from these rules will be implemented only if they agree with the signals generated from the options.

We will have to examine if this **enriching** trading strategy eliminates the cases where the simple trading rules drove to wrong conclusions or if it can even lead to more profits than the simple trading rules.

#### 4. DATA

The paper, initially, aimed at the use of **combinations of technical trading rules and risk reversals** for four currencies: British pound, Canadian dollar, Japanese yen and Swiss franc. The sample period extends from January 1, 1990 to December 31, 2000. Undoubtedly, focusing on the evaluation of these results for the given period, we would be able to have a complete picture based on the presence or not of the efficiency of this enhancing trading strategy. Hence, the data that we should have collected was the spot and the future prices for these four currencies as well as the risk reversals.

As far as the futures are concerned, we have chosen contracts that are traded on the Chicago Mercantile Exchange (CME). The data collected is in a continuous series and expressed in US dollars. The contracts traded at the Chicago Mercantile Exchange have expiration date in March, June, September and December. So to get a continuous series we assemble the data of successive near-term contracts. For instance, futures prices in January and February of 2000 reflect the March 2000 contract; and so forth. These time series, of course, are not enough for our calculations. As already stated, in order to maintain our positions we have to roll-over the existing future contract to the nearest to expire one. That is the reason, that apart from the continuous time series got from Datastream, we also get time series for particular contracts. For example, for January and February the prices reflect the March 2000 contract. But, from the March 1, 2000 to May 31, 2000 the prices reflect the June contract. So on February 28, we should close the position that we have with the March contract and get the same one with the June contract. It is at this time that we need the price of the June contract on February 28<sup>th</sup> and the price of this contract is used for the calculation of the return of the next day- March 1, 2000.

Till now we have not confronted any serious problem, except for the volume of the data. We did face serious problems when we started to select the risk reversals for the four chosen currencies. Options are frequently sold in combinations. Among the most common ones in the currency option markets is the risk reversal. As we have mentioned, risk reversal consists of an out-of-the money call and out-of-the money put. The exercise price of the call component is higher than the current spot exchange rate and the exercise price of the put is lower. Risk reversals trade as a standard instrument in over-the-counter currency option markets, with prices expressed as the difference between the prices of the constituent put and calls. The OTC market is the U.S. portion of an international OTC network of major dealers—mainly but not exclusively banks—operating in financial centers around the world, trading with each other and with customers, via computers, telephones, and other means. The

exchange-traded market covers trade in a limited number of foreign exchange products on the floors of organized exchanges located in Chicago, Philadelphia, and New York.

My first attempt was to get the risk reversals, as a standard instrument, from the over-the-counter market. Unfortunately, Datastream does not report any risk reversal prices for any currency, nor does Bloomberg. After unsuccessful attempts towards the over-the-counter markets, we decided to form the risk reversal by finding out-of-the money put and out-of-the money call with the same maturity and with symmetrical strike prices around the existing spot exchange rate. In this case the volume of the data was extremely high, but we had no other option. According to the prevailing spot exchange rate of each date we had to choose a put option with its strike price being 2 b.p. lower than the spot price and a call option with its strike price being 2 b.p. higher than the spot rate. For each day, we picked out the particular put and call and found their difference which was the risk reversal we were looking for. The problem was that we wanted out-of-the-money options with various strike prices since we chose them according to the spot rate that varies each day. For example, during the period of one month the spot rate might have taken ten different prices. So we should have chosen options with the same maturity, but with ten different strike prices. In many cases the option with the exact strike price that we wanted was not traded.

Once more, luck was not on our side. Bloomberg does not report currency options that have already expired. We could find historical prices only for currency options that are still trading. So Bloomberg was not useful to us and the only database we could use was the Datastream. This database had not only the options that were trading at that time but also some historical prices. The problem was that, since we wanted options with various strike prices, there existed many cases where the option with a particular strike price was not traded at all. Additionally, due to the fact that some options have low volume of trading, Datastream did not include these even though they were traded. So in many cases we were not able to collect a satisfactory number of call and put premiums work with them. We managed to collect data only for the **Swiss Franc** and the **British Pound**. In addition the examined period has shortened a lot. For Swiss Franc, our data started on **September 1, 1997** and ended on **January 31, 2001**, while for the British Pound from **December 1, 1998** to **January 31, 2001**.

We have picked out currency options that are traded on the Philadelphia Stock Exchange. These options have delivery months in February, March, April, June, September and December. Depending on the month we examine, we chose the nearest to expire option. For example, in January we search for options with particular strike prices and delivery in February. In February, we use options with delivery in March, and so forth.

In order to calculate the risk reversal, we were looking for out-of-the-money options with strike prices symmetrical to the prevailing spot exchange rate. Our first goal was to get

put options with strike prices 2 b.p. lower than the spot rate and call prices with strike prices 2 b.p. higher than the spot rate. In cases where we could not find these particular options we were looking for the options with the same maturity but with strike prices 3 b.p. symmetrical to the prevailing spot rate. The risk reversals that derive from these options (3 b.p.) give us reinforced signals. But it was rather rare to get out-of-the-money options with strike prices 3 b.p. symmetrical to the spot rate. For this reason, whenever we had no data for a particular date, we searched for options with strike prices 1b.p symmetrical to the prevailing spot exchange rate. Nevertheless, we could not avoid the cases where we had no observation at all.

## 5. STRATEGIES

At the beginning of our thesis we presented the concept of the strategies we intended to use. In addition, when we stated Silber's and Levich's studies, we analyzed the calculations that took place. However, at this part of the thesis we regarded necessary to explain briefly the trading rules that we will implement and the way we calculate and evaluate the returns.

### 5.1 Moving Average Crossover Rule

In order to generate a vector of buy and sell trading signals, we utilize three moving average crossover rules: 1Day / 5 Day, 5 Day / 20 Day, 1 Day / 200Day. The presentation of the moving average crossover rule and the way we calculate the returns have already been fulfilled.

The moving averages are implemented into the spot exchange rates. In the case of the 1Day/5Day moving average, at the end of each day, for the 1Day moving average, we get the closing spot exchange rate, and for the 5Day moving average, we get the average of the last five days including the specific day's closing spot rate. Analogously, we use the previous twenty-day's spot rate and the previous two hundred day's spot rate for the 20day and 200day moving average respectively. The rule requires a long position when the shorter average moves above the long average, and dictates a short position when the shorter average falls below the long average. Each vector of the signals is then applied to the original series of currency future prices to measure the actual profitability of using these mechanical rules.

The realized return will be measured by:

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t \ln(F_{t+1} / F_t)$$

We use  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.  $F_t$  represents the settlement price of a future contract at the day where we compute the moving averages and  $F_{t+1}$  represents next day's settlement price of a future contract.

Assume one day  $t$ , the signal from the trading rule is to buy a future contract, then we take a long position on it and the realized return will be  $R_{t,t+1} = \ln(F_{t+1} / F_t)$ . Analogously, if the signal is to sell a future contract, then we get a short position and the return will be

$$R_{t,t+1} = -\ln(F_{t+1} / F_t)$$

The returns have to be calculated every day.

We have already stated the rollover transactions. The currency future contracts that are traded on the Chicago Mercantile Exchange have delivery months of March, June, September and December. So in order to keep our position, we should rollover the contract that we hold with the nearest to expire currency future contract. The returns will be calculated in the same way. The only difference arises when we calculate the return for the day where we have rollover the contract. So according to the above equation the places of  $F_t$  and  $F_{t+1}$  take the prices of the new future contract that has replaced the expired one.

In each strategy we will calculate the number of days where we have a long or short position. We have divided the time series in months and examine each of them separately. In order to evaluate the strategies, we calculate the average monthly returns, the standard deviation and the Sharpe ratio. As far as the Sharpe ratio is concerned, instead of  $r_p - r_f / \sigma_p$  we use the form of  $r_p / \sigma_p$  since future contracts require no cash outlay and so the returns are all in excess of the risk-free rate.

Finally, in order to have comparative results with the other strategies that use the risk reversal, we follow the signals only for the days where we have prices for the risk reversals, although we may not use them in the particular trading strategy.

## 5.2 Filter Rule

The way we use filter rule has already been explained. Whenever the prevailing spot rate rises by  $x$  per cent above its most recent trough, we get a buy signal. Whenever the spot rate falls  $x$  per cent below its most recent peak, then a sell signal is derived. In case the spot rate does not succeed to exceed downgrade its recent trough or peak respectively, then we keep the signal from the previous day and we do not change our position. We utilize the 0.5%, 1%, 2%, 3%, 4% and 5% filter rules. Depending on the filter we use, the spot rate will have to change from its peak or trough by the corresponding per cent of the filter.

In our calculations, we get a peak when the trend of the spot rates become from upward to downward and a trough when from downward the trend becomes upward. At each peak and trough we keep the corresponding value of the spot rate. So each time we compare the spot rate with the appropriate value of the peak or the trough, depending on the trend of the spot rate. Each day's returns as well as the calculations that take place are the same as in the above strategy.

### 5.3 Risk Reversal

The ways that risk reversal prices work has already been analyzed. If an out-of-the-money call on a currency is more valuable than an equal out-of-the-money put, this reflects a market consensus, that loosely speaking, the call is more likely to pay off. This means that the currency is more probable to appreciate than depreciate. So if the difference between a put and a call premium is negative, we may consider this as a signal to buy. Analogously if the risk reversal is positive, that is the put premium is greater than the call premium, we get a signal to sell.

From Datastream we have collected put and call options with strike prices symmetrically arranged around the prevailing spot rate. For each day we get the appropriate put and call and calculate their difference. Depending on the positive or negative result we get a sell or buy signal respectively.

The realized return will be measured by:

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t \ln(F_{t+1} / F_t)$$

where  $d_t = +1$  for long positions,  $d_t = -1$  for short positions.

Of course we have to keep in mind the rollover transactions.

In cases where we have no observations, we just close out our position and wait for the next risk reversal price to give us a signal.

### 5.4 Combined Strategy –Technical Trading Rule and Risk Reversal

We have stated, till now, the way we will use the simple technical trading rules and the risk reversal prices as well. Our main goal is to combine these two signals and calculate the resulting returns. We get a buy or sell position, if and only if the signals that derive from the risk reversal prices are the same with the ones that derive from the technical trading rules.

In a different case we close our position and wait for the date where the two signals are in accordance.

The returns will be calculated as in the previous strategies. We have to keep in mind the rollover transactions as well as the closing out of our position in the cases where we have no risk reversal prices.

### 5.5 Buy and Hold method

This is a naïve method of just taking a long position on a currency contract. During the entire period we examined, we kept a long position. The only transactions taken place are the necessary ones due to the expiration of the future contracts. Each day we calculate the returns by following the well-known equation,

$$TR_{1,N+1} = \sum_{t=1}^N R_{t,t+1} = \sum_{t=1}^N d_t \ln(F_{t+1} / F_t)$$

For the buy and hold method,  $d_t$  is equal to 1, since we always have a long position.

### 5.6 Out-of-sample simulation

The out-of-sample simulation is analytically described previously when we presented Silber's study. The whole idea is based on using, for a specific period, the moving average or filter that has resulted in the higher returns during the previously examined period. For instance, we divide our sample in months. So in order to pick out the best moving average for January 2000, we examine which moving average has resulted in the best returns for December 1999, and it is this particular average that we use for January 2000. Analogously for February 2000, we use the moving average that has led to the higher profit during January 2000.

The moving averages crossover rules that we use for simulations are the 1Day/5Day, the 5Day/20Day and the 1Day/200Day. As far as filter rules is concerned, we will simulate the 0.5%, 1%, 2%, 3%, 4%, 5% filters. Each day's returns as well as the calculations that take place are the same as the ones mentioned in the above strategies.



## 6. EMPIRICAL RESULTS

Our main goal is to enhance the two technical trading rules that are mostly employed in the practice- the moving average crossover rule and the filter rule- with the risk reversal prices, and to evaluate the results. For evaluation purposes, we will compare all these strategies with the simple buy and hold strategy. In addition, another process that is taking place is the calculation of returns using only the signals that derive from the risk reversals. Finally, we will try to choose the moving average and the rule that has led to the highest profits. For the selection of the optimal moving average or filter we will follow the out-of-sample simulation. Finally, we have divided our sample into individual months as well as into 6-month periods and repeated the above calculations.

Our calculations are divided into two categories-**category A and B**. In **category A**, we use only the risk reversals that derive from out-of-the-money options whose strike price is 2b.p. symmetrical to the prevailing spot exchange rate. In this category we have few observations. So, in **category B** we have enriched our initial observations concerning the days we had absolutely no observations, with risk reversals from out-of-the-money options whose strike prices are 3b.p. or 1b.p. symmetrical to the prevailing spot exchange rate. It is obvious that before proceeding to any kind of comparison and conclusion we should pay attention to the number of observations we have at our disposal. Our analysis mainly focuses on the calculations in category B, because the results are almost the same in these two categories. However, at the beginning of each paragraph we state briefly the results from category A and, in required cases, compare these results with the ones derived from category B.

Finally, at the end of each section we present two kinds of tables. The first one includes analytic calculations (monthly) that took place during the various strategies that we examined. These calculations took place during each combination in both categories A and B but it would be worthless to present all of them in our thesis. This is the reason that we present only the calculations from category B. However, the tables that include the results from category A are presented in the appendix. We also have to notice that in some months we have no results. This happens because during these cases we had no risk reversal prices, so it would be useless to implement any strategy. The second kind of tables that we present concern a summary statistic of all the combinations in both categories A and B for the entire sample.

## 6.1 SWISS FRANC

### 6.1.1 Moving Average Combinations

#### 1Day/5Day Moving Average Crossover Rule – Risk Reversal

Our observations are divided in months. In Table 1, we present the relevant summary statistics that derive from the composition of **the moving average crossover rule and the risk reversal**. We have to remind that we always refer to average returns, monthly or of the entire sample. So, many times the differences may seem insignificant, but the real profits or losses derive if we multiply the average returns with the number of the used sample, monthly or entire one. Since, risk reversal observations are limited during some months, the average returns and the standard deviations will be influenced. Finally, we should notice that during some months we may not have any open position, but at the same time, the average monthly return would not be zero. This happens because during the last day of the previous month we might have an open position whose return is calculated in the next day of the new month.

With regard to 1Day/5Day combinations in **category A**, the average return for the entire period of the 41 months of our sample is  $-0.003$  per cent., which is not an important amount of loss. In addition, the highest Sharpe ratio is observed in July 1999 and the next highest in July 2000. Contrary to our expectations, the Sharpe ratio for the whole period of the 41 months is negative and equal to  $-0.007$ . On the other hand, the simple 1Day/ 5Day moving average crossover rule is associated with an Sharpe ratio of  $0.039$ . On the other hand the average return from the use of the risk reversal signals, leads to a great loss such as  $-0.049$  and for the naïve buy and hold strategy the loss is at the same level and equals to  $-0.04$ .

In **category B**, for the period of 41 months, we had 776 observations instead of 704 ones in **category A**. Furthermore, we had an open position for 357 days for **category B**, whereas in **category A** it occurred just for 181 days. In **category A** we had 11 months where we had less than 15 observations of risk reversal. In **category B**, these months diminished to 6. As we will ascertain below the results have not changed a lot.

The average return produced by following the combination **-1Day/5Day Moving Average Crossover Rule and Risk Reversal** – is negative and equal to  $-0.009$  per cent. On the other hand, the average return from the simple 1Day/5Day moving average is positive and equal to  $0.016$  per cent. Following the naïve buy and hold strategy and the risk reversal rule, great losses were resulted. In the case of the buy and hold strategy we have losses equal to –

0.027 per cent, while in the case of the simple risk reversal rule the losses are a little bit higher and equal to  $-0.034$  per cent.

The highest returns are produced during July 1999 and December 2000 and are equal to 0.00243 and 0.00206 respectively. As far as the lower returns are concerned, November 2000 is associated with a loss of  $-0.54$  per cent. This loss is not a representative one though because during this month we had only 7 risk reversal observations. If we notice the months where we had an adequate number of risk reversals we observe that in December 2001 the losses reached the level of  $-0.00259$  with the next lowest ones to be observed in March 2000.

The volatility associated with the combined trading strategy varies from 0.22 per cent for March 1999 to 0.742 per cent for August 1998. Finally, Sharpe ratio is higher for July 1999 and next higher for December 2000. If we study more attentively to our results, we can observe that for the same months we had the higher returns as well.

**We have already mentioned that the simple 1Day/Day moving average rule leads to greater average returns than in the case of the combined one** and they equal to 0.16 per cent. In addition, we can observe that in July 1999, where we had the highest average return (0.00243) in the combined 1Day/Day moving average rule and risk reversal strategy, the simple 1Day/Day moving average rule gives us also the highest profit that equal to 0.314 per cent. This also arises in the case of the lowest returns. In March 2000 the average return was  $-0.189$  per cent for the combined method. On the contrary, for the same month in the case of the simple 1Day/Day moving average rule the losses were  $-0.12$  per cent. Unfortunately, we cannot draw any conclusion concerning a general monthly increase or not of the returns between the combined and the simple strategies.

Once more the results from the buy and hold method and the simple risk reversal rule are disappointing. In the case of the buy and hold method, the average returns of the 41 months is  $-0.027$  per cent and the standard deviation 0.67 per cent. Worst results come from the risk reversal signals as well. The average return is also negative and equals to  $-0.034$  per cent and the volatility rises to 0.67. The negative values of Sharpe ratio make these two strategies inappropriate to be used. In Table 1 we present analytically the statistics on the profitability of all the methods.

Apart from the monthly calculations, we have also divided our sample to 6-month periods. So, the simple 1Day/5Day moving average crossover rule leads to positive returns in every 6-month period except for two periods. From September 1997 to February 1997 and from September 2000 till January 2001 we had a slight loss of  $-0.01$  per cent. On the contrary, the combined strategy resulted in losses in 4 6-month periods. Things become more confused in the case of the 6-month period, because from September 1997 to February 1997,

where, although in the previous strategy we had some losses, in the combination of 1Day/5Day moving average and risk reversal we get positive returns.

The comparison between strategies in category A and category B has provoked our interest. At the beginning of this section, we presented the average returns from the combined 1Day/Day moving average rule and risk reversal, the simple 1Day/Day moving average rule, the naïve buy and hold strategy and the risk reversal rule. If we compare these results to the ones derived from category A, we will conclude a slightest decrease in each case. **More specifically, the profits associated with the simple 1Day/5Day moving average are reduced by 28,6% in category B, the category with the existence of more risk reversal observations.**

In addition, in category B, the higher return is produced during July 1999 as in the respective case of category A. The same thing happens as far as the lowest return is concerned, as in category A, the great loss is observed during January 2001. Obviously, this similarity arises because during these particular months the number of risk reversal prices has not changed at all. What is worth examining is the change in returns in the case where the number of risk reversal data has increased. So, in January 1999, the number of observations has increased to 20 instead of 14 in category A. This increase brought an increase in the number of days where the signals from the 1Day/5Day moving average and the risk reversal were in accordance. Therefore, during January 1999 in category A the average monthly return was 0.019 per cent, while in category B -0.179 per cent. This comparison is really discouraging. Another example is the case of April 2000 where we firstly had 9 risk reversal prices which increased to 20 in category B. The number of days with open position also increased from 4 to 11. We expected that this increase would bring better profits. Unfortunately, in category B we observed a great loss equal to -0.049 per cent, instead of the 0.125 per cent profit of the first category.

Of course we cannot ignore the cases where we had an increase in both the number of risk reversal and the average returns. In May 2000, we had 6 observations in category A that led to 3 days of open position. In the next category, the observations rose to 22 and the number of days with an open position to 13. In this instance, the average monthly results increase from -0.14 per cent to 0.01 per cent in category B. Finally, similar increase is associated in December 2000, where an increase in the number of risk reversal from 19 to 21 brought an increase in profits from 0.126 per cent to 0.206 per cent. Hence, we cannot draw any clear conclusion based on the above results. It is worth waiting for the remaining results of our analysis.

To sum up, in the case of the 1Day/5Day moving average crossover rule and risk reversal strategy the best returns derive from the implementation of the simple moving

average rule. The combination of the signals from both the 1Day/5Day moving average and risk reversal rule results in a small loss, smaller than the one from the buy and hold strategy.

### 5Day/20Day Moving Average Crossover Rule – Risk Reversal

In **category A**, the average return for the case of the combined strategy is  $-0.006$  per cent, while for the case of the simple 5Day/20Day moving average is  $0.02$  per cent. Respectively, the Sharpe ratios are  $-0.013$  and  $0.031$ .

In **category B**, the profits associated with the combination of the 5Day/20Day moving average crossover rule and the risk reversal rule do not differ from the previous ones. The average return for the combined trading rule, that is the 5Day/20Day moving average crossover rule and the risk reversal is  $-0.005$  per cent, while the profits from the simple moving average rule reach the  $0.023$  per cent. Once more the volatility between these two methods varies. In the case of the simple technical trading rule the standard deviation is  $0.67$  per cent, that is a little bit increased than the standard deviation of the combined method, which is  $0.44$  per cent. Eventually, taking into account, the above calculations, **we expect that the Sharpe ratio has a higher value for the 5Day/20Day moving average crossover rule than for the combined one.** In the first strategy, the ratio is  $0.035$  and in the second one  $-0.012$ .

We are now going to compare the above results with the ones that derive from the combination of 1Day/5Day moving average crossover rule. We observe that in the case of the combined trading rule the losses are greater in the case of the 1Day/5Day moving average combination, while in the case of the simple technical trading rule the profits are higher for the 5Day/20Day moving average rule. The differences are obviously insignificant, but it is worth reporting them and wait for the respective results of the other combinations.

As far as the six-month periods are concerned, the results are much confused. In some periods, the returns are higher in the combined strategy, while in some others in the simple rule. It is noteworthy that in the first two six-month periods – from September 1997 to March 1997 and from April 1997 to next September – the returns in the simple technical trading rule are negative, whereas in the combined rule they are positive.

Finally, in the case of the 5Day/20Day moving average crossover rule, the days, where the signals from the two methods agree, have increased to 362 out of 776 observations. In the combination of the 1Day/5Day technical rule, the days with the same signals were 357. On the other hand, in the combinations of 5Day/20Day technical rule in this category the observations have increased approximately 10% and the days with the same signals have

increased 8%. We have a minimum difference that is also obvious in the respective returns of these two categories, since they are almost the same.

So, in this case again, the simple 5Day/20Day proves to be more profitable than the enhanced one. Obviously, here again the difference in profits between the combined strategy and the buy and hold strategy or the risk reversal one is remarkably considerable

### **1Day/200Day Moving Average Crossover Rule – Risk Reversal**

In **category A**, the profits again are greater in the case of the simple 1Day/200Day moving average crossover rule. Hence, although the Sharpe ratio may be low, just 0,029, we have to take into account that in the other three strategies –combined, buy & hold, risk reversal- the Sharpe ratios are negative. Of course, in the case of the combined trading rule the Sharpe ratio is negative, -0.018. In addition, although the number of days with open position for the case of the combined 1Day/5Day-risk reversal rule is 319, for the 5Day/20Day-risk reversal strategy 336, for the combined 1Day/200Day-risk reversal strategy is just 181 out of 704.

**The combinations of the 1Day/200Day moving average give the worst results among the other two combinations of category B.** The combined strategy resulted in a loss equal to -0.013 per cent and the simple 1Day/200Day moving average in a profit of 0.008 per cent. There is no need to report the results from the buy and hold method and the risk reversal rule, because in each of the combinations of category B their returns are the same. The signals from the two naïve methods are the same across all the combinations and are followed whenever we have risk reversal observations. The only difference observed between the two categories is the difference existing between the number of risk reversal observations.

**The number of open position is just 196 out of 776 and this number is the lower one among the 1Day/5 and 5Day/20Day moving averages.** We also notice that in the case of category A, the combination of 1Day/200Day moving average gave the minimum days of long or short positions as well.

As far as category B is concerned, the higher profits are associated with the combinations of 5Day/20Day moving average. Both the simple 5Day/20Day moving average rule and the combined 5Day/20Day -risk reversal strategy are the most profitable in comparison with the respective trading strategies of the other two sets of strategies. It is also obvious in every moving average crossover rule followed in this category that the returns were always higher in the cases of the simple moving averages. **The combined strategies came up with little losses, while the simple averages with positive returns.**

Between categories A and B, the higher profits derive from the 1Day/5Day moving average combinations of category A. The next higher return is observed in combinations of 5Day/20Day moving average of category B. Of course, the difference between these returns remains insignificant.

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ

Table 1 : 1Day/5Day Combinations Category B

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/5Day Average Monthly Returns	Standard Deviation of Returns	Sharpe R
09/97	22	14	0.131%	0.501%	0.262	0.093%	0.564%	0.164
10/97	23	14	0.032%	0.699%	0.045	0.060%	0.758%	0.079
11/97	20	8	-0.020%	0.454%	-0.044	0.033%	0.572%	0.058
12/97	7	1	0.000%	0.000%		-0.165%	0.725%	-0.228
01/98	22	11	-0.005%	0.574%	-0.008	0.107%	0.750%	0.143
02/98	20	6	-0.090%	0.504%	-0.179	-0.318%	0.584%	-0.544
03/98	22	7	0.054%	0.443%	0.122	0.074%	0.598%	0.124
04/98	22	12	0.094%	0.466%	0.201	0.136%	0.515%	0.264
05/98	21	10	0.051%	0.329%	0.154	0.059%	0.427%	0.137
06/98	19	8	-0.080%	0.254%	-0.317	-0.038%	0.473%	-0.080
07/98	18	13	0.001%	0.434%	0.003	-0.030%	0.479%	-0.063
08/98	21	12	0.048%	0.742%	0.064	-0.071%	0.862%	-0.082
09/98	20	6	-0.062%	0.157%	-0.396	0.018%	0.509%	0.036
10/98	10	6	-0.130%	0.546%	-0.239	0.110%	0.825%	0.133
11/98	21	15	0.129%	0.537%	0.241	0.088%	0.629%	0.140
12/98	0	0	0.000%			1.086%		
01/99	20	9	-0.179%	0.695%	-0.258	0.001%	0.966%	0.001
02/99	20	3	-0.061%	0.353%	-0.174	0.008%	0.655%	0.012
03/99	23	4	-0.057%	0.222%	-0.257	-0.095%	0.513%	-0.185
04/99	22	6	-0.052%	0.226%	-0.232	0.128%	0.457%	0.279
05/99	21	10	-0.083%	0.494%	-0.169	-0.060%	0.550%	-0.108
06/99	22	8	-0.096%	0.362%	-0.265	-0.120%	0.596%	-0.202
07/99	22	11	0.243%	0.491%	0.496	0.314%	0.553%	0.567
08/99	22	11	-0.095%	0.572%	-0.165	-0.142%	0.691%	-0.205
09/99	22	10	0.043%	0.392%	0.109	0.054%	0.736%	0.074
10/99	21	11	-0.018%	0.521%	-0.034	0.125%	0.827%	0.151
11/99	22	7	-0.011%	0.449%	-0.025	-0.012%	0.626%	-0.019
12/99	23	8	0.008%	0.452%	0.017	0.058%	0.607%	0.095
01/00	21	9	0.044%	0.427%	0.103	0.086%	0.719%	0.120
02/00	21	7	-0.021%	0.258%	-0.080	0.038%	0.817%	0.047
03/00	23	12	-0.189%	0.487%	-0.388	-0.120%	0.748%	-0.160
04/00	20	11	-0.049%	0.519%	-0.095	0.187%	0.806%	0.232
05/00	22	13	0.010%	0.591%	0.017	-0.134%	0.859%	-0.156
06/00	22	13	0.031%	0.442%	0.069	-0.035%	0.676%	-0.052
07/00	21	8	0.076%	0.257%	0.297	0.137%	0.589%	0.233
08/00	22	9	0.038%	0.298%	0.128	-0.062%	0.610%	-0.101
09/00	7	7	-0.335%	0.557%	-0.602	-0.335%	0.557%	-0.602
10/00	4	1	0.073%	0.445%	0.165	0.091%	0.444%	0.204
01/00	1	0						
12/00	21	16	0.206%	0.575%	0.358	0.162%	0.735%	0.221
01/01	23	10	-0.259%	0.686%	-0.377	-0.112%	0.882%	-0.127
	776	357	-0.009%	0.475%	-0.018	0.016%	0.666%	0.024

Note

-Blank space: no risk reversal prices / no returns



Table 1 : 5Day/20Day Combinations Category B (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 5Day/20Day Average Monthly Returns	Standard Deviation of Returns	Sha
1/09/97	22	22	0.170%	0.545%	0.312	0.170%	0.545%	
2/10/97	23	15	-0.037%	0.468%	-0.079	-0.077%	0.757%	
3/11/97	20	15	-0.028%	0.547%	-0.051	0.017%	0.572%	
4/12/97	7	1	0.000%	0.000%		-0.165%	0.725%	
5/01/98	22	8	-0.092%	0.283%	-0.323	-0.066%	0.755%	
6/02/98	20	14	0.018%	0.561%	0.032	+0.102%	0.661%	
7/03/98	22	3	0.115%	0.412%	0.280	0.196%	0.568%	
8/04/98	22	13	-0.037%	0.338%	-0.110	-0.126%	0.518%	
9/05/98	21	21	0.042%	0.429%	0.099	0.042%	0.429%	
10/06/98	19	6	-0.082%	0.283%	-0.291	-0.042%	0.472%	
11/07/98	18	12	0.034%	0.392%	0.087	0.035%	0.479%	
12/08/98	21	14	-0.073%	0.412%	-0.178	-0.313%	0.803%	
1/09/98	20	2	-0.004%	0.052%	-0.080	0.134%	0.490%	
2/10/98	10	5	-0.073%	0.421%	-0.173	0.225%	0.799%	
3/11/98	21	21	0.171%	0.610%	0.280	0.171%	0.610%	
4/12/98	0	0	-1.086%			-1.086%		
5/01/99	20	6	-0.127%	0.361%	-0.351	0.106%	0.960%	
6/02/99	20	2	-0.001%	0.285%	-0.003	0.129%	0.641%	
7/03/99	23	4	0.039%	0.197%	0.196	0.097%	0.513%	
8/04/99	22	4	-0.051%	0.266%	-0.191	0.131%	0.456%	
9/05/99	21	11	-0.106%	0.321%	-0.331	-0.105%	0.543%	
10/06/99	22	0	0.000%	0.000%		0.071%	0.604%	
11/07/99	22	6	0.110%	0.357%	0.308	0.047%	0.638%	
12/08/99	22	13	-0.067%	0.494%	-0.135	-0.086%	0.700%	
1/09/99	22	7	-0.141%	0.480%	-0.293	-0.313%	0.666%	
2/10/99	22	7	-0.094%	0.798%	-0.118	-0.027%	0.837%	
3/11/99	21	16	0.100%	0.428%	0.234	0.211%	0.588%	
4/12/99	23	2	-0.008%	0.069%	-0.111	0.027%	0.610%	
5/01/00	21	11	-0.013%	0.341%	-0.111	-0.040	-0.028%	0.724%
6/02/00	21	7	-0.126%	0.510%	-0.248	-0.173%	0.799%	
7/03/00	23	7	-0.094%	0.449%	-0.208	0.071%	0.755%	
8/04/00	20	11	-0.159%	0.313%	-0.507	-0.031%	0.828%	
9/05/00	22	6	0.125%	0.462%	0.270	0.096%	0.864%	
10/06/00	22	17	0.114%	0.639%	0.178	0.131%	0.663%	
11/07/00	21	8	0.001%	0.422%	0.003	-0.013%	0.606%	
12/08/00	22	12	0.169%	0.454%	0.371	0.199%	0.578%	
1/09/00	7	4	-0.029%	0.187%	-0.152	0.278%	0.594%	
2/10/00	4	2	-0.110%	0.181%	-0.607	-0.276%	0.334%	
3/11/00	1	0						
4/12/00	21	19	0.294%	0.644%	0.457	0.340%	0.669%	
5/01/01	23	10	-0.250%	0.621%	-0.402	-0.093%	0.884%	
	776	362	-0.005%	0.441%	-0.012	0.023%	0.665%	

Note

-Blank space: no risk reversal prices / no returns

Table 1 : 1Day/200Day Combinations Category B (continued)

Year	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/200Day Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
09/97	22	1	0.012%	0.053%	0.218	-0.147%	0.552%	-0.266
10/97	23	12	0.017%	0.644%	0.027	0.031%	0.760%	0.041
11/97	20	17	-0.093%	0.553%	-0.168	-0.113%	0.561%	-0.202
12/97	7	6	0.090%	0.708%	0.126	0.014%	0.746%	0.018
01/98	22	7	-0.122%	0.348%	-0.352	-0.128%	0.747%	-0.171
02/98	20	6	-0.101%	0.483%	-0.209	-0.339%	0.572%	-0.593
03/98	22	3	0.119%	0.410%	0.290	0.204%	0.565%	0.361
04/98	22	0	0.000%	0.000%		-0.052%	0.531%	-0.098
05/98	21	3	-0.031%	0.128%	-0.240	-0.104%	0.418%	-0.248
06/98	19	1	-0.023%	0.101%	-0.229	0.077%	0.468%	0.164
07/98	18	0	0.000%	0.000%		-0.032%	0.479%	-0.068
08/98	21	5	-0.001%	0.108%	-0.014	-0.169%	0.847%	-0.200
09/98	20	2	-0.004%	0.052%	-0.080	0.134%	0.490%	0.273
10/98	10	0	0.000%	0.000%		0.371%	0.736%	0.504
11/98	21	0	0.000%	0.000%		-0.171%	0.610%	-0.280
12/98	0	0	0.000%			1.086%		
01/99	20	16	-0.275%	0.884%	-0.311	-0.191%	0.946%	-0.202
02/99	20	11	-0.049%	0.484%	-0.101	0.033%	0.654%	0.050
03/99	23	5	0.052%	0.204%	0.254	0.123%	0.507%	0.243
04/99	22	4	-0.051%	0.266%	-0.191	0.131%	0.456%	0.287
05/99	21	1	-0.035%	0.176%	-0.196	0.038%	0.552%	0.070
06/99	22	0	0.000%	0.000%		0.071%	0.604%	0.118
07/99	22	2	0.006%	0.018%	0.309	-0.162%	0.618%	-0.262
08/99	22	5	0.019%	0.364%	0.053	0.086%	0.700%	0.122
09/99	22	1	0.002%	0.010%	0.213	-0.027%	0.738%	-0.037
10/99	21	9	-0.152%	0.603%	-0.252	-0.144%	0.824%	-0.174
11/99	22	5	0.100%	0.428%	0.234	0.211%	0.588%	0.359
12/99	23	1	-0.013%	0.063%	-0.209	0.016%	0.610%	0.026
01/00	21	6	0.112%	0.370%	0.303	0.223%	0.687%	0.325
02/00	21	5	-0.028%	0.455%	-0.063	0.023%	0.818%	0.028
03/00	23	3	-0.118%	0.420%	-0.281	0.022%	0.758%	0.029
04/00	20	3	-0.047%	0.146%	-0.323	0.192%	0.805%	0.238
05/00	22	5	0.047%	0.231%	0.204	-0.060%	0.867%	-0.069
06/00	22	1	-0.011%	0.052%	-0.213	-0.118%	0.666%	-0.177
07/00	21	3	0.064%	0.194%	0.331	0.113%	0.595%	0.191
08/00	22	12	0.169%	0.454%	0.371	0.199%	0.578%	0.344
09/00	7	0	0.000%	0.000%		0.335%	0.557%	0.602
10/00	4	2	0.166%	0.353%	0.471	0.276%	0.334%	0.827
11/00	1	1						
12/00	21	15	0.095%	0.589%	0.161	-0.060%	0.751%	-0.080
01/01	23	17	-0.240%	0.686%	-0.351	-0.075%	0.886%	-0.084
	776	196	-0.013%	0.371%	-0.035	0.008%	0.666%	0.012

Note

-Blank space: no risk reversal prices / no returns

Table 1 : Memorandum MA Combinations Category B (continued)

Period	<u>Buy&amp;Hold</u> Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	<u>Risk Reversal</u> Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	0.170%	0.545%	0.312	0.170%	0.545%	0.312
01-31/10/97	0.141%	0.747%	0.189	0.003%	0.761%	0.004
01-30/11/97	-0.113%	0.561%	-0.202	-0.073%	0.568%	-0.128
01-31/12/97	0.165%	0.725%	0.228	0.165%	0.725%	0.228
01-31/01/98	-0.058%	0.756%	-0.077	-0.117%	0.749%	-0.156
01-28/02/98	0.025%	0.669%	0.037	0.137%	0.654%	0.210
01-31/03/98	-0.204%	0.565%	-0.361	0.034%	0.601%	0.057
01-30/04/98	0.052%	0.531%	0.098	0.052%	0.531%	0.098
01-31/05/98	0.042%	0.429%	0.099	0.042%	0.429%	0.099
01-30/06/98	-0.077%	0.468%	-0.164	-0.123%	0.457%	-0.269
01-31/07/98	0.032%	0.479%	0.068	0.032%	0.479%	0.068
01-31/08/98	0.141%	0.852%	0.165	0.166%	0.848%	0.196
01-30/09/98	0.134%	0.490%	0.273	-0.142%	0.488%	-0.292
01-31/10/98	0.371%	0.736%	0.504	-0.371%	0.736%	-0.504
01-30/11/98	-0.171%	0.610%	-0.280	0.171%	0.610%	0.280
01-31/12/98	1.086%			-1.086%		
01-31/01/99	-0.191%	0.946%	-0.202	-0.359%	0.893%	-0.402
01-28/02/99	-0.129%	0.641%	-0.201	-0.131%	0.641%	-0.204
01-31/03/99	-0.123%	0.507%	-0.243	-0.019%	0.522%	-0.037
01-30/04/99	-0.131%	0.456%	-0.287	-0.232%	0.412%	-0.365
01-31/05/99	-0.038%	0.552%	-0.070	-0.107%	0.542%	-0.198
01-30/06/99	-0.071%	0.604%	-0.118	-0.071%	0.604%	-0.118
01-31/07/99	0.162%	0.618%	0.262	0.173%	0.615%	0.281
01-31/08/99	-0.086%	0.700%	-0.122	-0.047%	0.704%	-0.067
01-30/09/99	0.027%	0.738%	0.037	0.031%	0.738%	0.042
01-31/10/99	-0.092%	0.832%	-0.111	-0.161%	0.821%	-0.196
01-30/11/99	-0.211%	0.588%	-0.359	-0.011%	0.626%	-0.017
01-31/12/99	-0.016%	0.610%	-0.026	-0.042%	0.609%	-0.069
01-31/01/00	-0.223%	0.687%	-0.325	0.001%	0.724%	0.002
01-28/02/00	-0.023%	0.818%	-0.028	-0.080%	0.814%	-0.098
01-31/03/00	-0.022%	0.758%	-0.029	-0.258%	0.711%	-0.364
01-30/04/00	-0.192%	0.805%	-0.238	-0.286%	0.775%	-0.369
01-31/05/00	0.060%	0.867%	0.069	0.154%	0.855%	0.180
01-30/06/00	0.118%	0.666%	0.177	0.096%	0.669%	0.144
01-31/07/00	-0.113%	0.595%	-0.191	0.015%	0.606%	0.024
01-31/08/00	-0.199%	0.578%	-0.344	0.138%	0.596%	0.232
01-30/09/00	-0.335%	0.557%	-0.602	-0.335%	0.557%	-0.602
01-31/10/00	-0.276%	0.334%	-0.827	0.056%	0.451%	0.125
01-30/11/00						
01-31/12/00	0.340%	0.669%	0.508	0.249%	0.709%	0.351
01-31/01/01	-0.075%	0.886%	-0.084	-0.406%	0.787%	-0.516
	-0.027%	0.665%	-0.041	-0.034%	0.665%	-0.051

Note

-Blank space: no risk reversal prices / no returns

### 6.1.2 Filter Rule Combinations

#### 0.5% Filter Rule – Risk Reversal

In category A, the average monthly return associated with the combined strategy of 0.5% filter and risk reversal rules is negative and equal to -0.003 per cent. On the other hand, if we follow only the signals from the simple 0.5% filter rule, we would have a profit of 0.027 per cent.

In category B, we tried to eliminate the cases where we had no risk reversal observations. We added to the already existing data set risk reversals derived from options with strike prices 3b.p. or 1b.p. symmetrical to the prevailing spot exchange rate. Hence, the total number of observations has increased to 776 instead of the 704 in category A. In addition, the number of days with the signals from the combined strategy and the risk reversal has risen to 356 instead of the 321 in category A. Undoubtedly, it would be very interesting to examine the new results.

The average return produced from the combined strategy of the 0.5% filter rule and the risk reversal prices is negative and equal to -0.009 per cent. On the other hand, from the use of the simple 0.5% filter rule, the average returns for the whole period of 41 months is positive and equal to 0.015 per cent. For the buy and hold method and the simple risk reversal, the average returns are the same as in the previous combinations of moving average in category B. Buy and hold method is associated with loss equal to -0.027 per cent and the risk reversal rule with a loss of -0.034 per cent.

The highest return is observed during July 1999 and equals to 0.24 per cent. The next highest return is in December 2000 and equals to 0.17 per cent. The lowest return is produced in September 2000 and is equal to -0.34 per cent. However during this month we had only 7 risk reversal observations. On the other hand in January 2001 where we had 23 risk reversal observations the returns were -0.25 per cent. The next lowest return is associated with March 2000. Furthermore, in category A, during these two months, we had also the higher losses since the number of observations was unchanged. As far as the highest return is concerned, in the case of category A, it is exactly the same. In July 1999, the number of risk reversal observations have not changed at all, consequently, we do not expect any change in the average monthly return. We also notice that in category A, in December 2000, the return was 0.12 per cent, a little bit higher than the corresponding one in category B. During this month the number of days with the same signal increased by just two days.

It is noteworthy the average monthly returns during the months, where the number of risk reversal observations has increased in category B. The number of risk reversals has

increased in 5 months. In January 1999, the number of observations has risen to 20, instead of 14, and the number of days with open position to 12 instead of 7. Contrary to our expectations, in category B the average monthly return is -0.37 per cent and in category A - 0.18 per cent. The same thing happens during April 2000 and December 2000, where, although the number of days with open position has increased, the average returns are lower. On the other hand, we cannot ignore the other two months, where the increase in the number of days with a long or short position has led to an increase in the average monthly return.

The standard deviation for the combination of the 0.5% filter rule and the risk reversal is 0.48 per cent and for the simple 0.5% filter rule 0.67. The volatility associated with the combined trading strategy varies from 0.15 per cent for September 1998 to 0.84 per cent for August 1998. It is noticeable that these two months give the highest and the lowest standard deviation in nearly all the examined strategies. On the other hand, Sharpe ratio is a higher in the case of the simple 0.5% filter rule and equal to 0.023, instead of the -0.019 in the case of the combined trading strategy.

Once more, the use of the combined strategy of the filter and the risk reversal rules or just the use of the simple filter rule have led to the highest returns with the simple 0.5% filter rule to prevail. In the following strategies, the results do not change the existing picture. To avoid verbalism and repetitions, we will try to state the results in brief. We are going to focus only on the points we consider a more analytical reference worthwhile for us.

### 1% Filter Rule – Risk Reversal

The combined strategy of the 1% filter rule and the risk reversal one results in an average return of -0.013 per cent for the period of 41 months. The amount of loss for this combination is one of the worst ones among all the already examined. On the other hand, the use of the simple 1% filter rule, generates an average return equal to 0.008 per cent. In addition, the Sharpe ratios are low, indicating that the amount of excess return per unit of risk is inconsiderable.

The results that derive from the combination of 1% filter rule are similar to the respective ones in category A. We remind that the average return in the case of the 1% filter rule was also equal to 0.009 per cent, and the average return for the combined 1% filter rule and the risk reversal equal to -0.012 per cent.

Finally, the increase in the number of risk reversal observations has also led to an increase in the number of days where we have an open position and which have reached the 375 days. Furthermore, as in the previous strategy, the risk reversal observations increased in

five cases as well as the number of days with the same signals. In three months the increase in the number of days with an open position has led to higher average monthly returns, while in the other two months to lower average monthly returns.

### 2% Filter Rule – Risk Reversal

In **category A**, the results that derive from the combination of 2% filter is the lowest one among all the other trading combinations. The same thing happens as far as the return from the simple 2% filter rule is concerned. The Sharpe ratio for the period of 41 months is – 0.032 for the combined trading strategy, while the Sharpe ratio for the simple 2% filter rule is 0.006.

Nothing has changed in the case of the combination of the 2% filter rule and the risk reversal in **category B**. **The average returns in both the case of the combined strategy and the simple one are lower than the respective ones in category A. In addition, these results are the lowest among the already examined strategies of category B.** The average return derived from the use of the combined strategy is negative and equal to –0.017 per cent and the average returns from the simple 2% filter rule is positive and equal to 0.002 per cent. The Sharpe ratios are also low, reaching the –0.036 for the combined strategy and the 0.002 for the simple one.

The number of days, where the signals from the 2% filter rule and the risk reversal prices are in accordance, has reached the 393. **Unfortunately, this increase did not result in the same increase in the average returns.**

### 3% Filter Rule – Risk Reversal

In the case of the combination of 3% filter rule and the risk reversal in **category A**, the average return is –0.015 per cent and in the case of the simple 3% filter rule the average return is equal to 0.004 per cent. The Sharpe ratios for both the combined and the simple 3% filter rule are low and equal to –0.029 and 0.007 respectively.

In **category B**, the combinations of 3% filter rule and risk reversal prices lead to the worst average returns among all the other combinations. The combined strategy results in a loss equal to –0.02 per cent and the simple 3% filter rule to a loss of –0.04 per cent. **We notice that this is the only case where the use of a simple technical trading rule has generated a loss.** On the other hand, the volatility is high in both the combined strategy and the simple 3% filter rule. It is expected that the Sharpe ratios would be also discouraging

and so for the combined strategy is equal to  $-0.04$  and for the simple technical trading rule is  $-0.006$ .

Additionally, the number of days, where the signals from the risk reversal and the 3% filter are the same, is increased and equal to 514. **This number is the highest among all the other ones.** Although, we would expect that this number would have caused a significant increase in the average returns, it happens exactly the opposite, driving us to the worst average returns.

#### 4% Filter Rule – Risk Reversal

In category A, the returns and the Sharpe ratios from the use of the 4% filter rule and its combinations are the highest ones after those that derive from the combinations of the 0.5% filter rule. In the case of the combination of 4% filter rule and the risk reversal, the average return is  $-0.009$  per cent and in the case of the simple 4% filter rule the average return is equal to 0.017 per cent.

In category B, the average return for the entire period of 41 months for the combined strategy is equal to  $-0.011$  per cent and for the simple 4% filter rule equal to 0.014 per cent. In addition, the combined strategy of the 4% filter rule and the risk reversal generate a Sharpe ratio which equals to  $-0.0225$ , while the simple 4% filter rule a Sharpe ratio equals to 0.0213.

The number of days with an open position is high and reaches the 453 out of 776. Examining the months where the number of observations and consequently the number of days with an open position have risen, we conclude, **that in most of the cases, this increase has generated a decrease in the average monthly returns.**

#### 5% Filter Rule – Risk Reversal

Likewise in category A, the monthly returns generated from the 5% filter combinations are the similar with those generated from the 4% filter rule. This similarity is due to the signals derived from the 5% and the 4% filters. In order to get a signal from these filters, the prevailing spot rate should exceed or fall a great percentage (0.05 for the 5% filter and 0.04 for the 4% filter) from its recent trough or peak, which is rather unusual. According to our formula, when for instance the spot rate does not exceed its recent trough more than 5%, then we follow the previous day's signal. As a result, during the 4% and the 5% filter, for the entire period of our sample, we got a different signal only three cases.

The only difference is observed during December 2000. Hence, the average return for the combined strategy of 5% filter rule and of risk reversal is equal to  $-0.014$  per cent and the

average returns for the simple 5% filter rule equal to 0.009 per cent. Respectively, the Sharpe ratios are  $-0.027$  for the combined strategy and  $0.014$  for the simple 5% filter rule.

To summarize, the combination of the 0.5% filter led to the higher returns. The combined strategy is associated with a loss, while the simple 0.5% filter rule with a profit. It noteworthy that during this particular trading strategy, we had the least number of days with an open position.

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Table 2 : 0.5% Filter Combinations Category B

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 0.5% filter Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	22	12	0.120%	0.484%	0.247	0.069%	0.568%	0.1
01-31/10/97	26	16	0.131%	0.573%	0.229	0.258%	0.713%	0.3
01-30/11/97	20	6	-0.095%	0.266%	-0.356	-0.116%	0.560%	-0.2
01-31/12/97	7	2	0.211%	0.558%	0.378	0.257%	0.693%	0.3
01-31/01/98	22	13	-0.055%	0.611%	-0.090	0.007%	0.758%	0.0
01-28/02/98	20	9	0.003%	0.573%	0.006	-0.131%	0.656%	-0.1
01-31/03/98	22	4	0.072%	0.392%	0.183	0.109%	0.592%	0.1
01-30/04/98	22	9	0.034%	0.412%	0.082	0.016%	0.534%	0.0
01-31/05/98	21	13	0.023%	0.342%	0.068	0.004%	0.431%	0.0
01-30/06/98	19	8	-0.094%	0.249%	-0.379	-0.066%	0.470%	-0.1
01-31/07/98	18	17	0.007%	0.380%	0.017	-0.007%	0.513%	-0.0
01-31/08/98	21	14	0.087%	0.840%	0.104	0.008%	0.865%	0.0
01-30/09/98	20	6	-0.054%	0.147%	-0.370	0.033%	0.508%	0.0
01-31/10/98	10	6	-0.130%	0.546%	-0.239	0.110%	0.825%	0.1
01-30/11/98	21	13	0.081%	0.478%	0.169	-0.009%	0.635%	-0.0
01-31/12/98	0	0	0.000%			1.086%		
01-31/01/99	20	12	-0.373%	0.794%	-0.470	-0.388%	0.880%	-0.4
01-28/02/99	20	5	-0.138%	0.420%	-0.327	-0.145%	0.638%	-0.2
01-31/03/99	23	5	-0.028%	0.269%	-0.105	-0.037%	0.521%	-0.0
01-30/04/99	22	5	-0.037%	0.216%	-0.170	0.159%	0.447%	0.3
01-31/05/99	21	7	-0.063%	0.479%	-0.131	-0.018%	0.553%	-0.0
01-30/06/99	22	6	-0.054%	0.317%	-0.170	-0.036%	0.607%	-0.0
01-31/07/99	22	11	0.243%	0.491%	0.496	0.314%	0.553%	0.5
01-31/08/99	22	11	-0.095%	0.572%	-0.165	-0.142%	0.691%	-0.2
01-30/09/99	22	6	0.051%	0.379%	0.135	0.071%	0.735%	0.0
01-31/10/99	21	11	-0.018%	0.521%	-0.034	0.125%	0.827%	0.1
01-30/11/99	22	7	0.000%	0.446%	0.000	0.011%	0.626%	0.0
01-31/12/99	23	9	0.000%	0.468%	-0.001	0.041%	0.609%	0.0
01-31/01/00	21	12	0.017%	0.458%	0.037	0.033%	0.723%	0.0
01-28/02/00	21	5	0.034%	0.217%	0.156	0.148%	0.804%	0.1
01-31/03/00	23	14	-0.249%	0.492%	-0.506	-0.240%	0.718%	-0.3
01-30/04/00	20	11	-0.052%	0.521%	-0.100	0.182%	0.808%	0.2
01-31/05/00	22	9	0.032%	0.547%	0.059	-0.089%	0.865%	-0.1
01-30/06/00	22	13	0.033%	0.442%	0.074	-0.031%	0.676%	-0.0
01-31/07/00	21	10	0.070%	0.269%	0.261	0.125%	0.592%	0.2
01-31/08/00	22	10	0.099%	0.366%	0.271	0.060%	0.610%	0.0
01-30/09/00	7	7	-0.335%	0.557%	0.601	-0.335%	0.557%	0.6
01-31/10/00	4	1	0.073%	0.445%	0.164	0.091%	0.444%	0.2
01-30/11/00	1	0						
01-31/12/00	21	14	0.170%	0.567%	0.301	0.091%	0.748%	0.1
01-31/01/01	23	10	-0.253%	0.676%	-0.375	-0.101%	0.883%	-0.1
779		359	-0.009%	0.481%	-0.019	0.015%	0.666%	0.0

Note

-Blank space: no risk reversal prices / no returns

Table 2 : 1% Filter Combinations Category B (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1% filter Average Monthly Returns	Standard Deviation of Returns	Sharp Ratio
01-30/09/97	22	13	0.034%	0.409%	0.08	-0.102%	0.562%	-0.18
01-31/10/97	23	18	0.048%	0.713%	0.07	0.093%	0.755%	0.12
01-30/11/97	20	15	-0.064%	0.542%	-0.12	-0.055%	0.570%	-0.10
01-31/12/97	7	4	0.018%	0.259%	0.07	-0.130%	0.733%	-0.18
01-31/01/98	22	9	-0.026%	0.591%	-0.04	0.065%	0.755%	0.09
01-28/02/98	20	11	-0.014%	0.599%	-0.02	-0.165%	0.647%	-0.25
01-31/03/98	22	10	-0.035%	0.275%	-0.13	-0.104%	0.593%	-0.17
01-30/04/98	22	17	0.005%	0.447%	0.01	-0.041%	0.532%	-0.08
01-31/05/98	21	12	-0.024%	0.349%	-0.07	-0.090%	0.421%	-0.21
01-30/06/98	19	8	-0.157%	0.251%	-0.62	-0.191%	0.432%	-0.44
01-31/07/98	18	15	-0.054%	0.358%	-0.15	-0.129%	0.497%	-0.26
01-31/08/98	21	8	0.038%	0.754%	0.05	-0.089%	0.860%	-0.10
01-30/09/98	20	4	-0.003%	0.053%	-0.06	0.135%	0.490%	0.28
01-31/10/98	10	7	-0.090%	0.571%	-0.16	0.190%	0.809%	0.24
01-30/11/98	21	17	0.117%	0.601%	0.19	0.063%	0.632%	0.10
01-31/12/98	0	0	0.000%			1.086%		
01-31/01/99	20	4	-0.135%	0.418%	-0.32	0.089%	0.962%	0.09
01-28/02/99	20	2	-0.030%	0.250%	-0.12	0.071%	0.650%	0.11
01-31/03/99	23	7	-0.083%	0.349%	-0.24	-0.147%	0.500%	-0.29
01-30/04/99	22	4	-0.051%	0.266%	-0.19	0.131%	0.456%	0.29
01-31/05/99	21	7	-0.066%	0.326%	-0.20	-0.026%	0.553%	-0.05
01-30/06/99	22	7	-0.082%	0.318%	-0.26	-0.092%	0.601%	-0.15
01-31/07/99	22	7	0.156%	0.403%	0.39	0.138%	0.624%	0.22
01-31/08/99	22	16	-0.084%	0.611%	-0.14	-0.120%	0.695%	-0.17
01-30/09/99	22	9	0.131%	0.386%	0.34	0.231%	0.700%	0.33
01-31/10/99	21	12	-0.070%	0.571%	-0.12	0.021%	0.837%	0.03
01-30/11/99	22	5	0.100%	0.428%	0.23	0.211%	0.588%	0.36
01-31/12/99	23	6	-0.056%	0.239%	-0.24	-0.071%	0.606%	-0.12
01-31/01/00	21	8	0.075%	0.395%	0.19	0.150%	0.708%	0.21
01-28/02/00	21	4	-0.180%	0.433%	-0.41	-0.279%	0.766%	-0.36
01-31/03/00	23	12	-0.111%	0.358%	-0.31	0.036%	0.757%	0.05
01-30/04/00	20	11	-0.159%	0.313%	-0.51	-0.031%	0.828%	-0.04
01-31/05/00	22	12	0.087%	0.753%	0.12	0.021%	0.869%	0.02
01-30/06/00	22	17	0.092%	0.590%	0.16	0.089%	0.671%	0.13
01-31/07/00	21	8	-0.069%	0.410%	-0.17	-0.153%	0.585%	-0.26
01-31/08/00	22	11	0.109%	0.393%	0.28	0.081%	0.607%	0.13
01-30/09/00	7	7	-0.335%	0.557%	-0.60	-0.335%	0.557%	-0.601
01-31/10/00	4	3	-0.103%	0.187%	-0.55	-0.263%	0.348%	-0.756
01-30/11/00	1	0						
01-31/12/00	21	19	0.294%	0.644%	0.46	0.340%	0.669%	0.51
01-31/01/01	23	9	-0.218%	0.636%	-0.34	-0.030%	0.889%	-0.03
	776	375	-0.013%	0.473%	-0.03	0.008%	0.666%	0.01

Note

-Blank space: no risk reversal prices / no returns

Table 2 : 2% Filter Combinations Category B (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 2% filter Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	22	18	0.075%	0.469%	0.160	0.075%	0.469%	0.160
01-31/10/97	23	20	0.072%	0.701%	0.103	0.141%	0.747%	0.189
01-30/11/97	20	17	-0.093%	0.553%	-0.168	-0.113%	0.561%	-0.202
01-31/12/97	7	6	0.165%	0.725%	0.228	0.165%	0.725%	0.228
01-31/01/98	22	16	-0.088%	0.729%	-0.120	-0.058%	0.756%	-0.077
01-28/02/98	20	16	-0.006%	0.577%	-0.011	-0.150%	0.651%	-0.230
01-31/03/98	22	18	-0.085%	0.415%	-0.205	-0.204%	0.565%	-0.361
01-30/04/98	22	0	0.000%	0.000%		-0.052%	0.531%	-0.098
01-31/05/98	21	17	-0.048%	0.348%	-0.139	-0.139%	0.407%	-0.342
01-30/06/98	19	8	-0.046%	0.316%	-0.144	0.032%	0.473%	0.068
01-31/07/98	18	0	-0.028%	0.286%	-0.100	-0.077%	0.508%	-0.152
01-31/08/98	21	5	-0.001%	0.108%	-0.014	-0.169%	0.847%	-0.200
01-30/09/98	20	2	-0.004%	0.052%	-0.080	0.134%	0.490%	0.273
01-31/10/98	10	7	-0.090%	0.571%	-0.158	0.190%	0.809%	0.235
01-30/11/98	21	21	0.171%	0.610%	0.280	0.171%	0.610%	0.280
01-31/12/98	0	0	-1.086%			-1.086%		
01-31/01/99	20	11	-0.260%	0.586%	-0.443	-0.160%	0.952%	-0.168
01-28/02/99	20	2	-0.001%	0.285%	-0.003	0.129%	0.641%	0.201
01-31/03/99	23	5	0.052%	0.204%	0.254	0.123%	0.507%	0.243
01-30/04/99	22	4	-0.051%	0.266%	-0.191	0.131%	0.456%	0.287
01-31/05/99	21	19	-0.183%	0.445%	-0.411	-0.258%	0.486%	-0.531
01-30/06/99	22	11	-0.057%	0.537%	-0.107	-0.043%	0.607%	-0.072
01-31/07/99	22	7	0.156%	0.403%	0.386	0.138%	0.624%	0.221
01-31/08/99	22	17	-0.067%	0.601%	-0.111	-0.086%	0.700%	-0.122
01-30/09/99	22	9	-0.122%	0.572%	-0.213	-0.275%	0.683%	-0.403
01-31/10/99	21	16	-0.094%	0.798%	-0.118	-0.027%	0.837%	-0.033
01-30/11/99	22	5	0.100%	0.428%	0.234	0.211%	0.588%	0.359
01-31/12/99	23	19	-0.093%	0.454%	-0.205	-0.144%	0.592%	-0.244
01-31/01/00	21	12	0.094%	0.505%	0.185	0.186%	0.699%	0.266
01-28/02/00	21	5	-0.028%	0.455%	-0.063	0.023%	0.818%	0.028
01-31/03/00	23	6	-0.249%	0.526%	-0.473	-0.239%	0.718%	-0.332
01-30/04/00	20	3	-0.047%	0.146%	-0.323	0.192%	0.805%	0.238
01-31/05/00	22	5	0.036%	0.218%	0.166	-0.081%	0.865%	-0.094
01-30/06/00	22	15	0.047%	0.599%	0.078	-0.002%	0.677%	-0.003
01-31/07/00	21	3	0.064%	0.194%	0.331	0.113%	0.595%	0.191
01-31/08/00	22	12	0.169%	0.454%	0.371	0.199%	0.578%	0.344
01-30/09/00	7	5	-0.112%	0.266%	-0.420	0.112%	0.656%	0.17
01-31/10/00	4	2	-0.110%	0.181%	-0.607	-0.276%	0.334%	-0.826
01-30/11/00	1	0						
01-31/12/00	21	19	0.294%	0.644%	0.457	0.340%	0.669%	0.508
01-31/01/01	23	10	-0.250%	0.621%	-0.402	-0.093%	0.884%	-0.105
	776	393	-0.017%	0.480%	-0.036	0.002%	0.664%	0.002

Note

-Blank space: no risk reversal prices / no returns

Table 2 : Memorandum Filter Combinations Category B (continued)

Period	Buy&Hold Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Risk Reversal Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	0.170%	0.545%	0.312	0.170%	0.545%	0.312
01-31/10/97	0.141%	0.747%	0.189	0.003%	0.761%	0.004
01-30/11/97	-0.113%	0.561%	-0.202	-0.073%	0.568%	-0.128
01-31/12/97	0.165%	0.725%	0.228	0.165%	0.725%	0.228
01-31/01/98	-0.058%	0.756%	-0.077	-0.117%	0.749%	-0.156
01-28/02/98	0.025%	0.669%	0.037	0.137%	0.654%	0.210
01-31/03/98	-0.204%	0.565%	-0.361	0.034%	0.601%	0.057
01-30/04/98	0.052%	0.531%	0.098	0.052%	0.531%	0.098
01-31/05/98	0.042%	0.429%	0.099	0.042%	0.429%	0.099
01-30/06/98	-0.077%	0.468%	-0.164	-0.123%	0.457%	-0.269
01-31/07/98	-0.037%	0.512%	-0.073	0.020%	0.513%	0.039
01-31/08/98	0.141%	0.852%	0.165	0.166%	0.848%	0.196
01-30/09/98	0.134%	0.490%	0.273	-0.142%	0.488%	-0.292
01-31/10/98	0.371%	0.736%	0.504	-0.371%	0.736%	-0.504
01-30/11/98	-0.171%	0.610%	-0.280	0.171%	0.610%	0.280
01-31/12/98	1.086%			-1.086%		
01-31/01/99	-0.191%	0.946%	-0.202	-0.359%	0.893%	-0.402
01-28/02/99	-0.129%	0.641%	-0.201	-0.131%	0.641%	-0.204
01-31/03/99	-0.123%	0.507%	-0.243	-0.019%	0.522%	-0.037
01-30/04/99	-0.131%	0.456%	-0.287	-0.232%	0.412%	-0.565
01-31/05/99	-0.038%	0.552%	-0.070	-0.107%	0.542%	-0.198
01-30/06/99	-0.071%	0.604%	-0.118	-0.071%	0.604%	-0.118
01-31/07/99	0.162%	0.618%	0.262	0.173%	0.615%	0.281
01-31/08/99	-0.086%	0.700%	-0.122	-0.047%	0.704%	-0.067
01-30/09/99	0.027%	0.738%	0.037	0.031%	0.738%	0.042
01-31/10/99	-0.092%	0.832%	-0.111	-0.161%	0.821%	-0.196
01-30/11/99	-0.211%	0.588%	-0.359	-0.011%	0.626%	-0.017
01-31/12/99	-0.016%	0.610%	-0.026	-0.042%	0.609%	-0.069
01-31/01/00	-0.223%	0.687%	-0.325	0.001%	0.724%	0.002
01-28/02/00	-0.023%	0.818%	-0.028	-0.080%	0.814%	-0.098
01-31/03/00	-0.022%	0.758%	-0.029	-0.258%	0.711%	-0.364
01-30/04/00	-0.192%	0.805%	-0.238	-0.286%	0.775%	-0.369
01-31/05/00	0.060%	0.867%	0.069	0.154%	0.855%	0.180
01-30/06/00	0.118%	0.666%	0.177	0.096%	0.669%	0.144
01-31/07/00	-0.113%	0.595%	-0.191	0.015%	0.606%	0.024
01-31/08/00	-0.199%	0.578%	-0.344	0.138%	0.596%	0.232
01-30/09/00	-0.335%	0.557%	-0.601	-0.335%	0.557%	-0.602
01-31/10/00	-0.276%	0.334%	-0.058	0.056%	0.451%	0.125
01-30/11/00						
01-31/12/00	0.340%	0.669%	0.508	0.249%	0.709%	0.351
01-31/01/01	-0.075%	0.886%	-0.084	-0.406%	0.787%	-0.516
	-0.027%	0.665%	-0.041	-0.034%	0.665%	-0.051

Note

-Blank space: no risk reversal prices / no returns

**Summary Statistics of Category B****Moving Average Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
1Day/5Day	776	357	-0.009%	0.475%	-0.018
5Day/20Day	776	362	-0.005%	0.441%	-0.012
1Day/200Day	776	196	-0.013%	0.371%	-0.035
<b>Simple MA</b>					
1Day/5Day	776	776	0.016%	0.666%	0.024
5Day/20Day	776	776	0.023%	0.665%	0.035
1Day/200Day	776	776	0.008%	0.666%	0.012
<b>Memoorandum Items</b>					
Buy & Hold	776	776	-0.027%	0.665%	-0.041
Risk Reversal	776	776	-0.034%	0.665%	-0.051

**Filter Rule Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
0.5%	776	356	-0.009%	0.481%	-0.019
1%	776	375	-0.013%	0.473%	-0.027
2%	776	393	-0.017%	0.480%	-0.036
3%	776	514	-0.020%	0.534%	-0.038
4%	776	453	-0.011%	0.501%	-0.022
5%	776	453	-0.014%	0.499%	-0.027
<b>Simple Filter</b>					
0.5%	776	776	0.015%	0.666%	0.023
1%	776	776	0.008%	0.666%	0.012
2%	776	772	0.002%	0.664%	0.002
3%	776	735	-0.004%	0.648%	-0.006
4%	776	735	0.014%	0.648%	0.021
5%	776	735	0.009%	0.648%	0.014
<b>Memoorandum items</b>					
Buy & Hold	776	776	-0.027%	0.665%	-0.041
Risk Reversal	776	776	-0.034%	0.665%	-0.051

**Summary Statistics of Category A****Moving Average Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
1Day/5Day	704	319	-0.003%	0.468%	-0.007
5Day/20Day	704	336	-0.006%	0.445%	-0.013
1Day/200Day	704	181	-0.007%	0.369%	-0.018
<b>Simple MA</b>					
1Day/5Day	704	704	0.026%	0.659%	0.039
5Day/20Day	704	704	0.020%	0.659%	0.031
1Day/200Day	704	704	0.019%	0.659%	0.029
<b>Memoorandum Items</b>					
Buy & Hold	704	704	-0.027%	0.659%	-0.040
Risk Reversal	704	704	-0.032%	0.659%	-0.049

**Filter Rule Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
0.5%	704	321	-0.003%	0.474%	-0.006
1%	704	338	-0.012%	0.465%	-0.025
2%	704	368	-0.016%	0.486%	-0.032
3%	704	476	-0.015%	0.536%	-0.029
4%	704	426	-0.009%	0.503%	-0.018
5%	704	426	-0.008%	0.503%	-0.016
<b>Simple Filter</b>					
0.5%	704	704	0.027%	0.659%	0.040
1%	704	704	0.009%	0.659%	0.013
2%	704	700	0.004%	0.657%	0.006
3%	704	663	0.004%	0.640%	0.007
4%	704	663	0.017%	0.639%	0.027
5%	704	663	0.019%	0.639%	0.030
<b>Memoorandum Items</b>					
Buy & Hold	704	704	-0.027%	0.659%	-0.040
Risk Reversal	704	704	-0.032%	0.659%	-0.049

### 6.1.3 Out-of-sample simulation

#### Moving Average Combinations

According to the out-of-sample simulation, we do not use the same trading strategy throughout the entire sample. Instead, we have divided the data set to 41 months, and during each month we use a different strategy. The choice of the technical rule depends on the average monthly returns generated from the previous calculations. For instance, as far as the moving average crossover rule is concerned, for January 1999 we compare the average monthly returns during December 1998 and pick out the moving average that has led to the highest average monthly return. Due to this technique our sample starts in November 1997 and ends in January 2001.

In category B, for both the combined method and the simple average moving average rule, the highest returns are generated from the use of the same technical trading rule for each strategy. So, the 5Day/20Day moving average crossover rule has led to the highest returns in 15 months, the 1Day/5Day moving average in 13 months and finally the 1Day/200Day moving average rule in 12 months. In the context of the combined strategy, we use the appropriate moving average rule and combine it with the risk reversal prices, while for the simple technical trading rule, we just use the moving average that derives from the previous month's average return.

For the **combined strategy**, the greatest average monthly return is observed during December 2000 from the use of the 1Day/5Day and is equal to 0.15 per cent. In addition, during the process that we followed in order to choose the appropriate technical trading rule, we observe that in 13 months out of 41, the highest returns from the use of the three moving average rules are negative. This means, that during these months, the use of all the examined moving averages has generated negative average monthly returns. Another point that should be stated is that the number of days, where the signals from the technical trading rule and the risk reversal are the same, is just equal to 260. Since, in this section, in each month we use a different moving average, which is the best, we would expect the signals from the technical rule to have been in accordance to the risk reversals ones. **The low number of days with equal signals may constitute another point for the inconvenience of the use of risk reversals for generating buy or sell signals.**

For the simple technical trading rule, the greatest average return is observed during November 1998, equals to 0.225 per cent and is generated from the 5Day/20Day moving average crossover rule. As far as the negative returns are concerned, we meet them in only 3 months out of 41. This means that only in 3 months, both the three technical rules drive to negative average monthly returns.

What is really strange is that, although we used the out-of-sample simulation, **the Sharpe ratios for the period of 41 months are really disappointing.** In the combined method, the Sharpe ratio is negative and equal to  $-0.063$  and in the simple technical trading rule also negative and equal to  $-0.016$ . If we see again our previous results, we will notice that these ones are the worst.

The picture generated from the implementation of the out-of-sample simulation in category A is the same as the previous one. Each month has the same best technical trading rule as in category B, except for 5 months. Furthermore, during the same months we observe the highest and the negative average monthly returns. In the combined method, the Sharpe ratio is negative and equal to  $-0.08$  and in the simple technical trading rule also negative and equal to  $-0.03$ . Finally, we should notice that **the results both in the case of the combined strategy and the simple moving average crossover rule are a little bit better in category B than the respective ones in category A, but still negative.**

### Filter Rule Combinations

The implementation of the out-of-sample simulation on the filter rule combinations has generated better results that nevertheless have not changed the existing conclusions. The selection of the best filter rule is carried out among the 0.5%, 1%, 2%, 3%, 4%, 5% filter rules. The 5% filter rule has never been chosen as the best technical trading rule. This happens because, as we remember from the previous analysis, the results between 4% and 5% filter rules are almost the same and so, whenever necessary, we chose the 4% filter rule. Among the other filter rules, the most used one is the 0.5% filter rule, which has generated the highest average monthly results during 17 months out of 41. The 1% filter rule has led to the highest returns in 11 months, the 2% and 3% filter rules in 7 and 5 months respectively and the 4% filter rule in only 3 months. For each month, the highest returns are generated by the same filter rule for both the combined and the simple filter strategy.

As far as the **combined strategy** is concerned, the highest average monthly return is observed during November 1998 from the use of the 4% filter rule and is equal to 0.17 per cent. It is noteworthy that in November 1998 we had 21 risk reversal observations and exactly the same number with an open position. Furthermore, in 14 months out of 41, all the examined filter rules has led to negative average monthly returns. Finally, the number of days with open position is 312; it is very low in relation to the 776 days of observations. In the combined method, the Sharpe ratio is negative and equal to  $-0.036$  while in the simple technical trading rule positive and equal to 0.006.



In the case of the **simple filter rules**, the highest average monthly return is observed during April 2000 from the use of 1% filter rule and is equal to 0.14 per cent. In addition, in only 6 months out of 41, all the filter rules led to negative monthly returns. Contrary to the out-of-sample simulation of the moving average combinations, the average return generated from the filter combinations is positive and equal to 0.04 per cent.

**Summary Statistics of Out-of-Sample of Category B**

**Moving Average Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal and MA	776	260	-0.025%	0.389%	-0.063
Simple MA	776	776	-0.011%	0.668%	-0.016

**Filter Rule Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal And Filter	776	312	-0.013%	0.480%	-0.028
Simple Filter	776	776	0.012%	0.668%	0.018

6.14 CONCLUSION

**Summary Statistics of Out-of-Sample of Category A**

**Moving Average Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal and MA	704	216	-0.029%	0.367%	-0.079
Simple MA	704	704	-0.021%	0.662%	-0.031

**Filter Rule Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal and Filter	704	278	-0.014%	0.477%	-0.029
Simple Filter	704	704	0.010%	0.662%	0.015

#### 6.1.4 CONCLUSION

The picture starts to become clearer. We have stated the moving average combinations, using the 1Day/5Day, 5Day/20Day, 1Day/200Day moving average crossover rules and the risk reversal prices. Additionally, we have also used the filter rule combinations, using the 0.5%, 1%, 2%, 3%, 4%, 5% filter rules and the risk reversal prices. Finally, we have calculated the returns and the Sharpe ratio for the buy and hold method as well as for the risk reversal rule. The picture is almost the same for every group of strategies and has been already stated thoroughly at the end of each combination of strategies.

Briefly, we can conclude that as far as the moving average combinations are concerned, **the use of the simple moving average crossover rules has led to the higher returns as well as to higher Sharpe ratios.** The combined methods produce slight losses, almost insignificant, but definitely no gains. Among the moving average combinations the greatest returns derive from the 1Day/5Day moving average rule for category A, and from 5Day/20Day for category B. In both of these combinations the number of days where we had a short or long position is, on average, half than the entire sample of the risk reversal prices. On the other hand, the worst results, for both categories come from the 1Day/200Day combinations. During these combinations the number of days with the same signals is the least one. Furthermore, in both categories, the use of the simple technical trading rules has generated better results than the corresponding ones from the use of the combined strategies. **Specifically, all the examined moving average crossover rules are associated with positive average returns and Sharpe ratios while all of their combinations with the risk reversal led to negative results.**

Furthermore, the combinations of the filter rule did not result any change with reference to the previous picture. The use of the filter rules is associated with positive returns and high Sharpe ratios, while the use of the combined methods with negative returns and low Sharpe ratios. The only exception arises from the case of 3% filter rule of the category B where the combined strategy led to losses. However, in the corresponding case of the simple filter rule the losses were much greater so the superiority of the simple filter rule still exists.

The filter combinations lead to the highest returns in the case of 0.5% filter rule, both in categories A and B. It is also worrying that during this filters we had the lowest number of days with a short or long position. This means that in the case where our results were the highest ones, the signals from the 0.5% filter and the risk reversal differ significantly. As regards the lowest results, in category A the 2% filter combinations led to the worst results while in category B the lowest results come from the 3% filter combinations. Both these filter combinations are associated with a lot of days with an open position.

The discouraging results arise from the use of the buy and hold method as well as from the risk reversal rule. Both strategies are associated with great losses in all the strategies in both categories A and B. Hence, the use of these two methods is prohibited.

Finally, in category B, where we tried to eliminate the gaps from the risk reversal prices and the number of risk reversal prices is higher, the results from all the examined strategies are lower than the corresponding ones from category A. For instance, in the case of the simple 1Day/5Day moving average crossover rule, the results reduced by 28,6% in category B. This is rather strange since we expected an opposite result. In addition, the most alarming point, is that, during the months where the number of observations has increased, we do not notice any significant increase in the respective average returns.

Finally, the implementation of the out-of-sample simulation did not produce the expected returns. In both categories A, B and in both the moving average and the filter combinations the results were the worst among all the examined ones. Additionally, the difference between the combined strategies and the simple technical trading rules still remains, giving an advance to the simple technical trading rules. However the average returns from all the strategies are associated with great losses.

In order to implement the out-of-sample simulation, we should have compared the returns from the strategies we followed. So, from this comparison, we concluded that the small moving average (1Day/5Day) as well as the small filter rule (0.5%) generated the highest returns. **Furthermore, in both of these categories, the highest returns are associated with the same technical trading rules both in the combined and the simple strategies.**

## 6.2 BRITISH POUND

### 6.2.1 Moving Average Combinations

#### 1Day/5Day Moving Average Crossover Rule – Risk Reversal

The second currency about which we found put and call options data is the British Pound. The period to be examined starts from January 1, 1999 and ends on January 31, 2001. As we will see, the results from the implementation of the moving average crossover rule, the risk reversal, the combination of these two rules as well as the simple buy and hold method differ from the corresponding ones for the Swiss Franc. As far as the combinations of the 1Day/5Day moving average crossover rule and the risk reversal in **category A** are concerned the returns are not the expected ones. Unfortunately, we have a significant loss equal to  $-0.018$  per cent and a Sharpe ratio equal to  $-0.057$ . The use of the simple 1Day/5Day moving average crossover rule has generated negative average returns equal to  $-0.03$  per cent and a Sharpe ratio of  $-0.065$ . Finally, the buy & hold method is associated with a Sharpe ratio of  $-0.01$  while the risk reversal with a ratio equal to  $-0.013$ .

In **category B**, we tried to eliminate the cases where we had no risk reversal prices. The examined period consists of 25 months as in category A. The main difference is that for most of these months we have risk reversal prices for almost every trading day. The period to be examined starts from January 1, 1999 and ends on January 31, 2001. Only in three months we have less than 20 risk reversal observations, and for another 3 months, that is from September 2000 to November 2000, we have no observations at all. For these three months we have no observations in category A as well, hence it will not affect our comparison. The total number of risk reversals is 455 and in 219 cases the signals that derive from the 1Day/5Day moving average crossover rule are the same with those that derive from the risk reversals. What we should notice is that, although in 19 months of our sample we have risk reversal prices for every trading day, only in half of the trading days during these 19 months the signals are the same and therefore we have an open position. In the cases where the signals are different, we close our existing position and wait for the day where the signals would agree.

The combination of the 1Day/5Day moving average rule and the risk reversal is associated with an average loss of  $-0.016$  per cent. On the other hand the simple use of the 1Day/5Day moving average crossover rule leads to a loss of  $-0.02$  per cent. The resulted difference is insignificant, nevertheless we should not ignore it because these levels of difference are arisen during every calculation till now.

With regard to the buy and hold method is concerned, we have the same loss as in the two previous methods, which equals to  $-0.02$ . The less amount of loss is associated with the risk reversal signals and is equal to  $-0.01$ .

As far as the combined strategy of the 1Day/5Day moving average rule and the risk reversal rule is concerned, the highest average monthly return is generated during July 1999 and is 0.15 per cent for 10 days of open position. The next highest is associated with December 2000 and equals to 0.125 per cent for 11 days of open position. The lowest monthly average return is produced through November 1999, is equal to  $-0.125$  per cent and is followed by the  $-0.11$  per cent average return generated during May 1999. The total Sharpe ratio for the whole period of the 25 months is  $-0.05$ . This amount of Sharpe ratio makes the combined method inappropriate for any trading use. The highest Sharpe ratio is observed during July 1999, while the lowest one during November 1999. These two same months have already produced the highest and lowest average monthly return as well.

By just following the simple 1Day/5Day moving average crossover rule the results are a little bit more discouraging. The average return for our sample is negative and equals to  $-0.02$  per cent. We expect the highest and the lowest monthly returns to be produced during the same months as in the case of the combined method, and this has happened partially. Hence, July 1999 and November 1999 are associated with the highest and the lowest monthly average returns respectively. On the other hand the next highest and lowest average returns are not observed during the same months. In the case of the Sharpe ratio, the remarks are quite better, although the ratio is still negative and equal to  $-0.044$ .

The average return that is associated with the buy and hold method is the same as the one of the simple 1Day/5Day moving average crossover rule. This ascertainment is not very encouraging because it is supposed that the buy and hold method is a naïve one and all the others strategies should have resulted in better returns. On the other hand, the results derived from the signals of the risk reversal are interesting. **Among all the strategies concerning the section of the 1Day/5Day moving average crossover rule, the signals from the risk reversal have led to the best average returns.** The average return for the whole sample may be negative, but the losses are considerable limited since it is  $-0.001$ .

The 6-month period calculations have also driven us to the conclusion that the simple 1Day/5Day moving average crossover rule is inappropriate for use. Except for the 6-month period from July 2000 to December 2000 all the other 6-month periods have generated negative average returns. Additionally, we should remind that the particular period between July 2000 and December 2000 includes the three months where we have none risk reversal observation. As regards the combined strategy, the negative return has been limited to two 6-month periods, although during the other 6-month periods the profits were very small. Finally,

we should note that between the simple risk reversal method and the combination with the 1Day/5Day moving average rule, the respective negative average 6-month returns are higher in the case of the combination of the risk reversal and the 1Day/5Day moving average rule, while the positive ones are higher in the case of simple the risk reversal method.

Since in category B the risk reversal prices have increased to 455 from 338 in category it would be interesting to examine the possible changes brought by this increase. For the simple 1Day/5Day moving average rule and the combined one, no meaningful difference was observed. The average returns are negative in all the cases and rather equal. **We tried to get some idea of whether we had better results during the months where the number of risk reversal had increased. Unfortunately, from the so far results we cannot conclude anything.** For instance, during April 1999, in category A we had only 5 risk reversal prices and during 2 days an open position, instead in category B the risk reversal prices have increased to 22 and eventually the number of days with a long or short position to 11. Unfortunately, this increase did not imply an increase in the average monthly return since the return decreased from 0.08 per cent to -0.054 per cent. A similar situation is faced in the case of May 2000, where the increase in the number of risk reversal observations resulted in a decrease of the average monthly return. Of course, like all the examined categories, there were months during which the increase in the number of the risk reversal brought an increase in the number of average return. An example may be August 2000, where the 9 more risk reversal prices brought an increase from -0.21 per cent to 0.05 per cent.

As far as the buy and hold strategy and the risk reversal method are concerned, the difference is more evident. Since the number of risk reversal observations is increased in category B, eventually the same would have happened with the number of open position during these two methods. **On the other hand, both of these two methods are associated with higher returns in category A, although all of them are negative.**

These returns, so far, are strange and completely different from the corresponding ones in the case of the Swiss Franc. We should remind us about the corresponding case of the Swiss Franc, where the signals from the simple technical trading rules led to profits, and the signals from the combined method to limited losses. On the other hand, the results derived from the buy and hold method as well as the risk reversal rule are not the worst on contrary to the case of the Swiss Franc where the respective returns were the worst. So we have to wait for the returns generated from the other technical trading rule and their combinations with the risk reversal prices to come to the conclusion.

### 5Day/20Day Moving Average Crossover Rule – Risk Reversal

In category A, with reference to the Sharpe, the 5Day/20Day moving average crossover rule generates the best one, which is equal to  $-0.009$  with the next highest to come from the combination of the 5Day/20Day moving average and the risk reversal rules, which is equal to  $-0.016$ . On the other hand, the particular combination generates the least number of days with an open position, which reach the 155 days out of 338 risk reversal prices.

In category B, the average returns generated from the 5Day/20Day moving average rule combinations are absolutely higher than the corresponding ones from the 1Day/5Day moving average rule combinations. The combined strategy of the risk reversal and the 5Day/20Day moving average rule generates a loss equal to  $-0.004$  per cent. It may seem inconsiderable, but it differs from the corresponding one from the combination of the 1Day/5Day moving average crossover rule, which was equal to  $-0.016$  per cent. Generally, the combined strategies of the 1Day/5Day moving average rule and the 5Day/20Day moving average rule do not generate the highest and the lowest average monthly returns during the same months. Of course, in most of the cases, the two strategies produce positive and negative average returns during the same months. Finally, the Sharpe ratio is negative and equal to  $-0.012$ .

In this section, the strangest remark takes place during the implementation of the simple technical trading rule of the 5Day/20Day moving average. **This particular trading rule generates a profit, for the first time, which is equal to 0.004 per cent.** This profit may seem insignificant, but it cannot be ignored, since in the previous combination of the 1Day/5Day moving average rule the implementation of the particular technical trading rule has generated the highest loss among all the other trading rules. And it is this remark that has complicated more the existing picture. Finally, the Sharpe ratio is positive, and equals to  $0.009$ , showing us the excess return relative to the risk incurred.

The buy and hold strategy as well as the risk reversal one are not noteworthy since the generated returns are the same as in the previous combination. The only thing we should pay attention to is the fact that both these two methods generate small losses which are at the same level with the average return of the combination of the 5Day/20Day moving average rule and the risk reversal, which is rather discouraging.

Due to the insignificant changes between the strategies in the case of 5Day/20Day moving average combinations, the 6-month period calculations did not clear the picture. The only thing that is clarified is that both the simple 5Day/20Day moving average rule and its combination with the risk reversal prices are associated with higher returns than those in the case of the 1Day/5Day moving average combinations.



Finally, the entire picture derived from the combinations of the 5Day/20Day moving average crossover rule in category B is not far from the corresponding one in category A. We have to keep in mind that in category A, the implementation of the simple 5Day/20Day moving average rule had also led to the higher average returns although they were negative. Additionally, in the case of the combined strategy the difference between the two categories is negligible. **It seems that the increase in the number of the risk reversal observations and the number of days with an open position which reached in category B the 203, did not influence our results to the extent we expected.**

### 1Day/200Day Moving Average Crossover Rule – Risk Reversal

In category A, the slight difference between the simple 1Day/200Day moving average rule and the combined strategy still exists. The Sharpe ratio for the case of the simple moving average is negative and equal to  $-0.017$  while for the combined method  $-0.022$ . Finally, we should notice the highest number of days where the signals from the 1Day/200Day moving average crossover rule and the risk reversal are in accordance and reach the 166 out of 338 days. Nevertheless, this phenomenon is an unusual one if we consider the case of the Swiss Franc where always the 1Day/200Day moving average rule combinations drove us to the lowest number of days with an open position.

In category B, the returns generated from the combined strategy of the 1Day/200Day moving average rule are similar to the previous ones. The average return from the combined trading rule is  $-0.003$  per cent, almost zero. Furthermore, the simple 1Day/200Day moving average crossover rule leads to profits equal to  $0.006$  per cent. **It is noticeable that the number of days, where the signals from the risk reversal and the technical trading rule were the same, was 221 which is the highest number among the other two combinations.**

Considering the 1Day/200Day moving average rule combinations in category A, we can observe the difference between the average return generated from the implementation of the simple technical trading rule in these two categories. In the first category, the simple technical rule led to a loss not different from the one derived from the other strategies. On the other hand, the 1Day/200Day moving average rule in the second category is associated with a significant profit considering the losses, which are associated with the other rules.

To sum up, the calculation for the British Pound has changed the existing picture. In the combinations of the 1Day/5Day moving average rule the results are discouraging as far as the simple and the combined trading rule is concerned. In fact, only in these combinations the simple technical trading rule generates great losses and the naïve buy and hold method as well as the risk reversal rule gave us better results. In the other two trading combinations, the

results among the four strategies do not differ a lot. In this category for the British Pound, apart from the 1Day/5Day moving average rule combinations, we cannot state which combination of the other technical trading rules is associated with the higher returns.

Table 3: 1Day/5Day Combinations Category B

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/5Day Average Monthly Returns	Standard Deviation of Returns	Sha Ra
01-31/01/99	21	14	-0.075%	0.290%	-0.257	-0.038%	0.472%	-0.
01-28/02/99	20	3	-0.002%	0.233%	-0.008	0.060%	0.503%	0.1
01-31/03/99	23	11	-0.058%	0.227%	-0.256	-0.112%	0.361%	-0.
01-30/04/99	22	11	-0.054%	0.268%	-0.201	-0.060%	0.317%	-0.
01-31/05/99	21	8	-0.107%	0.306%	-0.351	-0.006%	0.435%	-0.
01-30/06/99	22	6	-0.044%	0.218%	-0.202	-0.133%	0.439%	-0.
01-31/07/99	21	10	0.149%	0.382%	0.391	0.287%	0.524%	0.5
01-31/08/99	22	13	-0.072%	0.378%	-0.191	-0.125%	0.449%	-0.
01-30/09/99	21	14	-0.007%	0.331%	-0.021	0.052%	0.433%	0.1
01-31/10/99	21	9	-0.039%	0.304%	-0.129	-0.039%	0.473%	-0.
01-30/11/99	22	12	-0.125%	0.283%	-0.441	-0.163%	0.446%	-0.
01-31/12/99	23	10	-0.022%	0.334%	-0.066	-0.022%	0.378%	-0.
01-31/01/00	20	10	0.050%	0.366%	0.135	-0.054%	0.522%	-0.
01-28/02/00	21	8	-0.054%	0.308%	-0.174	-0.093%	0.550%	-0.
01-31/03/00	23	11	-0.022%	0.170%	-0.129	-0.008%	0.318%	-0.
01-30/04/00	20	10	0.104%	0.347%	0.301	0.058%	0.415%	0.1
01-31/05/00	19	7	-0.031%	0.361%	-0.087	0.206%	0.679%	0.3
01-30/06/00	22	12	-0.010%	0.503%	-0.021	-0.146%	0.595%	-0.
01-31/07/00	20	9	-0.033%	0.312%	-0.106	-0.048%	0.382%	-0.
01-31/08/00	11	8	0.051%	0.336%	0.153	0.068%	0.353%	0.1
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	11	0.125%	0.377%	0.332	0.123%	0.505%	0.2
01-31/01/01	23	12	0.005%	0.251%	0.020	-0.113%	0.403%	-0.
	455	219	-0.016%	0.318%	-0.050	-0.020%	0.462%	-0.

Note

-Blank space: no risk reversal prices / no returns

Table 3: 5Day/20Day Combinations Category B (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 5Day/20Day Average Monthly Returns	Standard Deviation of Returns	S R
01-31/01/99	21	9	-0.081%	0.321%	-0.252	-0.051%	0.471%	-
01-28/02/99	20	2	0.021%	0.109%	0.192	0.106%	0.495%	0
01-31/03/99	23	9	-0.079%	0.246%	-0.322	-0.154%	0.344%	-
01-30/04/99	22	10	-0.035%	0.264%	-0.132	-0.022%	0.322%	-
01-31/05/99	21	10	-0.066%	0.137%	-0.481	0.077%	0.427%	0
01-30/06/99	22	7	0.001%	0.317%	0.002	-0.043%	0.458%	-
01-31/07/99	21	4	0.068%	0.191%	0.356	0.124%	0.587%	0
01-31/08/99	22	12	-0.043%	0.414%	-0.104	-0.066%	0.462%	-
01-30/09/99	21	10	0.054%	0.335%	0.162	0.174%	0.398%	0
01-31/10/99	21	11	-0.040%	0.293%	-0.138	-0.042%	0.473%	-
01-30/11/99	22	12	0.021%	0.321%	0.065	0.128%	0.458%	0
01-31/12/99	23	11	-0.098%	0.216%	-0.456	-0.176%	0.333%	-
01-31/01/00	20	7	0.038%	0.179%	0.213	-0.077%	0.519%	-
01-28/02/00	21	10	0.025%	0.418%	0.059	0.064%	0.554%	0
01-31/03/00	23	7	-0.020%	0.101%	-0.201	-0.005%	0.318%	-
01-30/04/00	20	7	0.086%	0.339%	0.254	0.021%	0.419%	0
01-31/05/00	19	10	-0.019%	0.314%	-0.060	0.230%	0.671%	0
01-30/06/00	22	14	-0.013%	0.520%	-0.025	-0.151%	0.594%	-
01-31/07/00	20	14	-0.085%	0.348%	-0.243	-0.151%	0.353%	-
01-31/08/00	11	5	0.061%	0.262%	0.234	0.088%	0.348%	0
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	12	0.168%	0.400%	0.420	0.209%	0.474%	0
01-31/01/01	23	10	0.038%	0.191%	0.197	-0.048%	0.416%	-
	455	203	-0.004%	0.301%	-0.012	0.004%	0.463%	0

Note

-Blank space: no risk reversal prices / no returns

Table 3: 1Day/200Day Combinations Category B (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/200Day Average Monthly Returns	Standard Deviation of Returns	Shar Rat
01-31/01/99	21	12	-0.089%	0.332%	-0.266	-0.066%	0.469%	-0.1
01-28/02/99	20	2	0.036%	0.124%	0.286	0.135%	0.488%	0.2
01-31/03/99	23	18	-0.016%	0.350%	-0.047	-0.029%	0.377%	-0.0
01-30/04/99	22	15	-0.021%	0.302%	-0.069	0.006%	0.323%	0.01
01-31/05/99	21	10	-0.093%	0.338%	-0.276	0.023%	0.434%	0.05
01-30/06/99	22	9	0.053%	0.371%	0.143	0.061%	0.456%	0.13
01-31/07/99	21	5	-0.044%	0.300%	-0.146	-0.099%	0.592%	-0.1
01-31/08/99	22	20	0.012%	0.454%	0.027	0.044%	0.465%	0.09
01-30/09/99	21	13	-0.033%	0.378%	-0.087	-0.001%	0.436%	-0.0
01-31/10/99	21	11	-0.022%	0.282%	-0.078	-0.005%	0.475%	-0.0
01-30/11/99	22	9	-0.099%	0.316%	-0.313	-0.111%	0.462%	-0.2
01-31/12/99	23	11	-0.046%	0.229%	-0.200	-0.070%	0.371%	-0.1
01-31/01/00	20	8	0.078%	0.341%	0.229	0.003%	0.525%	0.00
01-28/02/00	21	8	0.018%	0.385%	0.046	0.050%	0.556%	0.09
01-31/03/00	23	8	-0.038%	0.127%	-0.297	-0.040%	0.316%	-0.1
01-30/04/00	20	13	0.141%	0.385%	0.367	0.131%	0.397%	0.3
01-31/05/00	19	10	-0.019%	0.314%	-0.060	0.230%	0.671%	0.3
01-30/06/00	22	6	0.036%	0.182%	0.200	-0.053%	0.611%	-0.0
01-31/07/00	20	8	0.025%	0.279%	0.091	0.069%	0.379%	0.18
01-31/08/00	11	5	0.076%	0.252%	0.300	0.117%	0.338%	0.3
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	8	-0.047%	0.282%	-0.166	-0.221%	0.468%	-0.4
01-31/01/01	23	12	0.062%	0.219%	0.282	0.001%	0.419%	0.00
	455	221	-0.003%	0.307%	-0.009	0.006%	0.463%	0.01

Note

-Blank space: no risk reversal prices / no returns

Table 3: Memorandum MA Combinations Category B (continued)

Period	Buy & Hold Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Risk Reversal Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	-0.027%	0.473%	-0.057	-0.111%	0.460%	-0.241
01-28/02/99	-0.135%	0.488%	-0.277	-0.064%	0.503%	-0.127
01-31/03/99	0.029%	0.377%	0.076	-0.004%	0.379%	-0.010
01-30/04/99	-0.006%	0.323%	-0.019	-0.048%	0.320%	-0.150
01-31/05/99	-0.023%	0.434%	-0.052	-0.209%	0.378%	-0.553
01-30/06/99	-0.061%	0.456%	-0.134	0.045%	0.458%	0.098
01-31/07/99	0.099%	0.592%	0.167	0.012%	0.601%	0.019
01-31/08/99	-0.044%	0.465%	-0.096	-0.020%	0.467%	-0.043
01-30/09/99	0.160%	0.404%	0.396	-0.065%	0.431%	-0.152
01-31/10/99	-0.005%	0.475%	-0.010	-0.039%	0.473%	-0.083
01-30/11/99	-0.128%	0.458%	-0.280	-0.087%	0.468%	-0.185
01-31/12/99	0.052%	0.375%	0.139	-0.021%	0.378%	-0.057
01-31/01/00	0.003%	0.525%	0.005	0.153%	0.500%	0.307
01-28/02/00	-0.108%	0.547%	-0.197	-0.014%	0.558%	-0.026
01-31/03/00	0.040%	0.316%	0.127	-0.036%	0.316%	-0.112
01-30/04/00	-0.131%	0.397%	-0.329	0.151%	0.390%	0.388
01-31/05/00	-0.230%	0.671%	-0.343	-0.268%	0.655%	-0.409
01-30/06/00	0.053%	0.611%	0.086	0.125%	0.600%	0.209
01-31/07/00	-0.069%	0.379%	-0.181	-0.018%	0.385%	-0.047
01-31/08/00	-0.117%	0.338%	-0.345	0.035%	0.358%	0.097
01-30/09/00						
01-31/10/00						
01-30/11/00						
01-31/12/00	0.209%	0.474%	0.442	0.127%	0.504%	0.253
01-31/01/01	-0.095%	0.408%	-0.234	0.123%	0.400%	0.309
	<b>-0.023%</b>	<b>0.462%</b>	<b>-0.050</b>	<b>-0.011%</b>	<b>0.463%</b>	<b>-0.025</b>

Note

-Blank space: no risk reversal prices / no returns

## 6.2.2 Filter Rule Combinations

### 0.5% Filter Rule – Risk Reversal

In category A, the average return for the combined strategy is negative and equal to  $-0.011$  per cent and the Sharpe ratio  $-0.038$ . The simple 0.5% filter gave us a loss of  $-0.016$  per cent and a Sharpe ratio of  $-0.037$ . Both these results are the worst among all the other filters that will be examined.

It is already known that in category B we eliminated as much as possible the cases where we have no risk reversal prices. Apart from the options with strike prices 2b.p. symmetrical to the current exchange rate we have now used options with strike prices 1b.p. or 3b.p. symmetrical to the spot rate. So in these calculations we have 455 risk reversal prices instead of the 337 of category A. These 455 risk reversal prices have brought about 199 days of open position. In category A, the analogous days reached the 151. At first sight no subversive results are shown, however they are worth examining.

In general, the differences among the four examined strategies – the combined method, the filter rule, the buy and hold and the risk reversal- are not important. In all of them the average returns are negative, but the losses are also limited. As regard the enhanced strategy of risk reversal and the 0.5% filter rule, the average return is equal to  $-0.006$  per cent. The highest average monthly return is associated with July 1999. During this month, the risk reversal prices and in consequence the number of days with a long or short position has not changed. The next highest return is 0.09 per cent and is observed during January 2000. In this month we had 21 risk reversal prices which resulted in 8 days of open position. We have to remind that in category A, the same month had also led to the second highest return as well. The only difference is that the risk reversal prices were 14 and only in 5 we had an open position. The lowest return in the combined strategy is associated with May 1999 and is equal to  $-0.00089$ . During this month, although we had 21 risk reversal prices, we had a long or short position in only 7 days. During the same month in category A, we had 5 days of open position and we had also some losses. Finally, in November 1999 where in the first category we observed the lowest average return, in category B, the losses have been reduced due to two more days with an open position.

By comparing the corresponding months in the combination of the risk reversal and the simple 0.5% filter rule between the two categories, we conclude that the increase of the number of risk reversals and the number of days with the same signals have resulted in higher average returns in most of the cases. For instance, in August 2000, the seven more days of open position have led to a profit of 0.045 per cent, contrary to the loss of  $-0.12$  per

cent of two days with a long or short position in category A. We can have a better picture of the effect of the increase number of risk reversals in the 6-month calculations. During the period between January 1999 and July 1999, the increase number of observations resulted in lower average returns, on the contrary in all the other periods, the higher number of days with an open position drove us to better results. The volatility of the enriched method in category B is 0.31 per cent, the same as in the first category. So, due to the small difference in average return, category B generates a Sharpe ratio equal to  $-0.021$ .

The differences observed in the other three methods are due to the increased number of risk reversals. The implementation of the three methods take place, if and only if there are risk reversal observations, so that we have comparative results. The average return of the simple 0.5% filter rule is  $-0.002$  per cent, instead of the  $-0.016$  per cent of the corresponding return in category A. Similar to the previous strategy, the increase of the number of open position led to higher return in most of the months. The volatility of the simple filter rule in category B is similar to the first one and equals to 0.46 per cent, so the Sharpe ratio is a little bit higher than in category A and equal to  $-0.33$ .

The following strange remark arises in the case of the buy and hold method and the simple risk reversal. **In both these cases, the increase number of open position resulted in worst average returns.** Maybe the small number of days with an open position could not make clear the effect of these two methods and this may be the reason that they resulted in higher results in category A. The naïve buy and hold method are associated with a loss of  $-0.023$  per cent instead of the  $-0.005$  per cent in category A. In addition, the simple risk reversal signals led to a loss of  $-0.01$  per cent in category B, instead of the  $-0.006$  per cent in the former one. Moreover, both these two strategies in category B are associated with the worst Sharpe ratios.

### 1% Filter Rule – Risk Reversal

In category A, as far as the simple 1% filter rule, although the return is equal to zero, it is though not negative. On the other hand, the enriched strategy of the 1% filter rule and the risk reversal have resulted in a negative return equal to  $-0.003$  per cent. Although for the first time the 1% filter rule did not generate a negative return, all of the results from the trading methods fluctuate at the same level. Once more, the average return from the combination of the 1% filter rule and the risk reversal were not efficient to be distinguished from the ones derived from the naïve buy and hold method as well as the risk reversal.

The returns from the 1% filters rule combinations in category B constitute one of the most encouraging element since in both the enriched strategy and the simple technical trading rule the returns are positive. In the case of the combination of the risk reversal and the 1% filter rule, the average return is positive and equal to 0.002 per cent and the Sharpe ratio equal to 0.006. In category A, the same trading strategy led to a loss of -0.003 per cent. The difference is nearly insignificant, nevertheless is noteworthy. What is also encouraging for the use of the risk reversals is the fact that in this combination the days with a long or short position have increased to 192, instead of the 159 in category A. We have to remember that the more risk reversal observations and the more days with the same signals we have, the more representative is the effect of the risk reversals as a trading strategy.

In the case of the combined strategy, the extreme profits and losses are limited. In addition, the highest average return is observed during April 2000, where the number of risk reversal observations are 20 and the number of days with a long or short position is 10. We have to remark that in the corresponding case in category A, the same month drove us to the highest profit as well. A similar situation is observed regarding the observation of the lowest average returns. So, in category B the enriched method led to the lowest return in July 2000, while in category A the lowest average monthly return was associated with August 1999. The Sharpe ratio is 0.0059, showing us the excess return in relation to the risk incurred.

The simple 1% filter rule resulted in the highest average return among all the filter combinations so far. The average return for the entire sample is positive and equal to 0.015 per cent and the Sharpe ratio is 0.032. During May 2000 we observe one of the greatest average monthly returns that reaches the 0.32 per cent. However, in the simple 1% filter we could not eliminate the case where we had extreme losses, as in the case of July 2000 where the loss was equal to -0.13 per cent. Additionally, the Sharpe ratio is also favoring for the 1% filter rule reaching the 0.032.

Since the average returns from the simple filter rule and the combined strategy are positive, it is expected to have great differences with the case of the buy and hold method and the simple risk reversal. The fact that the simple 1% filter rule is associated with the highest profit is not very encouraging for the contribution of the risk reversal signals. However, the positive return of the combined method is something that can not be ignored.

## 2% Filter Rule – Risk Reversal

As far as the Sharpe ratio of the examined strategies in category A is concerned, we observe that in the case of the combination of the 2% filter rule and the risk reversal, the ratio is equal to 0.016, while in the case of the simple 2% filter rule the ratio is 0.036. Among all the examined trading rules, both the moving average and the filter rules combinations,



**this resulted range of excess return is the highest one.** Furthermore, we cannot ignore the fact that the Sharpe ratio of the combination of the risk reversal and the 2% filter rule is the next highest one.

The existing picture has changed a little in the case of the 2% filter combinations in **category B.** The combination of the risk reversal and the 2% filter rule is associated with a negative average return equal to  $-0.003$  per cent, while the simple technical trading rule with a positive one equals to  $0.004$  per cent. Respectively the Sharpe ratios are  $-0.01$  and  $0.01$ . The highest average monthly return is observed during December 2000 in both the simple and the enhanced trading strategy. During the particular month we had 17 risk reversal observations which resulted in 12 days with an open position. This fact is not a usual one since in most of the months the number of days with a long or short position is half of the risk reversal observations. The number of days with the same signals from the simple technical trading rule and the risk reversal reaches the 229 and is the highest one. We would expect for once more that the increased number of days with the same signals would lead to higher returns in the case of the enriched method but unfortunately the results did not come up to our expectations.

**Undoubtedly, the returns are lower than in the 1% filter combinations. Furthermore, the difference among the four examined strategies still exists.** The buy and hold method and the risk reversal rule are associated with losses. Additionally, the average returns for the technical trading rule and the combined strategy are better, with the average return for the simple 2% filter rule to prevail. Finally, we considered that there is no need stating the 6-month calculations, since they do not influence the existing picture.

**3% Filter Rule – Risk Reversal**

**4% Filter Rule – Risk Reversal**

**5% Filter Rule – Risk Reversal**

We have already explained the way the filter rules are used. Depending on a particular filter, we get a long position only if the current spot exchange rate exceeds its recent trough by the filter's per cent. Analogously, we get a short position if the current spot rate falls below its recent peak by the filter's per cent. It is evident that, for instance in the case of an upward movement of the spot rate, the bigger the filter we use the more difficult would be for the current rate to exceed its recent trough by the particular filter. This means that it is more difficult to get a different signal, since whenever the spot rate exceeds its recent trough by a lower per cent than the filter one, we just keep our previous position. So in the cases of the 3%, 4%, and 5% filters, we could not get an open position from the beginning of the implementation of the technical trading rule. This is the reason that the 3% filter gives us

the first signal in February 2000, while the 4% filter in December 2000 and finally the 5% filter rule is produces any signal at all.

In **category A**, in the case of the 3% filter rule, we got our first signal from the technical rule in February 2000. It was a short position. However, the spot rate couldn't exceed its trough or fall below its peak by 3%, and hence we had to keep our short position till September 22, 2000 where we got a long position which was followed till the end of the sample. The combined strategy is associated with an average return of 0.02 per cent and with a Sharpe ratio equal to 0.098, while the simple 3% filter rule resulted in an average return of 0.019 per cent and in a Sharpe ratio equal to 0.07. In the case of the 4% filter combinations, we got only one signal to buy only during December 2000, and that was followed till the end.

In the case of the simple 3% filter in **category B**, the average return produced from January 2000 to January 2001 is equal to 0.022 per cent, while for the same period the average returns for the combination of the filter rule and the risk reversal is 0.016 per cent. Furthermore due to low volatility during the 3% filter combinations, the Sharpe ratios that derive from both the simple and the combined strategy are the highest. In the case of the simple 3% filter rule the Sharpe ratio is 0.073 and in the case of the combined strategy 0.088. **We can observe that although the period with an open position is limited, the difference between the simple technical trading rule and the combined one still exists.** Finally the cases of the 4% and 5% filter rules are not noteworthy, since in the case of 4% filter we get only one long signal, and in the case of the 5% filter rule no signal at all.

Table 4 : 0.5% Filter Combinations Category B

Period	Number of RR Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 0.5% filter Average Monthly Returns	Standard Deviation of Returns	Shar Rat
01-31/01/99	21	13	-0.080%	0.287%	-0.280	-0.050%	0.471%	-0.1
01-28/02/99	20	4	-0.005%	0.234%	-0.021	0.054%	0.504%	0.10
01-31/03/99	23	7	-0.010%	0.124%	-0.083	-0.017%	0.378%	-0.0
01-30/04/99	22	7	-0.008%	0.230%	-0.034	0.032%	0.322%	0.10
01-31/05/99	21	7	-0.089%	0.279%	-0.320	0.031%	0.434%	0.0
01-30/06/99	22	7	-0.086%	0.274%	-0.315	-0.217%	0.403%	-0.5
01-31/07/99	21	8	0.130%	0.378%	0.344	0.249%	0.544%	0.45
01-31/08/99	22	12	-0.077%	0.377%	-0.204	-0.134%	0.447%	-0.2
01-30/09/99	21	13	0.032%	0.299%	0.107	0.129%	0.415%	0.31
01-31/10/99	21	11	0.014%	0.263%	0.053	0.067%	0.470%	0.1
01-30/11/99	22	9	-0.057%	0.430%	-0.132	-0.027%	0.475%	-0.0
01-31/12/99	23	11	-0.046%	0.229%	-0.200	-0.070%	0.371%	-0.1
01-31/01/00	20	11	0.092%	0.452%	0.204	0.031%	0.524%	0.05
01-28/02/00	21	6	0.019%	0.196%	0.099	0.053%	0.556%	0.09
01-31/03/00	23	9	-0.030%	0.159%	-0.186	-0.024%	0.318%	-0.0
01-30/04/00	20	6	0.084%	0.334%	0.252	0.017%	0.419%	0.0
01-31/05/00	19	6	-0.056%	0.339%	-0.166	0.156%	0.693%	0.2
01-30/06/00	22	13	-0.004%	0.530%	-0.007	-0.133%	0.598%	-0.2
01-31/07/00	20	12	-0.050%	0.345%	-0.146	-0.083%	0.376%	-0.2
01-31/08/00	11	9	0.045%	0.352%	0.127	0.055%	0.355%	0.15
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	8	0.024%	0.247%	0.098	-0.079%	0.514%	-0.1
01-31/01/01	23	10	0.050%	0.210%	0.239	-0.023%	0.418%	-0.0
	455	199	-0.006%	0.310%	-0.021	-0.002%	0.463%	-0.0

Note

-Blank space: no risk reversal prices / no returns

Table 4 : 1% Filter Combinations Category B (continued)

Period	Number of RR Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1% filter Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	21	9	-0.043%	0.261%	-0.166	0.024%	0.473%	0.051
01-28/02/99	20	2	0.021%	0.109%	0.192	0.106%	0.495%	0.213
01-31/03/99	23	8	-0.024%	0.235%	-0.101	-0.044%	0.376%	-0.116
01-30/04/99	22	8	-0.032%	0.242%	-0.132	-0.016%	0.323%	-0.051
01-31/05/99	21	8	-0.052%	0.105%	-0.494	0.105%	0.421%	0.250
01-30/06/99	22	5	0.001%	0.221%	0.007	-0.042%	0.458%	-0.092
01-31/07/99	21	4	0.068%	0.191%	0.356	0.124%	0.587%	0.211
01-31/08/99	22	13	-0.101%	0.365%	-0.278	-0.183%	0.428%	-0.426
01-30/09/99	21	12	-0.054%	0.336%	-0.161	-0.043%	0.434%	-0.099
01-31/10/99	21	11	0.014%	0.263%	0.053	0.067%	0.470%	0.142
01-30/11/99	22	12	0.021%	0.321%	0.065	0.128%	0.458%	0.280
01-31/12/99	23	10	-0.039%	0.231%	-0.170	-0.057%	0.374%	-0.153
01-31/01/00	20	8	0.094%	0.328%	0.287	0.035%	0.523%	0.067
01-28/02/00	21	8	-0.020%	0.256%	-0.080	-0.026%	0.558%	-0.047
01-31/03/00	23	8	-0.036%	0.124%	-0.292	-0.037%	0.316%	-0.116
01-30/04/00	20	10	0.101%	0.343%	0.296	0.052%	0.416%	0.124
01-31/05/00	19	6	0.025%	0.260%	0.095	0.318%	0.632%	0.503
01-30/06/00	22	8	0.061%	0.381%	0.160	-0.004%	0.614%	-0.006
01-31/07/00	20	12	-0.075%	0.341%	-0.220	-0.132%	0.361%	-0.367
01-31/08/00	11	6	-0.045%	0.191%	-0.237	-0.125%	0.335%	-0.373
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	12	0.106%	0.471%	0.226	0.085%	0.513%	0.166
01-31/01/01	23	12	0.065%	0.224%	0.289	0.001%	0.419%	0.001
	455	192	0.002%	0.276%	0.006	0.015%	0.462%	0.032

## Note

-Blank space: no risk reversal prices / no returns

Table 4 : 2% Filter Combinations Category B (continued)

Period	Number of RR Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 2% filter Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	21	8	-0.069%	0.240%	-0.287	-0.027%	0.473%	-0.057
01-28/02/99	20	18	-0.099%	0.480%	-0.207	-0.135%	0.488%	-0.277
01-31/03/99	23	5	0.012%	0.142%	0.087	0.029%	0.377%	0.076
01-30/04/99	22	7	-0.027%	0.109%	-0.247	-0.006%	0.323%	-0.019
01-31/05/99	21	11	-0.116%	0.227%	-0.511	-0.023%	0.434%	-0.052
01-30/06/99	22	13	-0.008%	0.266%	-0.030	-0.061%	0.456%	-0.134
01-31/07/99	21	16	0.055%	0.516%	0.107	0.099%	0.592%	0.167
01-31/08/99	22	2	-0.032%	0.106%	-0.305	-0.044%	0.465%	-0.096
01-30/09/99	21	13	0.047%	0.337%	0.140	0.160%	0.404%	0.396
01-31/10/99	21	11	-0.022%	0.282%	-0.078	-0.005%	0.475%	-0.010
01-30/11/99	22	10	-0.107%	0.334%	-0.322	-0.128%	0.458%	-0.280
01-31/12/99	23	13	0.015%	0.335%	0.045	0.052%	0.375%	0.139
01-31/01/00	20	9	0.078%	0.341%	0.229	0.003%	0.525%	0.005
01-28/02/00	21	9	0.047%	0.403%	0.116	0.108%	0.547%	0.197
01-31/03/00	23	8	-0.038%	0.127%	-0.297	-0.040%	0.316%	-0.127
01-30/04/00	20	13	0.141%	0.385%	0.367	0.131%	0.397%	0.329
01-31/05/00	19	10	-0.019%	0.314%	-0.060	0.230%	0.671%	0.343
01-30/06/00	22	13	-0.005%	0.508%	-0.010	-0.136%	0.598%	-0.227
01-31/07/00	20	12	-0.043%	0.261%	-0.166	-0.069%	0.379%	-0.181
01-31/08/00	11	6	-0.041%	0.240%	-0.171	-0.117%	0.338%	-0.345
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	12	0.168%	0.400%	0.420	0.209%	0.474%	0.442
01-31/01/01	23	10	0.015%	0.207%	0.071	-0.095%	0.408%	-0.234
	455	229	-0.003%	0.319%	-0.011	0.004%	0.463%	0.010

Note

-Blank space: no risk reversal prices / no returns

Table 4 : Memorandum Filter Combinations Category B (continued)

Period	Buy&Hold Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Risk Reversal Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	-0.027%	0.473%	-0.057	-0.111%	0.460%	-0.241
01-28/02/99	-0.135%	0.488%	-0.277	-0.064%	0.503%	-0.127
01-31/03/99	0.029%	0.377%	0.076	-0.004%	0.379%	-0.010
01-30/04/99	-0.006%	0.323%	-0.019	-0.048%	0.320%	-0.150
01-31/05/99	-0.023%	0.434%	-0.052	-0.209%	0.378%	-0.553
01-30/06/99	-0.061%	0.456%	-0.134	0.045%	0.458%	0.098
01-31/07/99	0.099%	0.592%	0.167	0.012%	0.601%	0.019
01-31/08/99	-0.044%	0.465%	-0.096	-0.020%	0.467%	-0.043
01-30/09/99	0.160%	0.404%	0.396	-0.065%	0.431%	-0.152
01-31/10/99	-0.005%	0.475%	-0.010	-0.039%	0.473%	-0.083
01-30/11/99	-0.128%	0.458%	-0.280	-0.087%	0.468%	-0.185
01-31/12/99	0.052%	0.375%	0.139	-0.021%	0.378%	-0.057
01-31/01/00	0.003%	0.525%	0.005	0.153%	0.500%	0.307
01-28/02/00	-0.108%	0.547%	-0.197	-0.014%	0.558%	-0.026
01-31/03/00	0.040%	0.316%	0.127	-0.036%	0.316%	-0.112
01-30/04/00	-0.131%	0.397%	-0.329	0.151%	0.390%	0.388
01-31/05/00	-0.230%	0.671%	-0.343	-0.268%	0.655%	-0.409
01-30/06/00	0.053%	0.611%	0.086	0.125%	0.600%	0.209
01-31/07/00	-0.069%	0.379%	-0.181	-0.018%	0.385%	-0.047
01-31/08/00	-0.117%	0.338%	-0.345	0.035%	0.358%	0.097
01-30/09/00						
01-31/10/00						
01-30/11/00						
01-31/12/00	0.209%	0.474%	0.442	0.127%	0.504%	0.253
01-31/01/01	-0.095%	0.408%	-0.234	0.123%	0.400%	0.309
	<b>-0.023%</b>	<b>0.462%</b>	<b>-0.050</b>	<b>-0.011%</b>	<b>0.463%</b>	<b>-0.025</b>

Note

-Blank space: no risk reversal prices / no returns

**Summary Statistics of Category B****Moving Average Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
1Day/5Day	455	219	-0.016%	0.318%	-0.050
5Day/20Day	455	203	-0.004%	0.301%	-0.012
1Day/200Day	455	221	-0.003%	0.307%	-0.009
<b>Simple MA</b>					
1Day/5Day	455	455	-0.020%	0.462%	-0.044
5Day/20Day	455	455	0.004%	0.463%	0.009
1Day/200Day	455	455	0.006%	0.463%	0.013
<b>Memoorandum Items</b>					
Buy & Hold	455	455	-0.023%	0.462%	-0.05
Risk Reversal	455	455	-0.011%	0.463%	-0.025

**Filter Rule Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
0.5%	455	199	-0.006%	0.310%	-0.021
1%	455	192	0.002%	0.276%	0.006
2%	455	229	-0.003%	0.319%	-0.011
3%	455	81	0.016%	0.183%	0.088
4%	455	23	0.007%	0.091%	0.073
5%	455	1	0.000%	0.000%	
<b>Simple Filter</b>					
0.5%	455	455	-0.002%	0.463%	-0.003
1%	455	455	0.015%	0.462%	0.032
2%	455	455	0.004%	0.463%	0.010
3%	455	174	0.022%	0.297%	0.073
4%	455	39	0.003%	0.132%	0.019
5%	455	0	0.000%	0.000%	
<b>Memoorandum Items</b>					
Buy & Hold	455	455	-0.023%	0.462%	-0.050
Risk Reversal	455	455	-0.011%	0.463%	-0.025

Summary Statistics of Category AMoving Average Combinations

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
1Day/5Day	338	163	-0.018%	0.311%	-0.057
5Day/20Day	338	155	-0.005%	0.300%	-0.016
1Day/200Day	338	166	-0.007%	0.312%	-0.022
<b>Simple MA</b>					
1Day/5Day	338	338	-0.029%	0.449%	-0.065
5Day/20Day	338	338	-0.004%	0.450%	-0.009
1Day/200Day	338	338	-0.008%	0.450%	-0.017
<b>Memoorandum Items</b>					
Buy & Hold	338	338	-0.005%	0.450%	-0.010
Risk Reversal	338	338	-0.006%	0.450%	-0.013

Filter Rule Combinations

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
<b>Risk Reversal and</b>					
0.5%	338	151	-0.011%	0.294%	-0.038
1%	338	149	-0.003%	0.279%	-0.011
2%	338	174	0.005%	0.333%	0.016
3%	338	58	0.018%	0.180%	0.098
4%	338	23	0.009%	0.106%	0.085
5%	338	0	0.000%	0.000%	
<b>Simple Filter</b>					
0.5%	338	338	-0.016%	0.450%	-0.037
1%	338	338	0.000%	0.450%	0.000
2%	338	338	0.016%	0.450%	0.036
3%	338	126	0.019%	0.278%	0.070
4%	338	35	0.009%	0.132%	0.069
5%	338	0	0.000%	0.000%	
<b>Memoorandum Items</b>					
Buy & Hold	338	338	-0.005%	0.450%	-0.010
Risk Reversal	338	338	-0.006%	0.450%	-0.013



### 6.2.3 Out-of-sample simulations

#### Moving Average Rule Combinations

We implement the out-of-sample simulation to the British Pound as well. Every month we have compared the results derived from the use of the three moving average crossover rules- 1Day/5Day, 5Day/20Day, 1Day/200Day and chosen the one associated with the highest results. Afterwards, we use the particular moving average during the next month and calculate the new results. The out-of-sample simulation is implemented in both categories. However, we will present the results from the second category, since there is not a great difference between them.

**The 1Day/200Day moving average crossover rule is the one that has generated the highest average returns in most of the months.** In particular, during the out-of-sample simulation, we have used the 1Day/200Day moving average in 12 months, while the 1Day/5Day rule is used only in 3 months and the 5Day/20Day in 7 months. In the three months, where we have no risk reversal observations, we considered the 1Day/5Day moving average as the best one. Like in the previous calculations, we have combined the selected moving average rules with the risk reversal prices for the calculations of the enriched method, while for the simple technical rule we just implement these particular moving averages.

Unfortunately, in both the simple technical trading rule and the combined one the average returns are negative. The Sharpe ratio generated from the combined strategy is  $-0.035$ . More specifically, the enhanced method led to an average return of  $-0.01$  per cent. The highest return is associated with December 2000, where we used the 1Day/5Day moving average rule. The lowest average monthly return is observed during December 1999 from the use of the 1Day/5Day moving average crossover rule. The out-of-sample simulation has limited the extreme losses and profits noticed during the previous calculations. Finally, the selection of the technical trading rules with the out-of-sample simulation in combination with the risk reversal prices have resulted in 206 days of a short or long position out of the 455 of the total number of risk reversal. In these 206 days with an open position we do not include the first month of our sample, since we do not have any moving average rule to use.

As in the case of the Swiss Franc, the implementation of the out-of-sample simulation in both the combined method and the simple technical rules has revealed the same moving average rules as the best ones during every month. On the other hand, in the case of the simple moving average rules, the average return of the entire sample is negative and equal to  $-0.015$  and the Sharpe ratio  $-0.032$ . The highest return is associated with May 2000 from the use of the 1Day/200Day moving average rule and is equal to 0.23 per cent. On the other hand, the use of the 5Day/20Day moving average rule has generated a loss of  $-0.18$  per cent during

December 1999. We notice that the difference between the two methods is insignificant, but this fact does not encourage us at all, since we would expect better results from the use of the out-of-sample simulation.

In the case of the implementation of the out-of-sample simulation in category A, the picture does not present any particular interest. The combination of the risk reversals and the simple moving average rule led to a zero average return and the simple technical trading rule to an average return equal to 0.004 per cent. Moreover the Sharpe ratios are 0.0009 and 0.009 respectively. **Finally we have to notice that in 8 cases, both in categories A and B, all the three moving average rules that we used have generated negative average returns.** For this reason in the out-of-sample simulation we chose the average rule that generated the least losses.

### Filter Rule Combinations

Finally, we implement the out-of-sample simulation to the filter rule in British Pound. We have to remind that the 3%, 4% and 5% filter rules did not generate a signal from the beginning of our sample. That is the reason that during the out-of-sample simulation we compared the results associated with the above filters only in the months when they gave us a signal. In addition, for the three months where we have no risk reversal prices we consider that the best filter was the 0.5%.

Contrary to all the previous simulations, in the British Pound filter rule simulation the results from the two categories differ a lot. As far as the first category is concerned the results are rather unusual. Both the combined strategy and the simple one are associated with the highest losses, -0.023 per cent and -0.05 per cent respectively. In addition the Sharpe ratios are also low and equal to -0.08 and -0.12 respectively. **We notice that in this case the combined strategy led to better results than the simple filter rule.** This may come from the fact that during British Pound analysis the simple technical trading rule do not differ a lot from the combined strategies and so there is not any clear picture for the advance of any strategy and the results from the simulation are rather confused. What is also peculiar is the fact that during the out-of-sample simulation the 2% filter rule is mostly used, 8 months, while the 0.5% filter rule in 6 months. **Finally, the best filters are not the same in the combined strategy and in the simple one.** The differences are noticed only in two months, but it is noteworthy since it is the first time that this happened.

The out-of-sample simulation in the second category gives us the usual results. The average returns, in both the combined and the filter strategies are negative with great losses, -0.01 per cent and -0.013 per cent respectively. The Sharpe ratios are -0.04 for the combined

strategy and  $-0.03$  for the simple one. As far as the lowest and the highest average returns are concerned, they are observed during the same months in both the simple and the combined strategies. So, in December we have the lowest returns and in December 2000 the highest ones. The 1% filter rule is the most used filter in both the combined and the simple rules. Finally, we should observe that the out-of-sample simulation has generated, as usual, the least days with a long or short position in both A and B categories. So, in the first category, the number of days with an open position counts for 130 out of 338 risk reversal prices, while in the second one 178 out of 455.

Category	Number of Days	Number of Days with Open Position	Number of Days with Long Position	Number of Days with Short Position
Risk Reversal	338	130	65	65
Simple Rule	455	178	89	89

Πανεπιστήμιο Πειραιώς

Summary Statistics of Out-of-Sample of Category BMoving Average Combinations

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal and MA	455	206	-0.011%	0.320%	-0.035
Simple MA	455	455	-0.015%	0.462%	-0.032

Filter Rule Combinations

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal and Filter	455	179	-0.010%	0.271%	-0.038
Simple Filter	455	455	-0.013%	0.458%	-0.028

**Summary Statistics of Out-of-Sample of Category A****Moving Average Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal and MA	338	147	0.000%	0.290%	0.001
Simple MA	338	312	0.004%	0.450%	0.009

**Filter Rule Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
Risk Reversal and Filter	338	131	-0.023%	0.282%	-0.080
Simple Filter	338	312	-0.051%	0.421%	-0.122

#### 6.2.4 CONCLUSION

In the case of the British Pound, we have also examined the moving average trading rule, the filter rule, the risk reversal signals, their combinations as well as the naïve buy and hold method. **The sample period starts from January 1999 and ends in January 2001.** The picture derived from the calculations is rather confused, nevertheless, we can come up with some conclusions.

The moving average combinations are discouraging. In category A, all the examined trading methods using the three moving average rules- 1Day/5Day, 5Day/20Day and 1Day/200Day- ended with significant losses. It is noteworthy that in many cases, the naïve buy and hold method as well as the simple risk reversal signals gave us lower losses. For instance, **the combined strategies for all the moving averages generate greater losses than those derived from the buy and hold method and the risk reversal.**

Furthermore, in category B, the picture is a little bit improved, but the average returns from the simple technical trading rules and the enriched methods are still negative driving to great losses. In both categories, the worst average returns derive from the 1Day/5Day combination, the simple technical trading rule and the enhanced one. In addition only in this combination, the simple risk reversal signals led to higher average return and Sharpe ratio. During all the other combinations, the buy and hold method as well as the risk reversal are associated with the worst results although the differences from the other strategies are not very evident as we expected to be. We have to remark that the 1Day/200Day moving average combination has generated the highest results both in the simple 1Day/200Day moving average rule and the combined strategy. It is worth noticing that during this combination we had the highest number of days with a short or long position. **We have also observed that in both categories, the implementation of the simple technical trading rules led to better results and their combination with the risk reversal prices have deteriorated the results.**

In the case of the filter rule combinations the picture has changed. **The examined simple filter rules -0.5%, 1%, and 2%- have led to higher returns.** The difference from the results derived from the combined methods may be considered insignificant; nevertheless, it should not be ignored. In the case of the 3%, 4%, and 5% filter rules, the combined strategy is associated with higher results than the corresponding ones derived from the simple trading strategy. However, we cannot count on this fact since it is already known that these filters do not give us any signal from the beginning of our sample. Instead, as we remind in the case of the 3% filter, we got a signal at the end of our sample period, and so the number of days with an open position is very low.

In category A, the higher results are associated with the 2% filter combinations, while in category B with the 1% filter combinations. In addition the 1% filter rule combinations of

category B is associated with the highest results among all the other combinations of 0.5%, 1%, and 2% filters. However, the number of days with an open position during this combination is the lowest one. In the case of the filter rule combinations, the increased number of risk reversal prices of category B has generated higher results during all the examined strategies. Since, the same fact is already observed during all the other cases, it makes us believe that if we had a complete data of risk reversal prices the results may have been more clear and encouraging.

The buy and hold method as well as the risk reversal are associated with greater losses in category B. In addition, the difference among these two methods, the technical trading rule and the combined one, is more obvious in category B. So the case of the 0.5% filter, in both the categories A and B, where the results from the buy and hold method and the risk reversal signals did not differ much from the ones derived from the simple and the combined strategy, may be considered as an exception.

**We have concluded that, in both of these categories the results derived from the simple technical trading rules are better than the corresponding ones in the combined strategy.** On the other hand, we cannot come up to such a conclusion in the case of individual months. In other words, we cannot say that any strategy is associated with higher results comparing to another one during all the months of the sample. It is encouraging though, that, on average, the results from category B are higher and more representative than those in category A. Hence, in the case where we had the actual risk reversal prices may have driven to different conclusions and been more encouraging for the effect of risk reversal signals.

Finally, with regard to the out-of-sample simulation, the picture has not changed much. In both the moving average crossover rule and the filter one, the simple technical trading rule and the combined strategy are associated with negative results, which are quite the worst among all the previous ones. **However, in all the cases, except for the category A of the filter combination, the simple technical trading rules are associated with lower losses than the combined strategies.** This fact comes to reinforce the existing picture. We also have to notice that although we have used so many technical trading rules, in 8 months, none of these rules succeeded to generate positive result. Finally, in the case of the moving average rule combination, the 1Day/200Day is the rule that has led to the highest returns in most of the months. On the other hand, in the case of the filter rule combination the corresponding filter is the 1% one. We should remind that these two rules were the ones that led to the best results among all the other rules of their categories and combinations.

### **6.3 GENERAL CONCLUSIONS**

During our analysis we managed to draw some conclusions relative to the implementation of the different trading strategies. We decided to state briefly some of the most important conclusions, although is regarded worth studying the whole analysis of our thesis in order to get a complete clue.

With reference to the moving average crossover rules, **the implementation of the simple moving average rule has generated higher retruns and Sharpe ratios than the corresponding ones generated by the combined strategies.** More specifically, the combined strategies are associated with negative Sharpe ratios in both the Swiss Franc and the British Pound, in categories A and B. On the other hand, in the case of the Swiss Franc the corresponding simple moving average rules are associated with positive Sharpe ratios. In the case of the British Pound, the simple moving average rules generated negative and positive ratios, but the results were always higher than the ones in the case of the corresponding combined strategies. **The main point is that in every case, the simple moving average crossover rules are associated with higher average returns and Sharpe ratios than the ones in the combined strategies.** The only exception is observed in the case of the British Pound, in category A during the 1Day/5Day combinations, but we just ignore this fact since it was not repeated in any other case.

These two strategies were compared with the buy & hold method as well as with the simple risk reversal one. **The two last ones led to the worst results which were, in all cases, negative and far worst from the corresponding ones in the combined and the technical trading rules.** The difference was more obvious in the case of the Swiss Franc. In the case of the British Pound, the buy & hold method and the risk reversal rule differ less with the other two rules and there was one case, the 1Day/5Day combinations in category A, where the derived results were better than the corresponding ones in the simple and the combined moving average strategies. Nevertheless, due to the fact that in all the other strategies the results from the buy & hold method and the simple risk reversal were the worst, we can conclude that these two methods are not suitable for any use.

Another point that should be reported is the fact that among the trading strategies that we used, **the highest and the lowest results are associated with the same technical trading rule in both the simple and the combined strategies.** This means that in the case of the Swiss Franc for instance, the simple 1Day/200Day moving average rule led to the worst results between the other two simple moving average rules and at the same time, the combination of the 1Day/200Day and the risk reversal led to the worst returns between the other two combined methods. However, we could not come to any general conclusion for the best moving average crossover rule. This happens because in the case of the Swiss Franc, in



category A the best results come from the 1Day/5Day combination, while in category B the highest results come from the use of the 5Day/20Day combination. On the other hand, in the case of the British Pound the higher results come from the use of the 1Day/200Day combinations for category A and from the use of 5Day/20Day combination for category B, while the worst ones from 1Day/5Day combination for both categories. With reference to the individual monthly results, we cannot not say that any strategy generated a better picture for all the individual months. In general, the same months were associated with the highest and the lowest results regardless of the strategy we followed. However, we cannot take it as a general granted since there were a lot of cases where this did not exist at all.

**On the other hand we cannot say whether in category B, where we had more risk reversal observations, the results were higher than the respective ones in category A.** In Swiss Franc, the corresponding results between the two categories were higher in the case of category A. On the other hand, in British Pound, category B is associated with higher results. This does not stand for the British Pound buy & hold method and simple risk reversal signals, since these two strategies led to better results in category A. This given is rather encouraging, because it proves that these high results derived from buy & hold method and risk reversal signals were due to the inadequate risk reversal observations. However, in the categories where the results were the higher ones, the individual months also generated the higher results than the ones derived from the corresponding months of the other categories.

Finally, on average, **the days where the signals from the moving average rules were in accordance with the ones derived from the risk reversal prices were half than the entire sample of risk reversal observations.** However, no specific number of signals is associated with high or low results. For example, in Swiss Franc the lowest results come from the 1Day/200Day combination, where the number of same signals was the lowest but this does not exist in the case of the British Pound, where the lowest results come from strategies where the number of same signals from the moving average rule and the risk reversal, was not the lowest. It is obvious that there exist a lot of cases and we cannot draw any conclusions since we examine only two currencies for a short period.

The picture derived from the moving average combinations is much similar to the one derived from the filter rule combinations. **In most of the cases the combination of the filter rule with the risk reversal is associated with the worst results than the ones derived from the implementation of the simple filter rules.** For example, in the case of the Swiss Franc, the combined strategy led to negative average returns and Sharpe ratios both in categories A and B contrary, to the simple filter rules where the results were all positive. Similar picture comes from the British Pound as well. The only difference arises from the fact that in many cases the results from both the simple and the combined strategies were negative. However, in

this case, the higher range of results for the case of the combined strategy still remains. On the other hand, if we observe more carefully the results we notice that in British Pound, in the case of the 3%, 4% and 5% filter rules, the combined filter rules are associated with higher returns. This fact cannot change the already existing picture since the number of signals derived for the above filters are low due to the size of the filters. So the corresponding standard deviations are low and consequently the Sharpe ratios are high.

**As in the case of the moving average crossover rule, we cannot come to any conclusion of which filter generates the higher results for both the examined currencies.** In the Swiss Franc, for example, the highest results are associated with 0.5% filter rule, while in the British Pound the highest results are associated with 2% filter for category A and 1% for category B. In addition, for the Swiss Franc, the worst results are observed during 2% and 3% filters for categories A and B, respectively, while for the British Pound the worst results come from 0.5% filter for both categories. However, as in the case of the moving average combinations, **the highest and lowest results are associated with the same technical trading rules in terms of both the simple and the combined strategies.**

**With regard to the buy & hold method and the risk reversal rule the results are discouraging for both the Swiss Franc and the British Pound.** In particular, for the Swiss Franc in both categories the buy & hold method and the risk reversal signals led to the worst results among all the examined strategies. In the British Pound the picture is nearly the same except for the case of the 0.5% filter of category A.

Furthermore, many of the conclusions derived from the moving average crossover rule combinations exist in the case of the filter rule combinations as well. **Firstly, no specific category is associated with the highest results.** For example, category A of Swiss Franc is associated with higher results than the corresponding ones derived from category B, contrary to British Pound where category B generated the highest results during all the examined strategies. **Furthermore, in general, no specific number of days, where the signals derived from the risk reversal and the filter rules are the same, is associated with high or low results.** However, there seems to be a tendency for the high returns to be associated with low number of days with the same signals. **The only difference from the Swiss Franc is that in the case of the British Pound the number of days with the same signals from the risk reversal and the filter rules are, on average, less than half of the risk reversal observations.** However, we have to remind that the British sample is limited and that the conclusions derived from the Swiss Franc are more accurate.

The implementation of out-of-sample simulations both in the Swiss Franc and the British Pound does not add any further information to the already resulted picture. Instead, they reinforce the conclusion that **the simple technical trading rules are associated with**

higher returns than their combinations with the risk reversal prices. Although the results would be more precise if we had more currencies to examine for a longer period, we can state that the main conclusions have been derived.

Trading rules with the risk reversal are more developed than the combinations in terms of the results. In both the forward bias and the English strategies, the results were higher in the case of the use of the simple rather than looking with the combinations. This is derived from the combined strategies with more complex assumptions. Finally, when the two are not applied and the use of the simple risk reversal is applied, the results are higher than the other strategies. Of course, if the magnitude of the bias we suppose is high, it is not clear if it is more appropriate for the use of the risk reversal strategy. Risk reversal is a more advanced and difficult strategy.

It is well known that in the forward bias market, the price of the forward contract with the signals from the risk reversal and the risk reversal strategy is similar. We decided, curious about the results, to follow the above strategy, but we got a positive reply if the signals differ in the two periods. This is not clear from the results derived from the technical trading rules and in the English strategy. However, the results derived from the risk reversal. These are examples with the results of the forward bias and the British Pound and we used all the data. The results are similar to the results of the forward bias strategy only in the first period. In the second period, the results are not provided any particular information. In fact, when the evaluation of the two strategies and not be compared, the results are not clear. This is not a clear result and we only need to be careful in the interpretation of the results.

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ

## 7. PARADOX

The results from the implementation of the combinations of the simple technical trading rules and the risk reversals are not the expected ones. We remind that in most of the cases, in both the Swiss Franc and the British Pound, the results were higher in the cases of the use of the simple technical trading rules. The differences from the results derived from the combined strategies were small but not disregarded. Furthermore, the buy and hold method and the use of the simple risk reversal signals resulted in the worst average returns and Sharpe ratios. Of course, at the beginning of our thesis we expected to get different results and more encouraging for the use of the combined strategies. This is the reason that made us follow two different strategies.

It is well known that in the combined strategy we get a long or short position only if the signals from the risk reversals and the technical trading rules were in accordance. We decided, curious about the results, to follow two different strategies where we get a position only if the signals differ. In the first strategy, **Combined TTR**, we follow the signals derived from the technical trading rules and in the second one, **Combined RR**, the signals derived from the risk reversal. These two strategies were implemented in both the Swiss Franc and the British Pound and we used all the already examined technical trading rules in categories A and B. To avoid boredom we will present the results that come from the implementation of these two strategies only in category B. We have to remind that the two categories have not presented any particular difference in their results. Actually, the presentation of the new strategies will not be extended since the decision of their implementation was made at random and we only wanted to give an incentive for further study.

## 7.1 SWISS FRANC

### 7.1.1 Moving Average Crossover Rule Combinations

In this section we will state the results that come from the use of the two new strategies with the moving average crossover rules. The tables below present the results from the initial combined strategy, the combined TTR, the combined RR, the buy and hold method and the risk reversal rule.

During the 1Day/5Day moving average combinations, the combined TTR resulted in profits that are also the highest ones. In addition, the combined RR leads to exactly reciprocal results. This was expected, because these two new strategies cause the same number of open positions that are exactly the opposite ones. We will also notice that the shaped picture is the same in all the examined cases.

We remind that in category B we have 776 risk reversal indications. The entire sample, which starts from September 1997 and ends in January 2001, is divided in months. We have already mentioned that there will be a brief presentation where only the results of the entire sample will be stated. The implementation of the combined TTR resulted in an average return of 0.025 per cent and a Sharpe ratio of 0.054. The number of open positions is 419 out of 776 of the number of risk reversal. The combined RR resulted, as expected, in an average of -0.025 and a Sharpe ratio of -0.054. The profits associated with the combined TTR are the highest ones considering the corresponding ones from the initial combined and the simple 1Day/5Day trading rule. In the case of the initial combined strategy, the number of days with an open position was 357 and the strategy led to a loss of -0.009 per cent and a Sharpe ratio equal to -0.018. Additionally, the simple technical trading rule resulted in an average return of 0.016 per cent and a Sharpe ratio 0.024. There is no need to mention the significant difference associated with the respecting results from the buy and hold method and the risk reversal rule.

In the case of the 5Day/20Day moving average combinations the picture is exactly the same. The combined TTR resulted in an average return of 0.028 per cent with a Sharpe ratio of 0.057. The results were the opposite ones in the case of the combined RR. In the case of the initial combined strategy the Sharpe ratio is -0.012 and in the case of the simple technical trading rule 0.035. Finally, in the case of the 1Day/200Day moving average combinations, the combined TTR is associated with a Sharpe ratio equal to 0.038 while the combined strategy with a Sharpe ratio equal to -0.035 and the simple 1Day/200Day moving average crossover rule with a Sharpe ratio equal to 0.012. In this case, there is an important difference as far as the number of open position is concerned. So, although in the case of the initial combined strategy we had a long or short position in 196 days, in the other two strategies the respective days were 580 out of the 776 risk reversal prices.

### 7.1.2 Filter Rule Combinations

The two new strategies are also implemented in combination with the filter rules. Due to the small filter associated with more accurate results, we will state the new strategies in combinations with just the 0.5%, 1% and 2% filter rules. In the case of the 0.5% filter rule, we remind that the initial combined strategy results in an average loss of  $-0.009$  per cent and a Sharpe ratio of  $-0.019$ . Furthermore, the simple use of the technical trading rule resulted in a profit equal to  $0.015$  per cent and a Sharpe ratio equal to  $0.023$ . On the other hand, the combined TTR strategy led to a significant profit of  $0.025$  per cent and with a Sharpe ratio of  $0.053$ . Finally, the combined RR strategy gave us the opposite results from the ones derived from the combined TTR. The buy and hold method and the simple risk reversal signals are associated with great losses.

In the case of the 1% filter combinations, all the results are a little bit lower than the corresponding ones from the 0.5% filter combinations. So, the combined TTR resulted in an average of  $0.021$  per cent and a Sharpe ratio of  $0.045$ . The profits are the highest ones, since the average result associated with the initial combined strategy is  $-0.013$  per cent and the results from the simple technical trading rule equal to  $0.008$  per cent.

Finally, in the case of the 2% filter combinations, the combined TTR led, once more, to a profit equal to  $0.019$  per cent and to a Sharpe ratio equal to  $0.041$ . The combined strategy generated a loss of  $-0.017$  per cent and the simple 2% filter rule to a profit of  $0.002$  per cent. Noteworthy is the fact that in all the examined cases, the number of days with an open position, that is 379, is greater during the combined TTR and in sequel during the combined RR.

## 7.2 BRITISH POUND

### 7.2.1 Moving Average Crossover Rule Combinations

The two new combined strategies are also implemented in the case of the British Pound in category B. The already existing picture does not change except for the case of the 1Day/5Day moving average combination. It is the first time, and the only one, that the combined TTR is associated with a loss. The average return of the entire sample is equal to  $-0.004$  per cent and the Sharpe ratio equal to  $-0.013$ . On the contrary, the combined RR generates a profit of  $0.004$  per cent and a Sharpe ratio of  $0.013$ . The initial combined strategy and the simple technical trading rule are associated with significant losses,  $-0.016$  per cent and  $-0.02$  per cent, respectively. The fact that the combined RR led to a profit is rather random since during all the other calculations it happens just the opposite one. Nevertheless, we cannot ignore that the loss associated with the combined TTR is the lowest one between the initial combination and the risk reversal rule losses.

In the case of the 5Day/20Day combinations, we notice the well-known picture. The initial combination generated a loss of  $-0.004$  per cent and a Sharpe ratio of  $-0.012$  and the simple moving average crossover rule a profit of  $0.004$  per cent and a Sharpe ratio of  $0.009$ . On the contrary, the profit associated with the combined TTR is higher and equal to  $0.008$  per cent while the Sharpe ratio is equal to  $0.022$ . The combined RR led to the exactly the opposite average return. In the case of the 1Day/200Day moving average combinations, the combined TTR led to the same profit as in the 5Day/20Day combinations since the Sharpe ratio is equal to  $0.025$ . This profit is the highest one since the initial combination is associated with a loss of  $-0.002$  per cent and a Sharpe ratio of  $-0.009$  and the simple technical trading rule with a profit of  $0.005$  per cent a Sharpe ratio of  $0.013$ . Once more, the number of days with an open position is greater in the cases of the combined TTR and RR than in the case of the initial combination. For instance, in the case of the 5Day/20Day moving average combinations, the combined TTR and RR generated 237 days with a long or short position, while the initial combinations only 203 out of the 455 risk reversal prices.

### 7.2.2 Filter Rule Combinations

Finally, the results derived from the filter rule combinations come to support the existing picture. During all the combinations, the combined TTR and RR generated the greatest number of long or short positions. In the case of the 0.5% filter rule, the combined TTR led to a profit equal to  $0.005$  per cent and to a Sharpe ratio equal to  $0.014$ . The combined RR is associated with the opposite results. Comparing the results derived from the combined TTR with the ones from the initial combination and the simple filter rule, we notice, once more, the difference among them. The initial combination is associated with a loss of  $-0.006$

per cent and the simple 0.5% filter rule with a loss of  $-0.002$  per cent, and their Sharpe ratios are  $-0.021$  and  $-0.003$  respectively.

With reference to the 1% filter combinations, the combined TTR led to a profit of 0.013 per cent and to a Sharpe ratio of 0.035. Additionally, the simple technical trading rule generates an average return of 0.02 per cent, while the initial combination a profit of 0.002 per cent. It is the first time that the use of the simple 1% filter rule is associated with a similar profit than the one derived from the combined TTR. Finally, during the 2% combinations the combined TTR led to a profit of 0.008 per cent and to a Sharpe ratio equal to 0.024. The initial combination is associated with a loss of  $-0.003$  per cent and a Sharpe ratio of  $-0.011$  and the simple 2% filter rule with a profit of 0.004 per cent and a Sharpe ratio of 0.01.

As already mentioned, we have implemented these two new combinations out of curiosity. We stated the results briefly and we believe that it is worth examining these in detail on another thesis.



**SWISS Moving Average Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Sharpe Ratio
<b>Combined Strategy</b>			
1Day/5Day	776	357	-0.018
5Day/20Day	776	362	-0.012
1Day/200Day	776	196	-0.035
<b>Combined TTR</b>			
1Day/5Day	776	419	0.054
5Day/20Day	776	414	0.057
1Day/200Day	776	580	0.038
<b>Combined RR</b>			
1Day/5Day	776	419	-0.054
5Day/20Day	776	414	-0.057
1Day/200Day	776	580	-0.038
<b>TTR</b>			
1Day/5Day	776	776	0.024
5Day/20Day	776	776	0.035
1Day/200Day	776	776	0.012
<b>Memoorandum Items</b>			
Buy & Hold	776	776	-0.041
Risk Reversal	776	776	-0.051

**SWISS Filter Rule Combination**

TRADING STRATEGY	Number of Observations	Number of Open Position	Sharpe Ratio
<b>Combined Strategy</b>			
0.5%	776	359	-0.019
1%	776	375	-0.027
2%	776	393	-0.036
<b>Combined TTR</b>			
0.5%	776	420	0.053
1%	776	401	0.044
2%	776	379	0.041
<b>Combined RR</b>			
0.5%	776	420	-0.053
1%	776	401	-0.044
2%	776	379	-0.041
<b>TTR</b>			
0.5%	776	776	0.023
1%	776	776	0.012
2%	776	772	0.002
<b>Memoorandum Items</b>			
Buy & Hold	776	776	-0.041
Risk Reversal	776	776	-0.051

## Notes

- Combined : Risk Reversal and MA
- Combined TTR : Risk Reversal and MA, follow MA signals
- Combined RR : Risk Reversal and MA, follow Risk Reversal signals
- TTR: Simple Moving Average Rule

**BRITISH Moving Average Combination**

TRADING STRATEGY	Number of Observations	Number of Open Position	Sharpe Ratio
<b>Combined Strategy</b>			
1Day/5Day	455	219	-0.050
5Day/20Day	455	203	-0.012
1Day/200Day	455	221	-0.009
<b>Combined TTR</b>			
1Day/5Day	455	237	-0.013
5Day/20Day	455	253	0.022
1Day/200Day	455	235	0.025
<b>Combined RR</b>			
1Day/5Day	455	419	0.013
5Day/20Day	455	414	-0.022
1Day/200Day	455	580	-0.025
<b>TTR</b>			
1Day/5Day	455	455	-0.044
5Day/20Day	455	455	0.009
1Day/200Day	455	455	0.013
<b>Memoorandum Items</b>			
Buy & Hold	455	455	-0.050
Risk Reversal	455	455	-0.025

**BRITISH Filter Rule Combinations**

TRADING STRATEGY	Number of Observations	Number of Open Position	Sharpe Ratio
<b>Combined Strategy</b>			
1%	455	199	-0.021
2%	455	192	0.006
3%	455	229	-0.011
<b>Combined TTR</b>			
1%	455	257	0.014
2%	455	262	0.035
3%	455	225	0.024
<b>Combined RR</b>			
1%	455	257	-0.014
2%	455	262	-0.035
3%	455	225	-0.024
<b>TTR</b>			
1%	455	455	-0.003
2%	455	455	0.032
3%	455	455	0.010
<b>Memoorandum Items</b>			
Buy & Hold	455	455	-0.050
Risk Reversal	455	455	-0.025

## Notes

- Combined : Risk Reversal and MA
- Combined TTR : Risk Reversal and MA, follow MA signals
- Combined RR : Risk Reversal and MA, follow Risk Reversal signals
- TTR: Simple Moving Average Rule

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**APPENDIX**

Πανεπιστήμιο Πειραιώς

Table 1: 10Day/5Day Combination

Year	Number of Risk Reversal Observations per month	Number of Open Positions per month for Conditional Strategy	Cap Asset (\$M)	Return	Volatility	Sharpe Ratio
1995	21	11	12.50	2.0%	3.8%	0.58
1996	23	14	12.50	2.5%	4.1%	0.62
1997	20	12	12.50	1.8%	3.6%	0.55
1998	7	4	12.50	-0.5%	3.2%	-0.15
1999	23	13	12.50	2.2%	3.9%	0.60
2000	25	14	12.50	2.8%	4.2%	0.65
2001	22	13	12.50	2.0%	3.8%	0.58
2002	21	12	12.50	1.9%	3.7%	0.57
2003	18	10	12.50	1.5%	3.5%	0.53
2004	16	9	12.50	1.2%	3.4%	0.50
2005	15	9	12.50	1.1%	3.3%	0.49
2006	14	9	12.50	1.0%	3.3%	0.48
2007	13	8	12.50	0.8%	3.2%	0.46
2008	11	7	12.50	0.5%	3.1%	0.43
2009	9	6	12.50	0.3%	3.0%	0.41
2010	14	9	12.50	1.5%	3.5%	0.52
2011	20	12	12.50	2.0%	3.8%	0.57
2012	22	13	12.50	2.2%	3.9%	0.59
2013	23	13	12.50	2.4%	4.0%	0.61
2014	24	14	12.50	2.5%	4.1%	0.62
2015	25	14	12.50	2.6%	4.1%	0.63
2016	26	15	12.50	2.7%	4.2%	0.64
2017	27	15	12.50	2.8%	4.2%	0.65
2018	28	16	12.50	2.9%	4.3%	0.66
2019	29	16	12.50	3.0%	4.3%	0.67
2020	30	17	12.50	3.1%	4.4%	0.68
2021	31	17	12.50	3.2%	4.4%	0.69
2022	32	18	12.50	3.3%	4.5%	0.70
2023	33	18	12.50	3.4%	4.5%	0.71
2024	34	19	12.50	3.5%	4.6%	0.72
2025	35	19	12.50	3.6%	4.6%	0.73
2026	36	20	12.50	3.7%	4.7%	0.74
2027	37	20	12.50	3.8%	4.7%	0.75
2028	38	21	12.50	3.9%	4.8%	0.76
2029	39	21	12.50	4.0%	4.8%	0.77
2030	40	22	12.50	4.1%	4.9%	0.78
2031	41	22	12.50	4.2%	4.9%	0.79
2032	42	23	12.50	4.3%	5.0%	0.80
2033	43	23	12.50	4.4%	5.0%	0.81
2034	44	24	12.50	4.5%	5.1%	0.82
2035	45	24	12.50	4.6%	5.1%	0.83
2036	46	25	12.50	4.7%	5.2%	0.84
2037	47	25	12.50	4.8%	5.2%	0.85
2038	48	26	12.50	4.9%	5.3%	0.86
2039	49	26	12.50	5.0%	5.3%	0.87
2040	50	27	12.50	5.1%	5.4%	0.88
2041	51	27	12.50	5.2%	5.4%	0.89
2042	52	28	12.50	5.3%	5.5%	0.90
2043	53	28	12.50	5.4%	5.5%	0.91
2044	54	29	12.50	5.5%	5.6%	0.92
2045	55	29	12.50	5.6%	5.6%	0.93
2046	56	30	12.50	5.7%	5.7%	0.94
2047	57	30	12.50	5.8%	5.7%	0.95
2048	58	31	12.50	5.9%	5.8%	0.96
2049	59	31	12.50	6.0%	5.8%	0.97
2050	60	32	12.50	6.1%	5.9%	0.98
2051	61	32	12.50	6.2%	5.9%	0.99
2052	62	33	12.50	6.3%	6.0%	1.00
2053	63	33	12.50	6.4%	6.0%	1.01
2054	64	34	12.50	6.5%	6.1%	1.02
2055	65	34	12.50	6.6%	6.1%	1.03
2056	66	35	12.50	6.7%	6.2%	1.04
2057	67	35	12.50	6.8%	6.2%	1.05
2058	68	36	12.50	6.9%	6.3%	1.06
2059	69	36	12.50	7.0%	6.3%	1.07
2060	70	37	12.50	7.1%	6.4%	1.08
2061	71	37	12.50	7.2%	6.4%	1.09
2062	72	38	12.50	7.3%	6.5%	1.10
2063	73	38	12.50	7.4%	6.5%	1.11
2064	74	39	12.50	7.5%	6.6%	1.12
2065	75	39	12.50	7.6%	6.6%	1.13
2066	76	40	12.50	7.7%	6.7%	1.14
2067	77	40	12.50	7.8%	6.7%	1.15
2068	78	41	12.50	7.9%	6.8%	1.16
2069	79	41	12.50	8.0%	6.8%	1.17
2070	80	42	12.50	8.1%	6.9%	1.18
2071	81	42	12.50	8.2%	6.9%	1.19
2072	82	43	12.50	8.3%	7.0%	1.20
2073	83	43	12.50	8.4%	7.0%	1.21
2074	84	44	12.50	8.5%	7.1%	1.22
2075	85	44	12.50	8.6%	7.1%	1.23
2076	86	45	12.50	8.7%	7.2%	1.24
2077	87	45	12.50	8.8%	7.2%	1.25
2078	88	46	12.50	8.9%	7.3%	1.26
2079	89	46	12.50	9.0%	7.3%	1.27
2080	90	47	12.50	9.1%	7.4%	1.28
2081	91	47	12.50	9.2%	7.4%	1.29
2082	92	48	12.50	9.3%	7.5%	1.30
2083	93	48	12.50	9.4%	7.5%	1.31
2084	94	49	12.50	9.5%	7.6%	1.32
2085	95	49	12.50	9.6%	7.6%	1.33
2086	96	50	12.50	9.7%	7.7%	1.34
2087	97	50	12.50	9.8%	7.7%	1.35
2088	98	51	12.50	9.9%	7.8%	1.36
2089	99	51	12.50	10.0%	7.8%	1.37
2090	100	52	12.50	10.1%	7.9%	1.38
2091	101	52	12.50	10.2%	7.9%	1.39
2092	102	53	12.50	10.3%	8.0%	1.40
2093	103	53	12.50	10.4%	8.0%	1.41
2094	104	54	12.50	10.5%	8.1%	1.42
2095	105	54	12.50	10.6%	8.1%	1.43
2096	106	55	12.50	10.7%	8.2%	1.44
2097	107	55	12.50	10.8%	8.2%	1.45
2098	108	56	12.50	10.9%	8.3%	1.46
2099	109	56	12.50	11.0%	8.3%	1.47
2100	110	57	12.50	11.1%	8.4%	1.48
2101	111	57	12.50	11.2%	8.4%	1.49
2102	112	58	12.50	11.3%	8.5%	1.50
2103	113	58	12.50	11.4%	8.5%	1.51
2104	114	59	12.50	11.5%	8.6%	1.52
2105	115	59	12.50	11.6%	8.6%	1.53
2106	116	60	12.50	11.7%	8.7%	1.54
2107	117	60	12.50	11.8%	8.7%	1.55
2108	118	61	12.50	11.9%	8.8%	1.56
2109	119	61	12.50	12.0%	8.8%	1.57
2110	120	62	12.50	12.1%	8.9%	1.58
2111	121	62	12.50	12.2%	8.9%	1.59
2112	122	63	12.50	12.3%	9.0%	1.60
2113	123	63	12.50	12.4%	9.0%	1.61
2114	124	64	12.50	12.5%	9.1%	1.62
2115	125	64	12.50	12.6%	9.1%	1.63
2116	126	65	12.50	12.7%	9.2%	1.64
2117	127	65	12.50	12.8%	9.2%	1.65
2118	128	66	12.50	12.9%	9.3%	1.66
2119	129	66	12.50	13.0%	9.3%	1.67
2120	130	67	12.50	13.1%	9.4%	1.68
2121	131	67	12.50	13.2%	9.4%	1.69
2122	132	68	12.50	13.3%	9.5%	1.70
2123	133	68	12.50	13.4%	9.5%	1.71
2124	134	69	12.50	13.5%	9.6%	1.72
2125	135	69	12.50	13.6%	9.6%	1.73
2126	136	70	12.50	13.7%	9.7%	1.74
2127	137	70	12.50	13.8%	9.7%	1.75
2128	138	71	12.50	13.9%	9.8%	1.76
2129	139	71	12.50	14.0%	9.8%	1.77
2130	140	72	12.50	14.1%	9.9%	1.78
2131	141	72	12.50	14.2%	9.9%	1.79
2132	142	73	12.50	14.3%	10.0%	1.80
2133	143	73	12.50	14.4%	10.0%	1.81
2134	144	74	12.50	14.5%	10.1%	1.82
2135	145	74	12.50	14.6%	10.1%	1.83
2136	146	75	12.50	14.7%	10.2%	1.84
2137	147	75	12.50	14.8%	10.2%	1.85
2138	148	76	12.50	14.9%	10.3%	1.86
2139	149	76	12.50	15.0%	10.3%	1.87
2140	150	77	12.50	15.1%	10.4%	1.88
2141	151	77	12.50	15.2%	10.4%	1.89
2142	152	78	12.50	15.3%	10.5%	1.90
2143	153	78	12.50	15.4%	10.5%	1.91
2144	154	79	12.50	15.5%	10.6%	1.92
2145	155	79	12.50	15.6%	10.6%	1.93
2146	156	80	12.50	15.7%	10.7%	1.94
2147	157	80	12.50	15.8%	10.7%	1.95
2148	158	81	12.50	15.9%	10.8%	1.96
2149	159	81	12.50	16.0%	10.8%	1.97
2150	160	82	12.50	16.1%	10.9%	1.98
2151	161	82	12.50	16.2%	10.9%	1.99
2152	162	83	12.50	16.3%	11.0%	2.00
2153	163	83	12.50	16.4%	11.0%	2.01
2154	164	84	12.50	16.5%	11.1%	2.02
2155	165	84	12.50	16.6%	11.1%	2.03
2156	166	85	12.50	16.7%	11.2%	2.04
2157	167	85	12.50	16.8%	11.2%	2.05
2158	168	86	12.50	16.9%	11.3%	2.06
2159	169	86	12.50	17.0%	11.3%	2.07
2160	170	87	12.50	17.1%	11.4%	2.08
2161	171	87	12.50	17.2%	11.4%	2.09
2162	172	88	12.50	17.3%	11.5%	2.10
2163	173	88	12.50	17.4%	11.5%	2.11
2164	174	89	12.50	17.5%	11.6%	2.12
2165	175	89	12.50	17.6%	11.6%	2.13
2166	176	90	12.50	17.7%	11.7%	2.14
2167	177	90	12.50	17.8%	11.7%	2.15
2168	178	91	12.50	17.9%	11.8%	2.16
2169	179	91	12.50	18.0%	11.8%	2.17
2170	180	92	12.50	18.1%	11.9%	2.18
2171	181	92	12.50	18.2%	11.9%	2.19
2172	182	93	12.50	18.3%	12.0%	2.20
2173	183	93	12.50	18.4%	12.0%	2.21
2174	184	94	12.50	18.5%	12.1%	2.22
2175	185	94	12.50	18.6%	12.1%	2.23
2176	186	95	12.50	18.7%	12.2%	2.24
2177	187	95	12.50	18.8%	12.2%	2.25
2178	188	96	12.50	18.9%	12.3%	2.26
2179	189	96	12.50	19.0%	12.3%	2.27
2180	190	97	12.50	19.1%	12.4%	2.28
2181	191	97	12.50	19.2%	12.4%	2.29
2182	192	98	12.50	19.3%	12.5%	2.30
2183	193	98	12.50	19.4%	12.5%	2.31
2184	194	99	12.50	19.5%	12.6%	2.32
2185						

Table 1 : 1Day/5Day Combinations Category A

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/5Day Average Monthly Returns	Standard Deviation of Returns	Sharpe R
-30/09/97	22	14	0.131%	0.501%	0.262	0.093%	0.564%	0.16
-31/10/97	23	14	0.032%	0.699%	0.045	0.060%	0.758%	0.07
-30/11/97	20	8	-0.020%	0.454%	-0.044	0.033%	0.572%	0.05
-31/12/97	7	1	0.000%	0.000%		-0.165%	0.725%	-0.22
-31/01/98	22	11	-0.005%	0.574%	-0.008	0.107%	0.750%	0.14
-28/02/98	20	6	-0.090%	0.504%	-0.179	-0.318%	0.584%	-0.54
-31/03/98	22	7	0.054%	0.443%	0.122	0.074%	0.598%	0.12
-30/04/98	22	12	0.094%	0.466%	0.201	0.136%	0.515%	0.26
-31/05/98	21	10	0.051%	0.329%	0.154	0.059%	0.427%	0.13
-30/06/98	19	8	-0.080%	0.254%	-0.317	-0.038%	0.473%	-0.08
-31/07/98	18	13	0.001%	0.434%	0.003	-0.030%	0.479%	-0.06
-31/08/98	21	12	0.048%	0.742%	0.064	-0.071%	0.862%	-0.08
-30/09/98	20	6	-0.062%	0.157%	-0.396	0.018%	0.509%	0.03
-31/10/98	10	6	-0.130%	0.546%	-0.239	0.110%	0.825%	0.13
-30/11/98	21	15	0.129%	0.537%	0.241	0.088%	0.629%	0.14
-31/12/98	0	0	0.000%			1.086%		
-31/01/99	14	5	0.019%	0.541%	0.035	0.219%	0.869%	0.25
-28/02/99	20	3	-0.061%	0.353%	-0.174	0.008%	0.655%	0.01
-31/03/99	23	4	-0.057%	0.222%	-0.257	-0.095%	0.513%	-0.18
-30/04/99	22	6	-0.052%	0.226%	-0.232	0.128%	0.457%	0.27
-31/05/99	21	10	-0.083%	0.494%	-0.169	-0.060%	0.550%	-0.10
-30/06/99	11	7	-0.188%	0.506%	-0.370	-0.259%	0.544%	-0.47
-31/07/99	22	11	0.243%	0.491%	0.496	0.314%	0.553%	0.56
-31/08/99	22	11	-0.095%	0.572%	-0.165	-0.142%	0.691%	-0.20
-30/09/99	22	10	0.043%	0.392%	0.109	0.054%	0.736%	0.07
-31/10/99	21	11	-0.018%	0.521%	-0.034	0.125%	0.827%	0.15
-30/11/99	22	7	-0.011%	0.449%	-0.025	-0.012%	0.626%	-0.01
-31/12/99	23	8	0.008%	0.452%	0.017	0.058%	0.607%	0.09
-31/01/00	21	9	0.044%	0.427%	0.103	0.086%	0.719%	0.12
-28/02/00	20	7	-0.022%	0.265%	-0.082	0.048%	0.837%	0.05
-31/03/00	23	12	-0.189%	0.487%	-0.388	-0.120%	0.748%	-0.16
-30/04/00	9	4	0.125%	0.580%	0.216	0.567%	0.919%	0.61
-31/05/00	6	3	-0.139%	0.411%	-0.338	-0.363%	0.445%	-0.81
-30/06/00	22	13	0.031%	0.442%	0.069	-0.035%	0.676%	-0.05
-31/07/00	21	8	0.076%	0.257%	0.297	0.137%	0.589%	0.23
-31/08/00	10	3	0.062%	0.233%	0.268	-0.054%	0.709%	-0.07
-30/09/00	0	0						
-31/10/00	0	0						
-30/11/00	0	0						
-31/12/00	19	14	0.126%	0.537%	0.235	0.013%	0.677%	0.02
-31/01/01	22	10	-0.271%	0.700%	-0.387	-0.099%	0.901%	-0.11
	704	319	-0.003%	0.468%	-0.007	0.026%	0.659%	0.03

Table 1 : 5Day/20Day Combinations Category A (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 5Day/20Day Average Monthly Returns	Standard Deviation of Returns	Shar Rat
-30/09/97	22	22	0.162%	0.533%	0.305	0.170%	0.545%	0.31
-31/10/97	23	15	-0.037%	0.468%	-0.079	-0.077%	0.757%	-0.10
-30/11/97	20	15	-0.028%	0.547%	-0.051	0.017%	0.572%	0.02
-31/12/97	7	1	0.000%	0.000%		-0.165%	0.725%	-0.22
-31/01/98	22	8	-0.092%	0.283%	-0.323	-0.066%	0.755%	-0.08
-28/02/98	20	14	0.018%	0.561%	0.032	-0.102%	0.661%	-0.15
-31/03/98	22	3	0.115%	0.412%	0.280	0.196%	0.568%	0.34
-30/04/98	22	13	-0.037%	0.338%	-0.110	-0.126%	0.518%	-0.24
-31/05/98	21	21	0.042%	0.429%	0.099	0.042%	0.429%	0.09
-30/06/98	19	6	-0.082%	0.283%	-0.291	-0.042%	0.472%	-0.08
-31/07/98	18	12	0.034%	0.392%	0.087	0.035%	0.479%	0.07
-31/08/98	21	14	-0.073%	0.412%	-0.178	-0.313%	0.803%	-0.39
-30/09/98	20	2	-0.004%	0.052%	-0.080	0.134%	0.490%	0.27
-31/10/98	10	5	-0.073%	0.421%	-0.173	0.225%	0.799%	0.28
-30/11/98	21	21	0.171%	0.610%	0.280	0.171%	0.610%	0.28
-31/12/98	0	0	-1.086%			-1.086%		
-31/01/99	14	3	-0.123%	0.506%	-0.400	-0.063%	0.896%	-0.07
-28/02/99	20	2	-0.001%	0.285%	-0.003	0.129%	0.641%	0.20
-31/03/99	23	4	0.039%	0.197%	0.196	0.097%	0.513%	0.18
-30/04/99	22	4	-0.051%	0.266%	-0.191	0.131%	0.456%	0.28
-31/05/99	21	11	-0.106%	0.321%	-0.331	-0.105%	0.543%	-0.19
-30/06/99	11	0	0.000%	0.000%		0.116%	0.596%	0.19
-31/07/99	22	6	0.110%	0.357%	0.308	0.047%	0.638%	0.07
-31/08/99	22	13	-0.067%	0.494%	-0.135	-0.086%	0.700%	-0.12
-30/09/99	22	7	-0.141%	0.480%	-0.293	-0.313%	0.666%	-0.47
-31/10/99	21	16	-0.094%	0.798%	-0.118	-0.027%	0.837%	-0.03
-30/11/99	22	5	0.100%	0.428%	0.234	0.211%	0.588%	0.35
-31/12/99	23	2	-0.008%	0.069%	-0.111	0.027%	0.610%	0.04
-31/01/00	21	11	-0.013%	0.341%	-0.040	-0.028%	0.724%	-0.03
-28/02/00	20	7	-0.133%	0.522%	-0.254	-0.173%	0.819%	-0.21
-31/03/00	23	7	-0.094%	0.449%	-0.208	0.071%	0.755%	0.09
-30/04/00	9	3	-0.093%	0.197%	-0.471	0.130%	1.087%	0.11
-31/05/00	6	3	0.177%	0.310%	0.570	0.269%	0.522%	0.51
-30/06/00	22	17	0.114%	0.639%	0.178	0.131%	0.663%	0.19
-31/07/00	21	8	0.001%	0.422%	0.003	-0.013%	0.606%	-0.02
-31/08/00	10	8	0.350%	0.496%	0.706	0.522%	0.454%	1.14
-30/09/00	0	0						
-31/10/00	0	0						
-30/11/00	0	0						
-31/12/00	19	17	0.230%	0.634%	0.362	0.220%	0.638%	0.34
-31/01/01	22	10	-0.261%	0.633%	-0.412	-0.079%	0.903%	-0.08
	704	336	-0.006%	0.445%	-0.013	0.020%	0.659%	0.03

Note

-Blank space: no risk reversal prices / no returns

Table 1 : 1Day/200Day Combinations Category A (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/200Day Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	22	1	0.011%	0.052%	0.213	-0.147%	0.552%	-0.266
01-31/10/97	23	12	0.017%	0.644%	0.027	0.031%	0.760%	0.041
01-30/11/97	20	17	-0.093%	0.553%	-0.168	-0.113%	0.561%	-0.202
01-31/12/97	7	6	0.090%	0.708%	0.126	0.014%	0.746%	0.018
01-31/01/98	22	7	-0.122%	0.348%	-0.352	-0.128%	0.747%	-0.171
01-28/02/98	20	6	-0.101%	0.483%	-0.209	-0.339%	0.572%	-0.593
01-31/03/98	22	3	0.119%	0.410%	0.290	-0.204%	0.565%	0.361
01-30/04/98	22	0	0.000%	0.000%		-0.052%	0.531%	-0.098
01-31/05/98	21	3	-0.031%	0.128%	-0.240	-0.104%	0.418%	-0.248
01-30/06/98	19	1	-0.023%	0.101%	-0.229	0.077%	0.468%	0.164
01-31/07/98	18	0	0.000%	0.000%		-0.032%	0.479%	-0.068
01-31/08/98	21	5	-0.001%	0.108%	-0.014	-0.169%	0.847%	-0.200
01-30/09/98	20	2	-0.004%	0.052%	-0.080	0.134%	0.490%	0.273
01-31/10/98	10	0	0.000%	0.000%		0.371%	0.736%	0.504
01-30/11/98	21	0	0.000%	0.000%		-0.171%	0.610%	-0.280
01-31/12/98	0	0	0.000%			1.086%		
01-31/01/99	14	11	-0.059%	0.833%	-0.071	0.063%	0.896%	0.071
01-28/02/99	20	11	-0.049%	0.484%	-0.101	0.033%	0.654%	0.050
01-31/03/99	23	5	0.052%	0.204%	0.254	0.123%	0.507%	0.243
01-30/04/99	22	4	-0.051%	0.266%	-0.191	0.131%	0.456%	0.287
01-31/05/99	21	1	-0.035%	0.176%	-0.196	0.038%	0.552%	0.070
01-30/06/99	11	0	0.000%	0.000%		0.116%	0.596%	0.194
01-31/07/99	22	2	0.006%	0.018%	0.309	-0.162%	0.618%	-0.262
01-31/08/99	22	5	0.019%	0.364%	0.053	0.086%	0.700%	0.122
01-30/09/99	22	1	0.002%	0.010%	0.213	-0.027%	0.738%	-0.037
01-31/10/99	21	9	-0.152%	0.603%	-0.252	-0.144%	0.824%	-0.174
01-30/11/99	22	5	0.100%	0.428%	0.234	0.211%	0.588%	0.359
01-31/12/99	23	1	-0.013%	0.063%	-0.209	0.016%	0.610%	0.026
01-31/01/00	21	6	0.112%	0.370%	0.303	0.223%	0.687%	0.325
01-28/02/00	20	5	-0.030%	0.467%	-0.064	0.032%	0.838%	0.038
01-31/03/00	23	3	-0.118%	0.420%	-0.281	0.022%	0.758%	0.029
01-30/04/00	9	2	-0.042%	0.132%	-0.316	0.232%	1.068%	0.218
01-31/05/00	6	3	0.224%	0.326%	0.687	0.363%	0.445%	0.816
01-30/06/00	22	1	-0.011%	0.052%	-0.213	-0.118%	0.666%	-0.177
01-31/07/00	21	3	0.064%	0.194%	0.331	0.113%	0.595%	0.191
01-31/08/00	10	8	0.350%	0.496%	0.706	0.522%	0.454%	1.149
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	19	15	0.172%	0.561%	0.307	0.106%	0.669%	0.158
01-31/01/01	22	17	-0.251%	0.700%	-0.359	-0.060%	0.904%	-0.066
<b>704</b>	<b>181</b>		<b>-0.007%</b>	<b>0.369%</b>	<b>-0.018</b>	<b>0.019%</b>	<b>0.659%</b>	<b>0.029</b>

Note

-Blank space: no risk reversal prices / no returns



Table 1 : Memorandum MA Combinations Category A (continued)

Period	Buy&Hold Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Risk Reversal Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	0.170%	0.545%	0.312	0.170%	0.545%	0.312
01-31/10/97	0.141%	0.747%	0.189	0.003%	0.761%	0.004
01-30/11/97	-0.113%	0.561%	-0.202	-0.073%	0.568%	-0.128
01-31/12/97	0.165%	0.725%	0.228	0.165%	0.725%	0.228
01-31/01/98	-0.058%	0.756%	-0.077	-0.117%	0.749%	-0.156
01-28/02/98	0.025%	0.669%	0.037	0.137%	0.654%	0.210
01-31/03/98	-0.204%	0.565%	-0.361	0.034%	0.601%	0.057
01-30/04/98	0.052%	0.531%	0.098	0.052%	0.531%	0.098
01-31/05/98	0.042%	0.429%	0.099	0.042%	0.429%	0.099
01-30/06/98	-0.077%	0.468%	-0.164	-0.123%	0.457%	-0.269
01-31/07/98	0.032%	0.479%	0.068	0.032%	0.479%	0.068
01-31/08/98	0.141%	0.852%	0.165	0.166%	0.848%	0.196
01-30/09/98	0.134%	0.490%	0.273	-0.142%	0.488%	-0.292
01-31/10/98	0.371%	0.736%	0.504	-0.371%	0.736%	-0.504
01-30/11/98	-0.171%	0.610%	-0.280	0.171%	0.610%	0.280
01-31/12/98	1.086%			-1.086%		
01-31/01/99	0.063%	0.896%	0.071	-0.182%	0.879%	-0.207
01-28/02/99	-0.129%	0.641%	-0.201	-0.131%	0.641%	-0.204
01-31/03/99	-0.123%	0.507%	-0.243	-0.019%	0.522%	-0.037
01-30/04/99	-0.131%	0.456%	-0.287	-0.232%	0.412%	-0.565
01-31/05/99	-0.038%	0.552%	-0.070	-0.107%	0.542%	-0.198
01-30/06/99	-0.116%	0.596%	-0.194	-0.116%	0.596%	-0.194
01-31/07/99	0.162%	0.618%	0.262	0.173%	0.615%	0.281
01-31/08/99	-0.086%	0.700%	-0.122	-0.047%	0.704%	-0.067
01-30/09/99	0.027%	0.738%	0.037	0.031%	0.738%	0.042
01-31/10/99	-0.092%	0.832%	-0.111	-0.161%	0.821%	-0.196
01-30/11/99	-0.211%	0.588%	-0.359	-0.011%	0.626%	-0.017
01-31/12/99	-0.016%	0.610%	-0.026	-0.042%	0.609%	-0.069
01-31/01/00	-0.223%	0.687%	-0.325	0.001%	0.724%	0.002
01-28/02/00	-0.032%	0.838%	-0.038	-0.092%	0.833%	-0.110
01-31/03/00	-0.022%	0.758%	-0.029	-0.258%	0.711%	-0.364
01-30/04/00	-0.232%	1.068%	-0.218	-0.316%	1.044%	-0.302
01-31/05/00	-0.363%	0.445%	-0.816	0.085%	0.595%	0.143
01-30/06/00	0.118%	0.666%	0.177	0.096%	0.669%	0.144
01-31/07/00	-0.113%	0.595%	-0.191	0.015%	0.606%	0.024
01-31/08/00	-0.522%	0.454%	-1.149	0.179%	0.686%	0.260
01-30/09/00						
01-31/10/00						
01-30/11/00						
01-31/12/00	0.220%	0.638%	0.345	0.239%	0.631%	0.379
01-31/01/01	-0.060%	0.904%	-0.066	-0.443%	0.785%	-0.564
	-0.027%	0.659%	-0.040	-0.032%	0.659%	-0.049

Note

-Blank space: no risk reversal prices / no returns

Table 2 : 0.5% Filter Combinations Category A

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 0.5% filter Average Monthly Returns	Standard Deviation of Returns	S R
01-30/09/97	22	12	0.120%	0.484%	0.247	0.069%	0.568%	0
01-31/10/97	22	12	0.131%	0.586%	0.224	0.265%	0.729%	0
01-30/11/97	20	6	-0.095%	0.266%	-0.356	-0.116%	0.560%	-
01-31/12/97	7	2	0.211%	0.558%	0.378	0.257%	0.693%	0
01-31/01/98	22	13	-0.055%	0.611%	-0.090	0.007%	0.758%	0
01-28/02/98	20	9	0.003%	0.573%	0.006	-0.131%	0.656%	-
01-31/03/98	22	4	0.072%	0.392%	0.183	0.109%	0.592%	0
01-30/04/98	22	9	0.034%	0.412%	0.082	0.016%	0.534%	0
01-31/05/98	21	13	0.023%	0.342%	0.068	0.004%	0.431%	0
01-30/06/98	19	8	-0.094%	0.249%	-0.379	-0.066%	0.470%	-
01-31/07/98	18	17	0.007%	0.380%	0.017	-0.007%	0.513%	-
01-31/08/98	21	14	0.087%	0.840%	0.104	0.008%	0.865%	0
01-30/09/98	20	6	-0.054%	0.147%	-0.370	0.033%	0.508%	0
01-31/10/98	10	6	-0.130%	0.546%	-0.239	0.110%	0.825%	0
01-30/11/98	21	13	0.081%	0.478%	0.169	-0.009%	0.635%	-
01-31/12/98	0	0	0.000%			1.086%		
01-31/01/99	14	7	-0.179%	0.739%	-0.243	-0.177%	0.880%	-
01-28/02/99	20	5	-0.138%	0.420%	-0.327	-0.145%	0.638%	-
01-31/03/99	23	5	-0.028%	0.269%	-0.105	-0.037%	0.521%	-
01-30/04/99	22	5	-0.037%	0.216%	-0.170	0.159%	0.447%	0
01-31/05/99	21	7	-0.063%	0.479%	-0.131	-0.018%	0.553%	-
01-30/06/99	11	6	-0.108%	0.453%	-0.238	-0.100%	0.599%	-
01-31/07/99	22	11	0.243%	0.491%	0.496	0.314%	0.553%	0
01-31/08/99	22	11	-0.095%	0.572%	-0.165	-0.142%	0.691%	-
01-30/09/99	22	6	0.051%	0.379%	0.135	0.071%	0.735%	0
01-31/10/99	21	11	-0.018%	0.521%	-0.034	0.125%	0.827%	0
01-30/11/99	22	7	0.000%	0.446%	0.000	0.011%	0.626%	0
01-31/12/99	23	9	0.000%	0.468%	-0.001	0.041%	0.609%	0
01-31/01/00	21	12	0.017%	0.458%	0.037	0.033%	0.723%	0
01-28/02/00	20	5	0.036%	0.223%	0.159	0.163%	0.822%	0
01-31/03/00	23	14	-0.249%	0.492%	-0.506	-0.240%	0.718%	-
01-30/04/00	9	4	0.125%	0.580%	0.216	0.567%	0.919%	0
01-31/05/00	6	1	-0.173%	0.386%	-0.447	-0.430%	0.362%	-
01-30/06/00	22	13	0.033%	0.442%	0.074	-0.031%	0.676%	-
01-31/07/00	21	10	0.070%	0.269%	0.261	0.125%	0.592%	0
01-31/08/00	10	4	0.143%	0.339%	0.422	0.108%	0.703%	0
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	19	13	0.123%	0.538%	0.229	0.008%	0.677%	0
01-31/01/01	22	10	-0.265%	0.689%	-0.384	-0.087%	0.902%	-
	704	321	-0.003%	0.474%	-0.006	0.027%	0.659%	0

Note

-Blank space: no risk reversal prices / no returns

Table 2 : 1% Filter Combinations Category A (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1% Filter Average Monthly Returns	Standard Deviation of Returns	Sharp Ratio
01-30/09/97	22	13	0.034%	0.409%	0.083	-0.102%	0.562%	-0.182
01-31/10/97	23	18	0.048%	0.713%	0.067	0.093%	0.755%	0.123
01-30/11/97	20	15	-0.064%	0.542%	-0.118	-0.055%	0.570%	-0.097
01-31/12/97	7	4	0.018%	0.259%	0.068	-0.130%	0.733%	-0.178
01-31/01/98	22	9	-0.026%	0.591%	-0.044	0.065%	0.755%	0.086
01-28/02/98	20	11	-0.014%	0.599%	-0.023	-0.165%	0.647%	-0.254
01-31/03/98	22	10	-0.035%	0.275%	-0.126	-0.104%	0.593%	-0.175
01-30/04/98	22	17	0.005%	0.447%	0.012	-0.041%	0.532%	-0.077
01-31/05/98	21	12	-0.024%	0.349%	-0.069	-0.090%	0.421%	-0.215
01-30/06/98	19	8	-0.157%	0.251%	-0.625	-0.191%	0.432%	-0.441
01-31/07/98	18	15	-0.054%	0.358%	-0.152	-0.129%	0.497%	-0.259
01-31/08/98	21	8	0.038%	0.754%	0.051	-0.089%	0.860%	-0.104
01-30/09/98	20	4	-0.003%	0.053%	-0.065	0.135%	0.490%	0.276
01-31/10/98	10	7	-0.090%	0.571%	-0.158	0.190%	0.809%	0.235
01-30/11/98	21	17	0.117%	0.601%	0.195	0.063%	0.632%	0.100
01-31/12/98	0	0	0.000%			1.086%		
01-31/01/99	14	2	-0.074%	0.265%	-0.277	0.034%	0.898%	0.038
01-28/02/99	20	2	-0.030%	0.250%	-0.118	0.071%	0.650%	0.110
01-31/03/99	23	7	-0.083%	0.349%	-0.238	-0.147%	0.500%	-0.294
01-30/04/99	22	4	-0.051%	0.266%	-0.191	0.131%	0.456%	0.287
01-31/05/99	21	7	-0.066%	0.326%	-0.204	-0.026%	0.553%	-0.046
01-30/06/99	11	6	-0.158%	0.446%	-0.354	-0.200%	0.571%	-0.350
01-31/07/99	22	7	0.156%	0.403%	0.386	0.138%	0.624%	0.221
01-31/08/99	22	16	-0.084%	0.611%	-0.137	-0.120%	0.695%	-0.173
01-30/09/99	22	9	0.131%	0.386%	0.340	0.231%	0.700%	0.330
01-31/10/99	21	12	-0.070%	0.571%	-0.122	0.021%	0.837%	0.026
01-30/11/99	22	5	0.100%	0.428%	0.234	0.211%	0.588%	0.359
01-31/12/99	23	6	-0.056%	0.239%	-0.236	-0.071%	0.606%	-0.117
01-31/01/00	21	8	0.075%	0.395%	0.191	0.150%	0.708%	0.211
01-28/02/00	20	4	-0.188%	0.442%	-0.426	-0.285%	0.786%	-0.363
01-31/03/00	23	12	-0.111%	0.358%	-0.310	0.036%	0.757%	0.048
01-30/04/00	9	3	-0.093%	0.197%	-0.471	0.130%	1.087%	0.119
01-31/05/00	6	3	-0.139%	0.411%	-0.338	-0.363%	0.445%	-0.816
01-30/06/00	22	17	0.092%	0.590%	0.156	0.089%	0.671%	0.132
01-31/07/00	21	8	-0.069%	0.410%	-0.169	-0.153%	0.585%	-0.261
01-31/08/00	10	6	0.224%	0.417%	0.536	0.269%	0.653%	0.412
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	19	17	0.230%	0.634%	0.362	0.220%	0.638%	0.345
01-31/01/01	22	9	-0.228%	0.649%	-0.351	-0.013%	0.906%	-0.014
<b>704</b>		<b>338</b>	<b>-0.012%</b>	<b>0.465%</b>	<b>-0.025</b>	<b>0.009%</b>	<b>0.659%</b>	<b>0.013</b>

Note

-Blank space: no risk reversal prices / no returns

Table 2 : 2% Filter Combinations Category A (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 2% filter Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	22	18	0.075%	0.469%	0.160	0.075%	0.469%	0.160
01-31/10/97	23	20	0.072%	0.701%	0.103	0.141%	0.747%	0.189
01-30/11/97	20	17	-0.093%	0.553%	-0.168	-0.113%	0.561%	-0.202
01-31/12/97	7	6	0.165%	0.725%	0.228	0.165%	0.725%	0.228
01-31/01/98	22	16	-0.088%	0.729%	-0.120	-0.058%	0.756%	-0.077
01-28/02/98	20	16	-0.006%	0.577%	-0.011	-0.150%	0.651%	-0.230
01-31/03/98	22	18	-0.085%	0.415%	-0.205	-0.204%	0.565%	-0.361
01-30/04/98	22	0	0.000%	0.000%		-0.052%	0.531%	-0.098
01-31/05/98	21	17	-0.048%	0.348%	-0.139	-0.139%	0.407%	-0.342
01-30/06/98	19	8	-0.046%	0.316%	-0.144	0.032%	0.473%	0.068
01-31/07/98	18	0	-0.028%	0.286%	-0.100	-0.077%	0.508%	-0.152
01-31/08/98	21	5	-0.001%	0.108%	-0.014	-0.169%	0.847%	-0.200
01-30/09/98	20	2	-0.004%	0.052%	-0.080	0.134%	0.490%	0.273
01-31/10/98	10	7	-0.090%	0.571%	-0.158	0.190%	0.809%	0.235
01-30/11/98	21	21	0.171%	0.610%	0.280	0.171%	0.610%	0.280
01-31/12/98	0	0	-1.086%			-1.086%		
01-31/01/99	14	8	-0.194%	0.505%	-0.383	-0.206%	0.873%	-0.236
01-28/02/99	20	2	-0.001%	0.285%	-0.003	0.129%	0.641%	0.201
01-31/03/99	23	5	0.052%	0.204%	0.254	0.123%	0.507%	0.243
01-30/04/99	22	4	-0.051%	0.266%	-0.191	0.131%	0.456%	0.287
01-31/05/99	21	19	-0.183%	0.445%	-0.411	-0.258%	0.486%	-0.531
01-30/06/99	11	5	-0.095%	0.474%	-0.200	-0.074%	0.603%	-0.123
01-31/07/99	22	7	0.156%	0.403%	0.386	0.138%	0.624%	0.221
01-31/08/99	22	17	-0.067%	0.601%	-0.111	-0.086%	0.700%	-0.122
01-30/09/99	22	9	-0.122%	0.572%	-0.213	-0.275%	0.683%	-0.403
01-31/10/99	21	16	-0.094%	0.798%	-0.118	-0.027%	0.837%	-0.033
01-30/11/99	22	5	0.100%	0.428%	0.234	0.211%	0.588%	0.359
01-31/12/99	23	19	-0.093%	0.454%	-0.205	-0.144%	0.592%	-0.244
01-31/01/00	21	12	0.094%	0.505%	0.185	0.186%	0.699%	0.266
01-28/02/00	20	5	-0.030%	0.467%	-0.064	0.032%	0.838%	0.038
01-31/03/00	23	6	-0.249%	0.526%	-0.473	-0.239%	0.718%	-0.332
01-30/04/00	9	2	-0.042%	0.132%	-0.316	0.232%	1.068%	0.218
01-31/05/00	6	3	0.177%	0.310%	0.570	0.269%	0.522%	0.516
01-30/06/00	22	15	0.047%	0.599%	0.078	-0.002%	0.677%	-0.003
01-31/07/00	21	3	0.064%	0.194%	0.331	0.113%	0.595%	0.191
01-31/08/00	10	8	0.350%	0.496%	0.706	0.522%	0.454%	1.149
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	19	17	0.230%	0.634%	0.362	0.220%	0.638%	0.345
01-31/01/01	22	10	-0.261%	0.633%	-0.412	-0.079%	0.903%	-0.088
	704	368	-0.016%	0.486%	-0.032	0.004%	0.657%	0.006

Note

-Blank space: no risk reversal prices / no returns

Table 2 : Memorandum Filter Combinations Category A (continued)

Period	Buy&Hold Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Risk Reversal Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-30/09/97	0.170%	0.545%	0.312	0.170%	0.545%	0.312
01-31/10/97	0.142%	0.765%	0.185	-0.002%	0.778%	-0.003
01-30/11/97	-0.113%	0.561%	-0.202	-0.073%	0.568%	-0.128
01-31/12/97	0.165%	0.725%	0.228	0.165%	0.725%	0.228
01-31/01/98	-0.058%	0.756%	-0.077	-0.117%	0.749%	-0.156
01-28/02/98	0.025%	0.669%	0.037	0.137%	0.654%	0.210
01-31/03/98	-0.204%	0.565%	-0.361	0.034%	0.601%	0.057
01-30/04/98	0.052%	0.531%	0.098	0.052%	0.531%	0.098
01-31/05/98	0.042%	0.429%	0.099	0.042%	0.429%	0.099
01-30/06/98	-0.077%	0.468%	-0.164	-0.123%	0.457%	-0.269
01-31/07/98	-0.037%	0.512%	-0.073	0.020%	0.513%	0.039
01-31/08/98	0.141%	0.852%	0.165	0.166%	0.848%	0.196
01-30/09/98	0.134%	0.490%	0.273	-0.142%	0.488%	-0.292
01-31/10/98	0.371%	0.736%	0.504	-0.371%	0.736%	-0.504
01-30/11/98	-0.171%	0.610%	-0.280	0.171%	0.610%	0.280
01-31/12/98	1.086%			-1.086%		
01-31/01/99	0.063%	0.896%	0.071	-0.182%	0.879%	-0.207
01-28/02/99	-0.129%	0.641%	-0.201	-0.131%	0.641%	-0.204
01-31/03/99	-0.123%	0.507%	-0.243	-0.019%	0.522%	-0.037
01-30/04/99	-0.131%	0.456%	-0.287	-0.232%	0.412%	-0.565
01-31/05/99	-0.038%	0.552%	-0.070	-0.107%	0.542%	-0.198
01-30/06/99	-0.116%	0.596%	-0.194	-0.116%	0.596%	-0.194
01-31/07/99	0.162%	0.618%	0.262	0.173%	0.615%	0.281
01-31/08/99	-0.086%	0.700%	-0.122	-0.047%	0.704%	-0.067
01-30/09/99	0.027%	0.738%	0.037	0.031%	0.738%	0.042
01-31/10/99	-0.092%	0.832%	-0.111	-0.161%	0.821%	-0.196
01-30/11/99	-0.211%	0.588%	-0.359	-0.011%	0.626%	-0.017
01-31/12/99	-0.016%	0.610%	-0.026	-0.042%	0.609%	-0.069
01-31/01/00	-0.223%	0.687%	-0.325	0.001%	0.724%	0.002
01-28/02/00	-0.032%	0.838%	-0.038	-0.092%	0.833%	-0.110
01-31/03/00	-0.022%	0.758%	-0.029	-0.258%	0.711%	-0.364
01-30/04/00	-0.232%	1.068%	-0.218	-0.316%	1.044%	-0.302
01-31/05/00	-0.363%	0.445%	-0.816	0.085%	0.595%	0.143
01-30/06/00	0.118%	0.666%	0.177	0.096%	0.669%	0.144
01-31/07/00	-0.113%	0.595%	-0.191	0.015%	0.606%	0.024
01-31/08/00	-0.522%	0.454%	-1.149	0.179%	0.686%	0.260
01-30/09/00						
01-31/10/00						
01-30/11/00						
01-31/12/00	0.220%	0.638%	0.345	0.239%	0.631%	0.379
01-31/01/01	-0.060%	0.904%	-0.066	-0.443%	0.785%	-0.564
	-0.027%	0.659%	-0.040	-0.032%	0.659%	-0.049

Note

-Blank space: no risk reversal prices / no returns

Table 2: 1Day-1Day Combinations Category A

Period	Number of Obs. Observations per Month	Number of Obs. Periods per Category	Cost and Storage Average Return	Standard Deviation of Returns	Mean Return	Sharpe Ratio	Standard Deviation of Returns	Std. Error
01-11-1997	22	11	0.005	0.035	0.005	0.143	0.005	
01-12-1997	22	11	0.005	0.035	0.005	0.143	0.005	
01-01-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-02-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-03-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-04-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-05-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-06-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-07-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-08-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-09-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-10-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-11-1998	22	11	0.005	0.035	0.005	0.143	0.005	
01-12-1998	22	11	0.005	0.035	0.005	0.143	0.005	
02-01-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-02-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-03-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-04-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-05-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-06-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-07-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-08-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-09-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-10-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-11-1999	22	11	0.005	0.035	0.005	0.143	0.005	
02-12-1999	22	11	0.005	0.035	0.005	0.143	0.005	

**BRITISH**  
**Moving Average Rule Combinations**  
**Filter Rule Combinations**

Category A

Πανεπιστήμιο Πειραιώς

Table 3: 1Day/5Day Combinations Category A

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/5Day Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	19	13	-0.080%	0.307%	-0.260	-0.091%	0.442%	-0.
01-28/02/99	19	3	-0.002%	0.240%	-0.009	0.089%	0.500%	0.1
01-31/03/99	23	11	-0.058%	0.227%	-0.256	-0.112%	0.361%	-0.
01-30/04/99	5	2	0.077%	0.429%	0.180	0.071%	0.455%	0.1
01-31/05/99	12	4	-0.085%	0.130%	-0.651	-0.006%	0.348%	-0.
01-30/06/99	10	2	-0.094%	0.250%	-0.377	-0.172%	0.472%	-0.
01-31/07/99	21	10	0.149%	0.382%	0.391	0.287%	0.524%	0.5
01-31/08/99	22	13	-0.072%	0.378%	-0.191	-0.125%	0.449%	-0.
01-30/09/99	14	11	-0.014%	0.403%	-0.036	-0.042%	0.432%	-0.
01-31/10/99	12	6	-0.034%	0.342%	-0.100	0.027%	0.426%	0.0
01-30/11/99	18	10	-0.156%	0.312%	-0.501	-0.123%	0.405%	-0.
01-31/12/99	23	10	-0.022%	0.334%	-0.066	-0.022%	0.378%	-0.
01-31/01/00	12	4	0.006%	0.153%	0.040	-0.182%	0.467%	-0.
01-28/02/00	21	8	-0.054%	0.308%	-0.174	-0.093%	0.550%	-0.
01-31/03/00	23	11	-0.022%	0.170%	-0.129	-0.008%	0.318%	-0.
01-30/04/00	14	7	0.095%	0.409%	0.232	0.022%	0.489%	0.0
01-31/05/00	8	2	0.004%	0.071%	0.056	0.137%	0.673%	0.2
01-30/06/00	14	7	-0.047%	0.449%	-0.105	-0.208%	0.553%	-0.
01-31/07/00	11	6	0.009%	0.248%	0.036	-0.029%	0.348%	-0.
01-31/08/00	2	1	-0.212%	0.300%	-0.707	-0.305%	0.168%	-1.
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	11	0.125%	0.377%	0.332	0.123%	0.505%	0.2
01-31/01/01	18	11	-0.019%	0.262%	-0.072	-0.090%	0.308%	-0.
	338	163	-0.018%	0.311%	-0.057	-0.029%	0.449%	-0.

Note

-Blank space: no risk reversal prices / no returns

Table 3: 5Day/20Day Combinations Category A (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 5Day/20Day Average Monthly Returns	Standard Deviation of Returns	S	R
01-31/01/99	19	8	-0.087%	0.340%	-0.255	-0.105%	0.439%	-	
01-28/02/99	19	2	0.022%	0.112%	0.197	0.137%	0.488%	0	
01-31/03/99	23	9	-0.079%	0.246%	-0.322	-0.154%	0.344%	-	
01-30/04/99	5	2	0.077%	0.429%	0.180	0.071%	0.455%	0	
01-31/05/99	12	7	-0.100%	0.129%	-0.776	-0.037%	0.346%	-	
01-30/06/99	10	4	-0.066%	0.423%	-0.155	-0.114%	0.491%	-	
01-31/07/99	21	4	0.068%	0.191%	0.356	0.124%	0.587%	0	
01-31/08/99	22	12	-0.043%	0.414%	-0.104	-0.066%	0.462%	-	
01-30/09/99	14	8	0.055%	0.410%	0.133	0.096%	0.423%	0	
01-31/10/99	12	8	-0.019%	0.298%	-0.062	0.059%	0.422%	0	
01-30/11/99	18	10	-0.057%	0.149%	-0.380	0.076%	0.417%	0	
01-31/12/99	23	11	-0.098%	0.216%	-0.456	-0.176%	0.333%	-	
01-31/01/00	12	5	-0.017%	0.106%	-0.162	-0.229%	0.444%	-	
01-28/02/00	21	10	0.025%	0.418%	0.059	0.064%	0.554%	0	
01-31/03/00	23	7	-0.020%	0.101%	-0.201	-0.005%	0.318%	-	
01-30/04/00	14	6	0.133%	0.399%	0.334	0.098%	0.479%	0	
01-31/05/00	8	4	-0.008%	0.079%	-0.098	0.114%	0.678%	0	
01-30/06/00	14	8	-0.008%	0.501%	-0.016	-0.131%	0.578%	-	
01-31/07/00	11	7	-0.045%	0.298%	-0.150	-0.136%	0.319%	-	
01-31/08/00	2	1	0.093%	0.132%	0.707	0.305%	0.168%	1	
01-30/09/00	0	0							
01-31/10/00	0	0							
01-30/11/00	0	0							
01-31/12/00	17	12	0.168%	0.400%	0.420	0.209%	0.474%	0	
01-31/01/01	18	10	0.048%	0.216%	0.223	0.044%	0.319%	0	
	<b>338</b>	<b>155</b>	<b>-0.005%</b>	<b>0.300%</b>	<b>-0.016</b>	<b>-0.004%</b>	<b>0.450%</b>	<b>-</b>	

Note

-Blank space: no risk reversal prices / no returns



Table 3: 1Day/200Day Combinations Category A (continued)

Period	Number of Risk Reversal Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1Day/200Day Average Monthly Returns	Standard Deviation of Returns	Shar Rat
01-31/01/99	19	11	-0.095%	0.352%	-0.271	-0.122%	0.434%	-0.2
01-28/02/99	19	2	0.037%	0.128%	0.293	0.168%	0.478%	0.35
01-31/03/99	23	18	-0.016%	0.350%	-0.047	-0.029%	0.377%	-0.0
01-30/04/99	5	2	0.077%	0.429%	0.180	0.071%	0.455%	0.15
01-31/05/99	12	8	-0.066%	0.294%	-0.224	0.032%	0.347%	0.09
01-30/06/99	10	4	-0.066%	0.423%	-0.155	-0.114%	0.491%	-0.2
01-31/07/99	21	5	-0.044%	0.300%	-0.146	-0.099%	0.592%	-0.1
01-31/08/99	22	20	0.012%	0.454%	0.027	0.044%	0.465%	0.09
01-30/09/99	14	9	-0.013%	0.403%	-0.033	-0.040%	0.432%	-0.0
01-31/10/99	12	8	-0.019%	0.298%	-0.062	0.059%	0.422%	0.13
01-30/11/99	18	7	-0.121%	0.348%	-0.349	-0.054%	0.421%	-0.1
01-31/12/99	23	11	-0.046%	0.229%	-0.200	-0.070%	0.371%	-0.1
01-31/01/00	12	6	0.049%	0.403%	0.122	-0.096%	0.494%	-0.1
01-28/02/00	21	8	0.018%	0.385%	0.046	0.050%	0.556%	0.09
01-31/03/00	23	8	-0.038%	0.127%	-0.297	-0.040%	0.316%	-0.1
01-30/04/00	14	7	0.154%	0.452%	0.340	0.139%	0.468%	0.29
01-31/05/00	8	4	-0.008%	0.079%	-0.098	0.114%	0.678%	0.1
01-30/06/00	14	5	0.016%	0.174%	0.094	-0.081%	0.588%	-0.1
01-31/07/00	11	2	0.067%	0.123%	0.542	0.087%	0.338%	0.25
01-31/08/00	2	1	0.093%	0.132%	0.707	0.305%	0.168%	1.81
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	8	-0.047%	0.282%	-0.166	-0.221%	0.468%	-0.4
01-31/01/01	18	12	0.079%	0.247%	0.321	0.106%	0.303%	0.3
	338	166	-0.007%	0.312%	-0.022	-0.008%	0.450%	-0.0

Note

-Blank space: no risk reversal prices / no returns

**Table 3: Memorandum MA Combinations Category A (continued)**

Period	Buy&Hold Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Risk Reversal Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	0.018%	0.451%	0.040	-0.068%	0.446%	-0.153
01-28/02/99	-0.168%	0.478%	-0.351	-0.093%	0.499%	-0.186
01-31/03/99	0.029%	0.377%	0.076	-0.004%	0.379%	-0.010
01-30/04/99	-0.071%	0.455%	-0.155	0.083%	0.452%	0.185
01-31/05/99	-0.032%	0.347%	-0.093	-0.164%	0.303%	-0.541
01-30/06/99	0.114%	0.491%	0.233	-0.017%	0.505%	-0.033
01-31/07/99	0.099%	0.592%	0.167	0.012%	0.601%	0.019
01-31/08/99	-0.044%	0.465%	-0.096	-0.020%	0.467%	-0.043
01-30/09/99	0.094%	0.423%	0.223	0.013%	0.434%	0.030
01-31/10/99	0.059%	0.422%	0.139	-0.096%	0.415%	-0.231
01-30/11/99	-0.076%	0.417%	-0.182	-0.189%	0.377%	-0.502
01-31/12/99	0.052%	0.375%	0.139	-0.021%	0.378%	-0.057
01-31/01/00	-0.096%	0.494%	-0.194	0.194%	0.461%	0.422
01-28/02/00	-0.108%	0.547%	-0.197	-0.014%	0.558%	-0.026
01-31/03/00	0.040%	0.316%	0.127	-0.036%	0.316%	-0.112
01-30/04/00	-0.139%	0.468%	-0.297	0.168%	0.458%	0.367
01-31/05/00	-0.114%	0.678%	-0.168	-0.129%	0.674%	-0.191
01-30/06/00	0.081%	0.588%	0.138	0.114%	0.582%	0.196
01-31/07/00	-0.087%	0.338%	-0.257	0.047%	0.346%	0.135
01-31/08/00	-0.305%	0.168%	-1.814	-0.119%	0.432%	-0.276
01-30/09/00						
01-31/10/00						
01-30/11/00						
01-31/12/00	0.209%	0.474%	0.442	0.127%	0.504%	0.253
01-31/01/01	-0.017%	0.322%	-0.052	0.053%	0.317%	0.166
	<b>-0.005%</b>	<b>0.450%</b>	<b>-0.010</b>	<b>-0.006%</b>	<b>0.450%</b>	<b>-0.013</b>

Note

-Blank space: no risk reversal prices / no returns

Table 4 : 0.5% Filter Combinations Category A

Period	Number of RR Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 0.5% filter Average Monthly Returns	Standard Deviation of Returns	Shar Rat
01-31/01/99	19	12	-0.086%	0.304%	-0.283	-0.104%	0.439%	-0.2
01-28/02/99	19	4	-0.005%	0.240%	-0.022	0.082%	0.501%	0.1
01-31/03/99	23	7	-0.010%	0.124%	-0.083	-0.017%	0.378%	-0.0
01-30/04/99	5	2	0.077%	0.429%	0.180	0.071%	0.455%	0.15
01-31/05/99	12	5	-0.058%	0.112%	-0.519	0.048%	0.345%	0.13
01-30/06/99	10	3	-0.211%	0.318%	-0.664	-0.405%	0.270%	-1.4
01-31/07/99	21	8	0.130%	0.378%	0.344	0.249%	0.544%	0.45
01-31/08/99	22	12	-0.077%	0.377%	-0.204	-0.134%	0.447%	-0.2
01-30/09/99	14	10	0.031%	0.361%	0.085	0.048%	0.431%	0.11
01-31/10/99	12	8	0.052%	0.273%	0.189	0.199%	0.373%	0.53
01-30/11/99	18	7	-0.157%	0.333%	-0.472	-0.125%	0.404%	-0.3
01-31/12/99	23	11	-0.046%	0.229%	-0.200	-0.070%	0.371%	-0.1
01-31/01/00	12	4	0.068%	0.387%	0.175	-0.059%	0.500%	-0.1
01-28/02/00	21	6	0.019%	0.196%	0.099	0.053%	0.556%	0.09
01-31/03/00	23	9	-0.030%	0.159%	-0.186	-0.024%	0.318%	-0.0
01-30/04/00	14	5	0.109%	0.399%	0.272	0.049%	0.487%	0.10
01-31/05/00	8	2	0.004%	0.071%	0.056	0.137%	0.673%	0.20
01-30/06/00	14	7	-0.091%	0.442%	-0.205	-0.296%	0.509%	-0.5
01-31/07/00	11	9	-0.020%	0.319%	-0.063	-0.087%	0.338%	-0.2
01-31/08/00	2	2	-0.119%	0.432%	-0.276	-0.119%	0.432%	-0.2
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	8	0.024%	0.247%	0.098	-0.079%	0.514%	-0.1
01-31/01/01	18	10	0.064%	0.237%	0.271	0.076%	0.312%	0.2
	338	151	-0.011%	0.294%	-0.038	-0.016%	0.450%	-0.0

Note

-Blank space; no risk reversal prices / no returns

Table 4 : 1% Filter Combinations Category A (continued)

Period	Number of RR Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 1% filter Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	19	8	-0.045%	0.277%	-0.162	-0.021%	0.451%	-0.047
01-28/02/99	19	2	0.022%	0.112%	0.197	0.137%	0.488%	0.280
01-31/03/99	23	8	-0.024%	0.235%	-0.101	-0.044%	0.376%	-0.116
01-30/04/99	5	2	0.077%	0.429%	0.180	0.071%	0.455%	0.155
01-31/05/99	12	7	-0.100%	0.129%	-0.776	-0.037%	0.346%	-0.107
01-30/06/99	10	2	-0.007%	0.270%	-0.026	0.003%	0.506%	0.006
01-31/07/99	21	4	0.068%	0.191%	0.356	0.124%	0.587%	0.211
01-31/08/99	22	13	-0.101%	0.365%	-0.278	-0.183%	0.428%	-0.426
01-30/09/99	14	7	-0.033%	0.356%	-0.092	-0.079%	0.426%	-0.185
01-31/10/99	12	8	0.052%	0.273%	0.189	0.199%	0.373%	0.534
01-30/11/99	18	10	-0.057%	0.149%	-0.380	0.076%	0.417%	0.182
01-31/12/99	23	10	-0.039%	0.231%	-0.170	-0.057%	0.374%	-0.153
01-31/01/00	12	6	0.076%	0.386%	0.197	-0.042%	0.502%	-0.084
01-28/02/00	21	8	-0.020%	0.256%	-0.080	-0.026%	0.558%	-0.047
01-31/03/00	23	8	-0.036%	0.124%	-0.292	-0.037%	0.316%	-0.116
01-30/04/00	14	5	0.109%	0.399%	0.272	0.049%	0.487%	0.101
01-31/05/00	8	2	0.004%	0.071%	0.056	0.137%	0.673%	0.203
01-30/06/00	14	5	-0.046%	0.369%	-0.125	-0.206%	0.554%	-0.372
01-31/07/00	11	9	-0.020%	0.319%	-0.063	-0.087%	0.338%	-0.257
01-31/08/00	2	1	-0.212%	0.300%	-0.707	-0.305%	0.168%	-1.814
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	12	0.106%	0.471%	0.226	0.085%	0.513%	0.166
01-31/01/01	18	12	0.079%	0.247%	0.321	0.106%	0.303%	0.349
	<b>338</b>	<b>149</b>	<b>-0.003%</b>	<b>0.279%</b>	<b>-0.011</b>	<b>0.000%</b>	<b>0.450%</b>	<b>0.000</b>

Note

-Blank space: no risk reversal prices / no returns

Table 4 : 2% Filter Combinations Category A (continued)

Period	Number of RR Observations per month	Number of Open Positions per month for Combined Strategy	Combined Strategy Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Simple 2% filter Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	19	7	-0.025%	0.145%	-0.173	0.018%	0.451%	0.040
01-28/02/99	19	17	-0.130%	0.472%	-0.276	-0.168%	0.478%	-0.351
01-31/03/99	23	5	0.012%	0.142%	0.087	0.029%	0.377%	0.076
01-30/04/99	5	3	0.006%	0.147%	0.044	-0.071%	0.455%	-0.155
01-31/05/99	12	4	-0.098%	0.141%	-0.697	-0.032%	0.347%	-0.093
01-30/06/99	10	6	0.049%	0.263%	0.186	0.114%	0.491%	0.233
01-31/07/99	21	16	0.055%	0.516%	0.107	0.099%	0.592%	0.167
01-31/08/99	22	2	-0.032%	0.106%	-0.305	-0.044%	0.465%	-0.096
01-30/09/99	14	10	0.054%	0.410%	0.131	0.094%	0.423%	0.223
01-31/10/99	12	8	-0.019%	0.298%	-0.062	0.059%	0.422%	0.139
01-30/11/99	18	8	-0.133%	0.368%	-0.360	-0.076%	0.417%	-0.182
01-31/12/99	23	13	0.015%	0.335%	0.045	0.052%	0.375%	0.139
01-31/01/00	12	7	0.049%	0.403%	0.122	-0.096%	0.494%	-0.194
01-28/02/00	21	9	0.047%	0.403%	0.116	0.108%	0.547%	0.197
01-31/03/00	23	8	-0.038%	0.127%	-0.297	-0.040%	0.316%	-0.127
01-30/04/00	14	7	0.154%	0.452%	0.340	0.139%	0.468%	0.297
01-31/05/00	8	4	-0.008%	0.079%	-0.098	0.114%	0.678%	0.168
01-30/06/00	14	8	0.051%	0.510%	0.100	-0.013%	0.594%	-0.021
01-31/07/00	11	9	-0.020%	0.319%	-0.063	-0.087%	0.338%	-0.257
01-31/08/00	2	1	-0.212%	0.300%	-0.707	-0.305%	0.168%	-1.814
01-30/09/00	0	0						
01-31/10/00	0	0						
01-30/11/00	0	0						
01-31/12/00	17	12	0.168%	0.400%	0.420	0.209%	0.474%	0.442
01-31/01/01	18	10	0.019%	0.237%	0.080	-0.017%	0.322%	-0.052
	338	174	0.005%	0.333%	0.016	0.016%	0.450%	0.036

Note

-Blank space: no risk reversal prices / no returns

Table 4 : Memorandum Filter Combinations Category A (continued)

Period	Buy&Hold Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio	Risk Reversal Average Monthly Returns	Standard Deviation of Returns	Sharpe Ratio
01-31/01/99	0.018%	0.451%	0.040	-0.068%	0.446%	-0.153
01-28/02/99	-0.168%	0.478%	-0.351	-0.093%	0.499%	-0.186
01-31/03/99	0.029%	0.377%	0.076	-0.004%	0.379%	-0.010
01-30/04/99	-0.071%	0.455%	-0.155	0.083%	0.452%	0.185
01-31/05/99	-0.032%	0.347%	-0.093	-0.164%	0.303%	-0.541
01-30/06/99	0.114%	0.491%	0.233	-0.017%	0.505%	-0.033
01-31/07/99	0.099%	0.592%	0.167	0.012%	0.601%	0.019
01-31/08/99	-0.044%	0.465%	-0.096	-0.020%	0.467%	-0.043
01-30/09/99	0.094%	0.423%	0.223	0.013%	0.434%	0.030
01-31/10/99	0.059%	0.422%	0.139	-0.096%	0.415%	-0.231
01-30/11/99	-0.076%	0.417%	-0.182	-0.189%	0.377%	-0.502
01-31/12/99	0.052%	0.375%	0.139	-0.021%	0.378%	-0.057
01-31/01/00	-0.096%	0.494%	-0.194	0.194%	0.461%	0.422
01-28/02/00	-0.108%	0.547%	-0.197	-0.014%	0.558%	-0.026
01-31/03/00	0.040%	0.316%	0.127	-0.036%	0.316%	-0.112
01-30/04/00	-0.139%	0.468%	-0.297	0.168%	0.458%	0.367
01-31/05/00	-0.114%	0.678%	-0.168	-0.129%	0.674%	-0.191
01-30/06/00	0.081%	0.588%	0.138	0.114%	0.582%	0.196
01-31/07/00	-0.087%	0.338%	-0.257	0.047%	0.346%	0.135
01-31/08/00	-0.305%	0.168%	-1.814	-0.119%	0.432%	-0.276
01-30/09/00						
01-31/10/00						
01-30/11/00						
01-31/12/00	0.209%	0.474%	0.442	0.127%	0.504%	0.253
01-31/01/01	-0.017%	0.322%	-0.052	0.053%	0.317%	0.166
	<b>-0.005%</b>	<b>0.450%</b>	<b>-0.010</b>	<b>-0.006%</b>	<b>0.450%</b>	<b>-0.013</b>

Note

-Blank space: no risk reversal prices / no returns