# The Information Content of Risk Reversals

**by**
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***Abstract***

Over the past few years, there has been much controversy among market practitioners about the use of relative calls and puts prices as indicators of a market's underlying trend.

In this research, we investigate whether there is any informational value that can be derived from risk reversals (the volatility amount by which, for a given currency, a 25-delta call is more/less expensive than a 25-delta put) and used to assess the future evolution of exchange rates. Risk reversals are a measure of the skewness of an asset's expected price distribution: as they are traded in the marketplace and are therefore directly observable, there is an obvious intuitive appeal to testing whether they effectively tell us something about the realised price evolution.

The analysis is applied on daily data, to the USD/JPY, USD/CHF, GBP/USD and AUD/USD exchange rates and risk reversals over the period February 1996-April 2000.

Contrary to many market participants' beliefs, it is shown that for the currencies and the period considered, risk reversal data do not help in assessing the future evolution of exchange rates.

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# 1. INTRODUCTION

The debate over the potential added value of using risk reversals (RR henceforth) as directional indicator is still ongoing among market practitioners. It is possible that the belief in a positively correlated directional information embedded in RR values in fact derives from the usually very high level of contemporaneous correlation rather than from lagged information that may exist between the RR and the underlying time series. It is a matter of fact that still too many market practitioners tend to be confused over the conclusions that can be derived from contemporaneous and lagged correlations. Since the option market represents only a fraction of the global FX daily turnover, some USD 90 billion versus an estimated total of USD 1.5 trillion it would seem indeed surprising that such a sub-sample would express the true market model. It would require that the assumption that option market participants have access to privileged information holds. In light of the high speed at which information diffused in the FX markets this would seem highly unlikely.

In this research, we investigate whether there is any informational value that can be derived from risk reversals (the volatility amount by which, for a given currency, a 25-delta call is more/less expensive than a 25-delta put) and used to assess the future evolution of exchange rates. Risk reversals are a measure of the skewness of an asset’s expected price distribution: as they are traded in the marketplace and are therefore directly observable, there is an obvious intuitive appeal to testing whether they effectively tell us something about the realised price evolution.

The motivation of this paper is therefore to try to answer the much often asked question: is there any embedded information in RR data that could be used within a directional forecasting context? The paper is organised as follows. Section 2 presents risks reversals in the context of the FX and the currency options markets. Section 3 describes our risk reversal data and shows how difficult it is to use risk reversals in a directional forecasting context on the basis of the statistical evidence provided. Accordingly, section 4 investigates alternative ways to use risk reversals, assessing the economic significance of technical trading rules applied to risk reversals. Section 5 provides some concluding remarks.

# 2. MARKET EXPECTATIONS AND RISK REVERSALS

Currency options are often used to implement strategies on the future direction of foreign exchange rate movements. Risk reversals are directional option strategies that involve the simultaneous sale (purchase) of a put and purchase (sale) of a call. Generally these strategies are built around options that have 1-month of time value and that have out-of-the-money strikes corresponding to 25% delta. For example, a risk reversal for EUR/USD consisting of a long out-of-the-money EUR put / USD call and a short out-of-the-money EUR call / USD put is a bearish bet on the EUR exchange rate. At the outset the risk reversal will have a delta of 50% and very little sensitivity to gamma[1], vega[2] and theta[3] because of the offsetting effect of the long and short position. This is well illustrated by Figure 1 that shows how the how the delta of such a strategy evolves as a function of the remaining time value of the option strategy[4].

Risk reversals are a measure of the relative value of options with strikes above or below the current at-the-money (ATM) forward rate and consequently express the skew that may exist in the volatility smile from time to time. Risk reversals are usually priced as the difference in implied volatility of the put minus that of the call price.

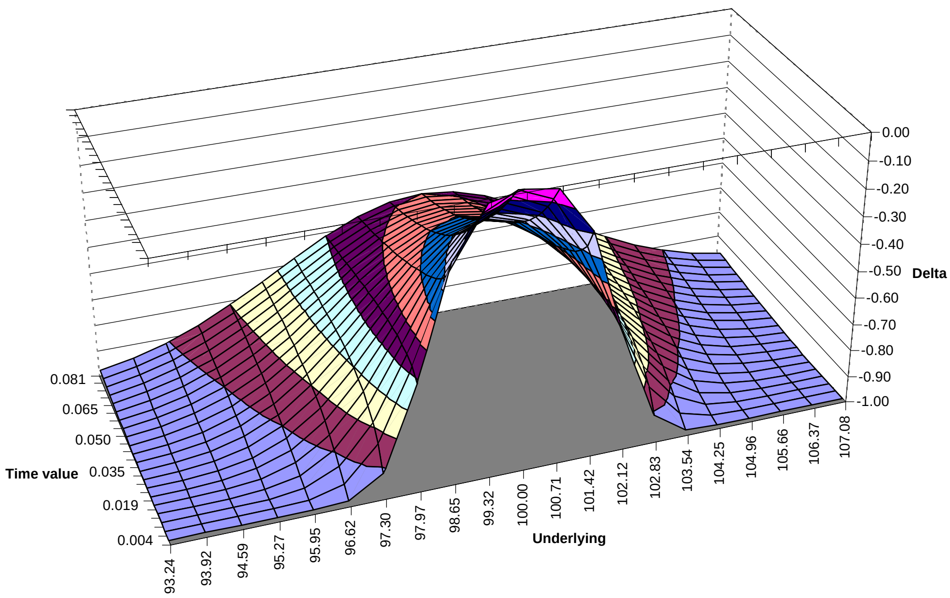


**Figure 1:** Delta of a 1-Month Risk Reversal as a Function of the Time Value Remaining and the Spot Rate Path

The strikes of risk reversals are chosen so that the cost of buying the put offsets the premium received for selling the call. If the directional view is correct, the strategy makes money because the long option is profitable and obtained "free", so to speak. However, if the directional view is incorrect, there is unlimited risk in the short open position. Consequently, as mentioned by De Rosa (2000), risk reversals can be considered as an aggressive directional strategy (see also Figure 2 below).

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1 The increase in the value of the position for a 1% increase in the volatility, expressed in base currency.

2 The increase in the delta of the position for a 1% increase in the spot rate.

3 The increase in value of the position on the next weekday if all other inputs stay the same (expressed in base currency).

4 The assumptions for Figure 1 are as follows: spot price = 100, volatility = 10%, risk free rate = 0%).

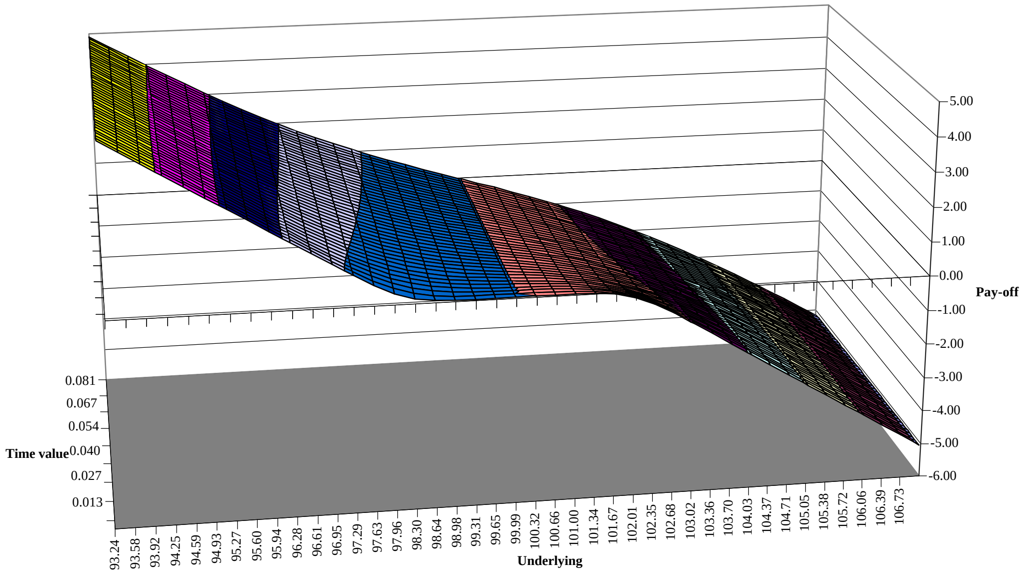


**Figure 2:** Example of Payoff of a 1-Month Risk Reversal as a Function of the Time Value Remaining and the Spot Rate Path

Options prices have gained increasing attention in recent years as forward-looking financial indicators and informative predictors of future asset price behaviour (see Campa *et al*. (1998)). Looking at the recent academic literature there might be indeed some added value, within a volatility or correlation-forecasting context, to use derivative markets as a source of supplementary information instead of concentrating solely on the underlying time price series (see, amongst others, Jorion (1995), Campa and Chang (1997) and Buschena and Ziegler (1999)).

Accordingly there has been much interest and controversy amongst market practitioners on the usefulness of risk reversals as a valuable indicator of forthcoming market movements (see Kusber (1997) for instance).

Illustrating the focus of market participants on RR as a measure of market expectation, the Federal Reserve Bank of New York announced the following in its foreign exchange operation report for the period July - September 1996: *"The dollar's largest one-day move occurred early in the period on July 16. On this day, the dollar traded in a 3.1 percent range against the mark, implied volatility on one-month dollar-mark options spiked higher, and prices of risk reversals indicated a rise in the perceived risk of a further significant dollar decline. As with other sharp dollar moves over the period, the dollar's trading ranges over subsequent days fell back toward the period's average, implied volatility on dollar-mark options reverted toward record-low levels, and risk reversal prices moved closer to neutral"*. In a further example of market participants' belief in the usefulness of risk reversal within a forecasting context, The Financial Times of January 28$^{th}$ 2000 reported the following: *"Until Thursday the market had been overwhelmingly expecting that the Euro had troughed. Risk reversals, the market's best guess of market direction, reflected this. Despite the Euro's fall since the New Year, Euro calls have continued to be more expensive than Euro puts. This was even the case on Wednesday as the Euro flirted with parity. Thursday the risk reversals moved* *to a neutral bias. "This is highly bearish for the Euro, shattering the complacent belief that the currency has reached its low", said Tony Norfield, Global Head of Treasury Research at ABN Amro. "This is the first sign of serious unease," he added"*.

Others in the markets think more of RR as a possible contrarian indicator. They postulate that at extreme levels (which they define as RR being on excess of one standard deviation of their past history), RR could be used as a simple indicator to time the high likelihood of a price reversal. This view relies on the assumption that the risk distribution skew reflected by the RR is too large and that hence the risk is that the currency actually moves against the market expectation priced in the RR.

## 3. DATA DESCRIPTION AND STATISTICAL ANALYSIS

In this paper we use time series of four exchange rates, namely, USD/JPY, USD/CHF, GBP/USD and AUD/USD. The period covered spans from 15/02/1996 to 14/04/2000 or a total of 1085 observations per time series. For each exchange rate we have the spot foreign exchange rate, 1-month risk reversals[5], 1-month implied volatility and the relevant 1-month interest rate series. As is usual in empirical financial research, we use daily spot returns, defined as log ($S_t/S_{t-1}$). These returns are multiplied by 100, so that we end up with percentage changes in the exchange rates considered. We also compute a daily cash flow return which, on top of the spot return, takes also in consideration the interest differential between both currencies under consideration. We first look in Table 1 at the main summary statistics of the risk reversals and spot series over our entire sample period.

**Table 1:** Summary Statistics Of Risk Reversals And Spot Returns

| | RR(USD/JPY) | USD/JPY_ret | RR(USD/CHF) | USD/CHF_ret | RR(GBP/USD) | GBP/USD_ret | RR(AUD/USD) | AUD/USD_ret |
|---|---|---|---|---|---|---|---|---|
| **Mean** | 0.923 | 0.000 | 0.229 | 0.000 | -0.069 | 0.000 | -0.353 | 0.000 |
| **Median** | 0.650 | 0.001 | 0.200 | 0.001 | -0.100 | 0.000 | -0.300 | 0.000 |
| **Maximum** | 4.100 | 0.037 | 2.000 | 0.027 | 1.000 | 0.017 | 0.450 | 0.060 |
| **Minimum** | -1.100 | -0.066 | -0.900 | -0.034 | -1.000 | -0.021 | -1.500 | -0.030 |
| **Std. Dev.** | 1.054 | 0.009 | 0.495 | 0.007 | 0.329 | 0.005 | 0.376 | 0.007 |
| **Skewness** | 0.794 | -1.136 | 0.852 | -0.459 | 0.344 | 0.096 | -0.513 | 0.840 |
| **Kurtosis** | 2.830 | 10.903 | 4.069 | 4.692 | 3.335 | 4.034 | 3.157 | 11.305 |
| **Jarque-Bera** | 114.987 | 3051.196 | 182.442 | 167.186 | 26.421 | 49.973 | 48.620 | 3239.548 |
| **Probability** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

As can be seen, all the series under review are clearly non-normal[6]. We also conduct standard tests of heteroskedasticity, stationarity and autocorrelation. This is shown in Table 2 below: in line with the numerous articles published on exchange rate changes (see, amongst others, Baillie and Bollerslev (1989), Engle and Bollerslev (1986), Hsieh (1989), West and Cho (1995)), these tests show that logarithmic spot returns are all heteroskedastic and stationary. They are also non-correlated, although some evidence of

[5] We wish to thank Robert Godber and Dr. John Slee of NatWest Global Financial Markets who kindly provided us with the risk reversal series used in this paper.

[6] This is also the case for the daily cash flow return series. In the following, in order to conserve space, we do not report the results of the tests conducted with the cash flow return series, as they are very close to those conducted with the simple spot returns.

autocorrelation exists for the AUD/USD return series at the 5% significance level.

**Table 2:** Heteroskedasticity, Stationarity And Correlation Tests

| | RR(USD/JPY) | USD/JPY_ret | RR(USD/CHF) | USD/CHF_ret | RR(GBP/USD) | GBP/USD_ret | RR(AUD/USD) | AUD/USD_ret |
|---|---|---|---|---|---|---|---|---|
| **ARCH-LM Test:** | | | | | | | | |
| **F-statistic** | 6444.177 | 158.758 | 6422.532 | 20.222 | 3441.480 | 9.348 | 5976.752 | 21.853 |
| **Probability** | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 |
| **Unit Root Tests*:** | | | | | | | | |
| **ADF (level)** | -3.916 | -14.802 | -4.566 | -15.549 | -5.529 | -15.246 | -3.899 | -14.468 |
| **Phillips-Peron (level)** | -4.130 | -32.718 | -5.244 | -34.409 | -6.488 | -31.770 | -4.329 | -35.691 |
| **Serial Correlation LM Test:** | | | | | | | | |
| **F-statistic** | 8123.981 | 0.096 | 4467.739 | 2.067 | 2833.602 | 0.655 | 5991.607 | 3.711 |
| **Probability** | 0.000 | 0.908 | 0.000 | 0.127 | 0.000 | 0.520 | 0.000 | 0.025 |

*Note: For these tests, MacKinnon's 1% critical value is - 3.4392.

Table 2 also shows that risk reversals are all heteroskedastic and stationary, but, contrary to spot returns, they are strongly autocorrelated.

Figures 6 to 9 show that there is a strong evidence of a contemporaneous relationship between variations in the risk reversal and the underlying spot return series. However this would be of little interest within a forecasting context unless one could forecast risk reversals in a far more accurate way than one could do with the spot price.

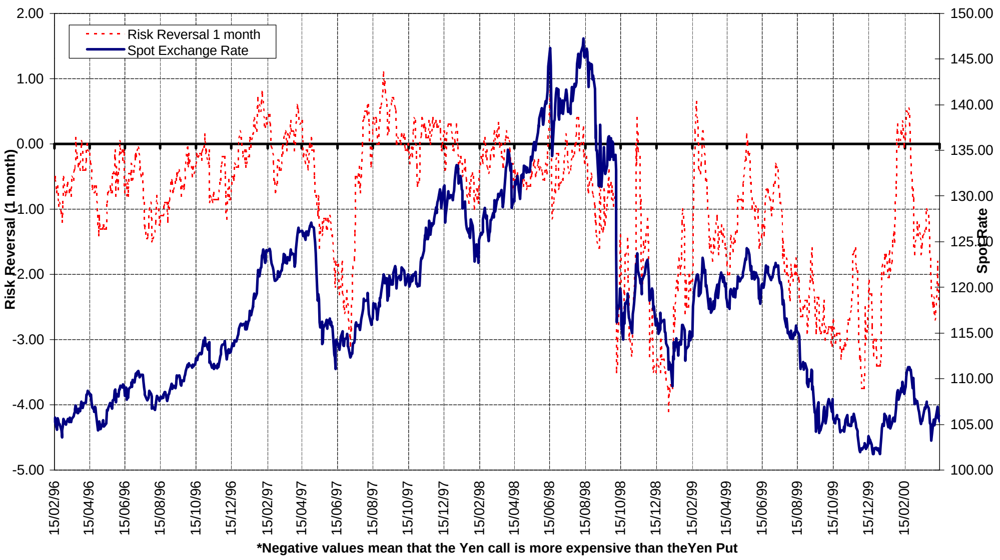


**Figure 3:** USD/JPY and RR (15/02/1996 to 14/04/2000)

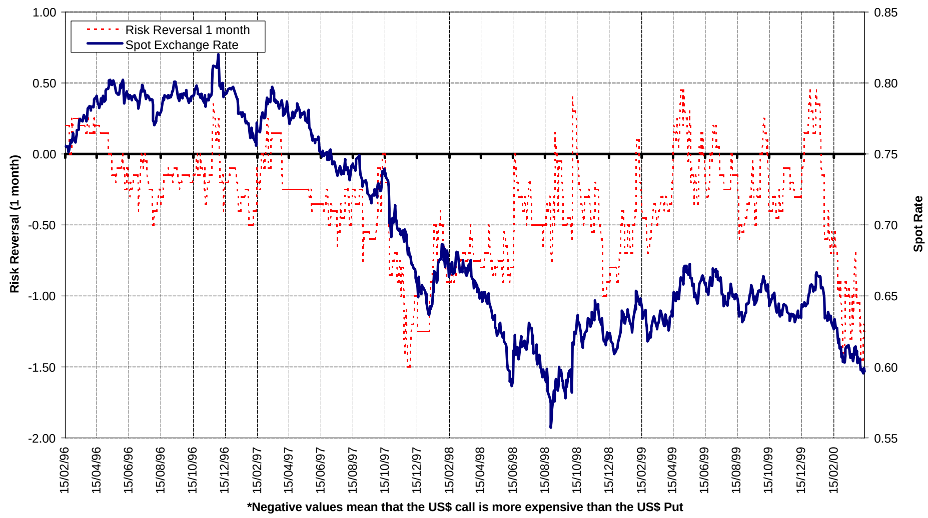


**Figure 4:** AUD/USD and RR (15/02/1996 to 14/04/2000)

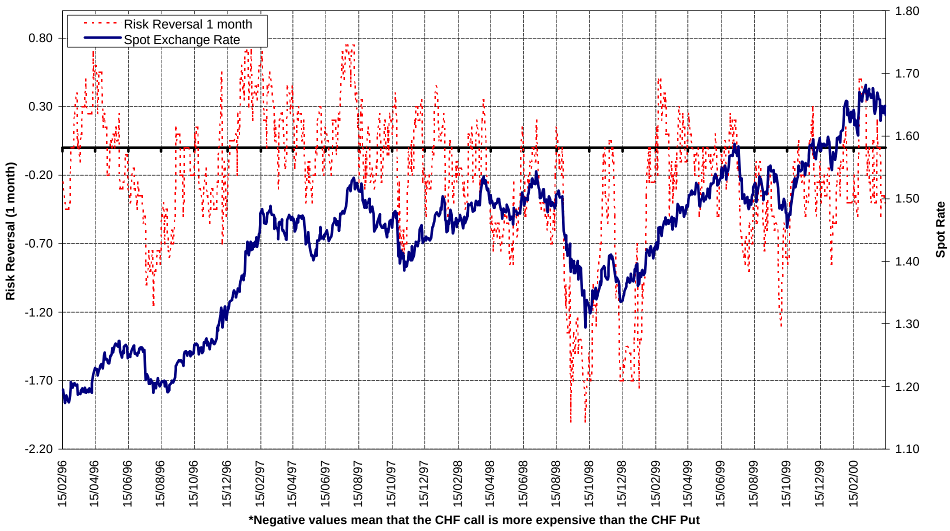


**Figure 5:** USD/CHF and RR (15/02/1996 to 14/04/2000)

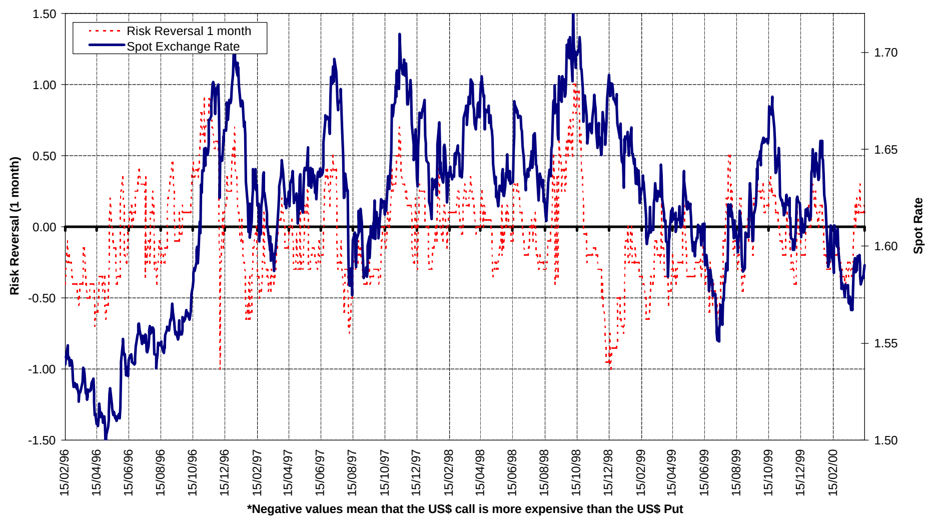


**Figure 6:** GBP/USD and RR (15/02/1996 to 14/04/2000)

In the following, we use well-established econometric tests to investigate the existence of a lagged relationship between the RR series and the spot series and hence the possible added value of using RR to forecast the direction of foreifgn exchange rates.

As one might hope that there is a distributed lag structure between the spot return and the risk reversal, we look at the cross correlations between both time series. These are shown for the first five lags in Table 3.

**Table 3:** Risk Reversals/Spot Return Cross Correlations

| i | USD/JPY RR,SPOT_RET(-i) lag | USD/JPY RR,SPOT_RET(+i) lead | USD/CHF RR,SPOT_RET(-i) lag | USD/CHF RR,SPOT_RET(+i) lead | GBP/USD RR,SPOT_RET(-i) lag | GBP/USD RR,SPOT_RET(+i) lead | AUD/USD RR,SPOT_RET(-i) lag | AUD/USD RR,SPOT_RET(+i) lead |
|---|---|---|---|---|---|---|---|---|
| 0 | -0.1596 | -0.1596 | -0.1804 | -0.1804 | 0.1847 | 0.1847 | 0.1323 | 0.1323 |
| 1 | -0.1970 | 0.0140 | -0.2243 | 0.0338 | 0.2681 | -0.0293 | 0.1791 | -0.0021 |
| 2 | -0.1926 | 0.0228 | -0.2271 | 0.0247 | 0.2571 | -0.0326 | 0.1913 | 0.0170 |
| 3 | -0.1661 | 0.0143 | -0.2065 | 0.0105 | 0.1984 | -0.0287 | 0.1821 | 0.0231 |
| 4 | -0.1486 | 0.0034 | -0.1492 | 0.0099 | 0.1679 | -0.0275 | 0.1690 | 0.0164 |
| 5 | -0.1512 | -0.0053 | -0.1346 | -0.0072 | 0.1594 | -0.0162 | 0.1707 | 0.0137 |

The cross correlations of Table 3 seem to indicate that, as a general rule, the corrrelation between the risk reversal and lagged values of the exchange rate changes is much stronger than that between the spot return and lagged values of the risk reversal.

Admittedly, correlation, or the absence of it, does not in any way imply a causation relationship between risk reversals and spot returns.

This is why, in order to check for the possible existence of a causality link between both time series more thoroughly, we then implement Granger causality tests. Following Granger (1969), with a pair of linear covariance-stationary series X and Y, X is said to cause Y if the past values of X can be used to forecast Y more accurately than using only the past values of Y. The test involves the estimation of the following distributed lag regressions:

$$X_t = \sum_{i=1}^{n} a_i Y_{t-i} + \sum_{j=1}^{n} b_j X_{t-j} + u_{1t} \qquad (1)$$

$$Y_t = \sum_{i=1}^{m} c_i Y_{t-i} + \sum_{j=1}^{m} d_j X_{t-j} + u_{2t} \qquad (2)$$

The first equation indicates that the current value of X depends only on its own values as well as those of Y. Similarly, the current value of Y is related to its own past values as well as those of X in the second equation. The tests check whether all the coefficients of the lagged Ys in the first equation and all those of the lagged Xs in the second equation are zero: the null hypotheses tested are therefore that Y does not Granger-cause X and that X does not Granger-cause Y.

The original model suggested by Granger (1969) tests for temporal causality between two variables assumed to be stationary. We have seen above that this is indeed the case of our risk reversal and spot return series.

The output of the causality tests and their associated p-values are shown in Table 4 below.

**Table 4:** Pairwise Granger Causality Tests

| Null Hypothesis: | USD/JPY F-Statistic | USD/JPY Probability | USD/CHF F-Statistic | USD/CHF Probability | GBP/USD F-Statistic | GBP/USD Probability | AUD/USD F-Statistic | AUD/USD Probability |
|---|---|---|---|---|---|---|---|---|
| RR does not Granger Cause SPOT_RET | 1.191 | 0.304 | 0.202 | 0.817 | 0.669 | 0.512 | 0.580 | 0.560 |
| SPOT_RET does not Granger Cause RR | 18.650 | 0.000 | 26.360 | 0.000 | 64.337 | 0.000 | 38.108 | 0.000 |

In all cases, there is a resounding rejection of any causal link from the risk reversal to the spot return change while the null hypothesis that the change in the exchange rate does not Granger-cause the risk reversal is clearly rejected.

In the circumstances, it is doubtful that any model incorporating the risk reversal as a further explanatory variable would help forecast the change in the exchange rate. Still, despite the disappointing statistical results above, we tried to develop alternative spot return models incorporating risk reversals, particularly two variable vector autoregression (VAR) models as they are often successful in forecasting systems of interrelated variables.

Unfortunately, in all cases, the results of these models (not reported here in order to conserve space) never showed statistically significant parameters for the risk reversal variables in the spot return equation.

Similarly, we developed neural network regression models of exchange rate changes incorporating lagged spot returns and risk reversals, hoping that some nonlinear relationships may thus be uncovered: the results (again not shown in order to conserve space) were also disappointing, showing no improvement from the inclusion of the risk reversal time series.

In other words, even if risk reversals have been useful in recovering the probability density function of exchange rate changes (see, amongst others, Malz (1996a, 1996b), McCauley and Melick (1996) and Campa *et al*. (1998)), our statistical analysis of the the USD/JPY, USD/CHF, GBP/USD and AUD/USD exchange rates and risk reversals over the period February 1996-April 2000 shows little evidence to suggest that risk reversals can help forecast future exchange rate movements.

As this may not necessarily preclude the succesful use of more *ad hoc* empirical methods based on technical analysis, we investigate some of these in the following section.

## 4. EMPIRICAL APPROACHES

In the following, we investigate the economic implications of using RRs as a source of information to trade the spot foreign exchange market. For doing so, we look at the two most common assumptions made by market practitioners of RR being either a trend indicator or an early trend reversal indicator when “high values” occurs.

Technical trading strategies have the advantage of enabling the trader to make decisions in the financial markets without having to rely on an analysis of the fundamentals (see, amongst others, Dunis (1989) and Kaufman (1998)): the hypothesis is that all available information and economic data flows, are already fully taken into account in the exchange rate.

Accordingly, to evaluate the economic viability of any of these two assumptions, we devise four technical trading strategies using the RR levels and compare the returns obtained to those generated by using a simple 21-day moving average trading strategy on the spot exchange rate itself[7].

**4.1 - The Moving Average Trading Rule**

The cornerstone of technical analysis is that "everything is in the rate". Instead of analysing fundamental data in real time, technical analysis studies the market's reaction to the participants' perception of economic fundamentals and the supply-demand balance of the market. This reaction is seen in the price that market participants are willing to pay for currencies.

Statistical trading encompasses today a wide variety of techniques designed to identify and exploit recurrent patterns in historical prices. A large majority of foreign exchange traders tend to use technical analysis on the basis that, if exchange rate returns are serially dependent, they are at least partly predictable.

In presence of negative autocorrelations, when investors observe positive returns, they revise downwards their expectations and vice-versa. In such circumstances, contrarian strategies of buying the asset after a negative return and selling the asset after a positive return should earn abnormal returns.

Conversely, in presence of positive autocorrelations, when investors observe positive returns, they revise upwards their expectations and vice-versa. In such cases, trend-following strategies of buying the asset after a positive return and selling the asset after a negative return should earn abnormal returns.

Moving averages are certainly one of the oldest and most widely used methods by market practitioners, as noted, for instance, by Dunis (1989) and Kaufman (1998). The simplest rule of this family is the simple moving average which says: when the rate penetrates from below (above) a moving average of a given length a buy (sell) signal is generated. Figure 7 below illustrates the workings of such a trading rule.

[7] We choose 21-day for the order of the moving averages that we use in our trading rules as this time span matches the time horizon of our 1-month RR series.

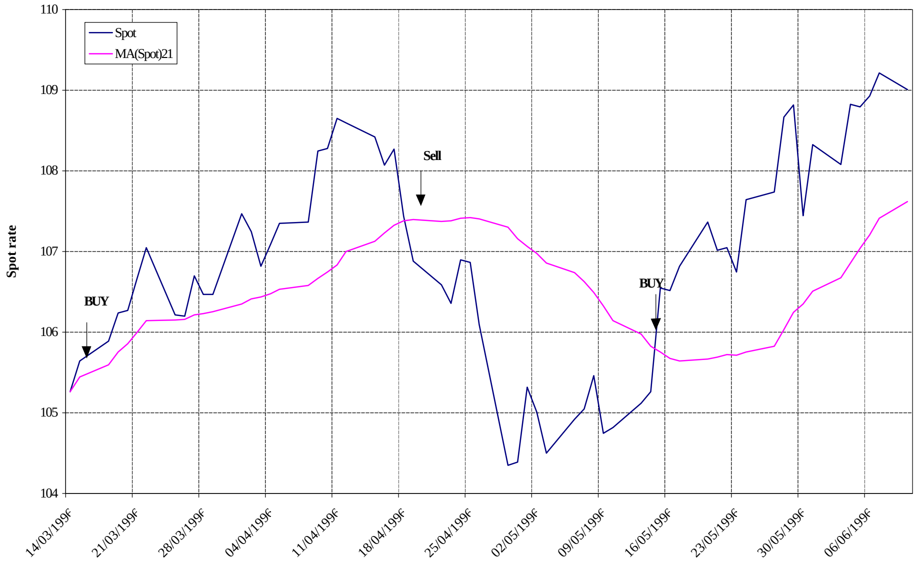


**Figure 7:** Example of a 21-Day Moving Average Strategy on the USD/JPY

Table 5 shows the summary statistics of the performance that would have been obtained by using the 21-day moving average strategy and applying it to the four exchange rates for which we are evaluating the RR strategies.

**Table 5:** Summary Statistics of the 21-Day Moving Strategy Rule

| | USD/JPY | AUD/USD | USD/CHF | GBP/USD |
|---|---|---|---|---|
| **Annualised Return** | 7.89% | -1.28% | 3.50% | 0.53% |
| **Annualised Volatility** | 13.87% | 10.70% | 10.85% | 7.35% |
| **Return/Volatility ratio** | 0.57 | -0.12 | 0.32 | 0.07 |
| **Maximum daily loss** | -4.06% | -5.85% | -2.70% | -1.56% |
| **Maximum daily profit** | 6.77% | 3.06% | 3.40% | 2.09% |
| **Maximum cumulative loss** | -17.89% | -30.48% | -13.45% | -9.00% |
| **Observations** | 1063 | 1063 | 1063 | 1063 |
| **% Winning days** | 52.21% | 49.76% | 49.76% | 48.54% |

Using a 21-day moving average would have proved a profitable strategy for three out of the four exchange rates during the period investigated, particularly for the USD/JPY and USD/CHF exchange rates. The profitability of trend-following strategies in the currency markets has been extensively covered by academic research, but, in this paper, we only use our results as a benchmark to gauge the economic value of the four trading strategies based on RR levels that we develop in the following sections.

### 4.2 - The RR as a Directional Indicator

In this section we look at two possible strategies where RR are used as a directional indicator of the price which we respectively label S1 and S2. In strategy S1, comparing a 21-day moving average of the RR value to the current RR value generates the trading signals: if the current value of the RR is above its moving average level, we have a buy signal, else we have a sell signal, which we apply on the spot exchange rate[8]. The strategy is described in Figure 8.

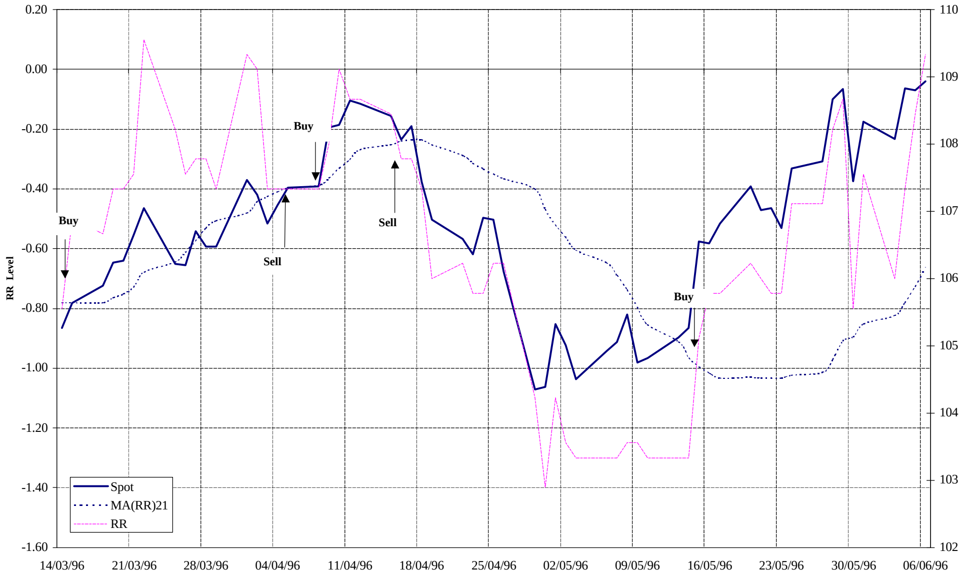


**Figure 8:** Example of Strategy S1 of a 21-day RR Moving Average on the USD/JPY

**Table 6:** Summary Statistics of the 21-day RR Moving Average Strategy (S1)

| | USD/JPY | AUD/USD | USD/CHF | GBP/USD |
|---|---|---|---|---|
| **Annualised Return** | 4.81% | -4.26% | -1.70% | 0.03% |
| **Annualised Volatility** | 13.88% | 10.70% | 10.85% | 7.35% |
| **Return/Volatility ratio** | 0.35 | -0.40 | -0.16 | 0.00 |
| **Maximum daily loss** | -4.06% | -5.85% | -2.70% | -1.50% |
| **Maximum daily profit** | 6.77% | 2.74% | 3.40% | 2.09% |
| **Maximum cumulative loss** | -22.92% | -34.23% | -22.45% | -12.30% |
| **Observations** | 1063 | 1063 | 1063 | 1063 |
| **% Winning days** | 49.95% | 49.20% | 48.17% | 48.82% |

The returns generated by strategy S1 are overall quite poor and do not beat what would have been achieved by the use of a simple moving average on the spot exchange rate itself, and this for all four exchange rates.

The trading signals of our second strategy S2 are simply generated according to the sign of the RR: if the RR is negative, the strategy generates a sell signal, else it generates a buy signal.

8 For all the trading strategies presented in this paper, sell signals imply selling the base currency for the quoted one (i.e. selling the USD/JPY means selling the USD and buying the JPY), and vice versa.

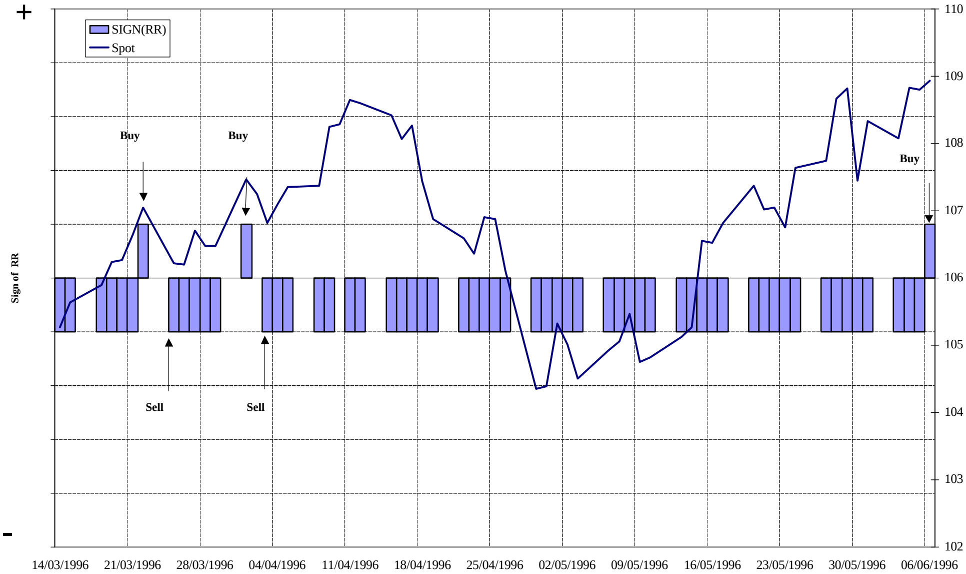


**Figure 9:** Example of RR Sign Strategy S2 on the USD/JPY

**Table 7:** Summary Statistics of the RR Sign Strategy (S2)

| | USD/JPY | AUD/USD | USD/CHF | GBP/USD |
|---|---|---|---|---|
| **Annualised Return** | -3.57% | 6.79% | -8.46% | -1.94% |
| **Annualised Volatility** | 13.69% | 10.53% | 10.49% | 7.03% |
| **Return/Volatility ratio** | -0.26 | 0.64 | -0.81 | -0.28 |
| **Maximum daily loss** | -4.06% | -5.85% | -2.70% | -1.56% |
| **Maximum daily profit** | 6.77% | 3.06% | 3.40% | 2.09% |
| **Maximum cumulative loss** | -33.73% | -16.71% | -45.73% | -16.98% |
| **Observations** | 1063 | 1063 | 1063 | 1063 |
| **% Winning days** | 45.06% | 50.80% | 43.27% | 44.68% |

Here again, except in the case of the AUD/USD, the results are poor and do not match on average the returns generated by a simple trading rule applied to the spot exchange rate itself.

### 4. 3 - The Contrarian Approach

Promoting the use of RR within a contrarian context, J. P. Morgan (2000) presented their approach as follows: “*For risk reversals, we follow the common practice of treating positive and negative observations differently - for instance, a high positive value is seen in the context of just positive observations, rather than the whole distribution. [...] we build a one standard-deviation band around two different means and literally disregard anything that is inside it. [...] When [risk reversals] are at an unusually high or low level then you extract value out of it... and you go against them. The skew is two large hence the risk is that the currency actually moves in the opposite direction.* “

Accordingly, we devise two mean reverting strategies S3 and S4. For both strategies, we create two ‘sub-series’ out of the initial RR time series. One is made of the positive RRs and the other one of the negative RRs. We then create two bands: the upper band is equal to the mean of the positive RR series plus one standard deviation, the lower band is equal to the mean of the negative RR series minus one standard deviation. In strategy S3, we estimate both means and standard deviations on a cumulative basis (i.e. resampled every day). In strategy S4, the sampling of means and standard deviations is done on a rolling 21-day basis.

The mean-reverting signals are then generated as follows: if the RR is superior to the upper band, sell until the RR becomes lower than the upper band (in which case the signal is then 'neutral'), conversely, if the RR is inferior to the lower band, buy until the RR become higher than the lower band (in which case the signal is then 'neutral'). There is no signal generated when the current RR lies between the two bands. The strategies S3 and S4 are illustrated by Figures 10 and 11 below.

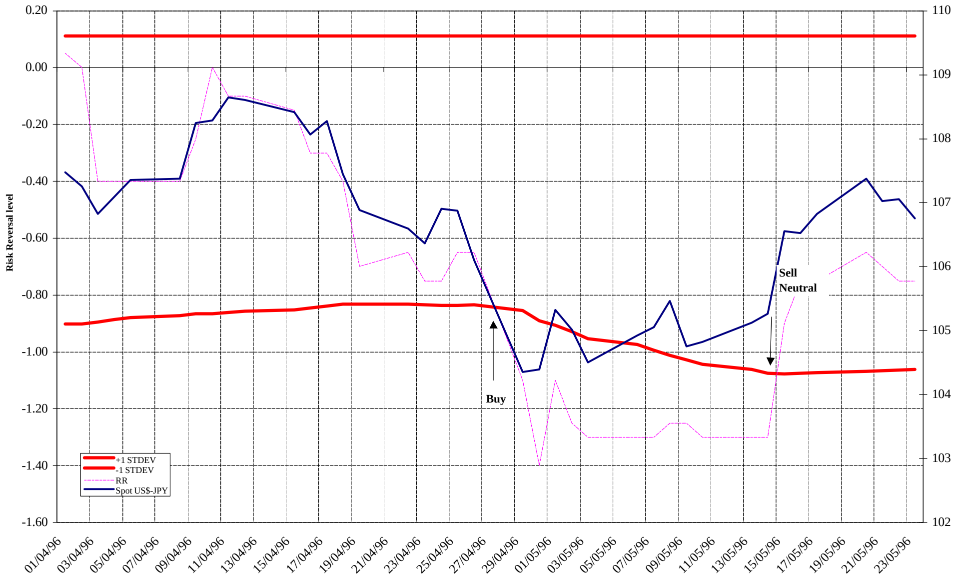


**Figure 10:** Example of the Cumulative Band RR Strategy S3 on the USD/JPY

**Table 8:** Summary Statistics of the Cumulative Band Strategy (S3)

| | USD-JPY | AUD-USD | GBP-USD | USD-CHF |
|---|---|---|---|---|
| **Annualised Return** | 5.21% | -3.02% | 1.21% | -3.55% |
| **Annualised Volatility** | 11.54% | 7.73% | 4.05% | 7.11% |
| **Return/Volatility ratio** | 0.45 | -0.39 | 0.30 | -0.50 |
| **Maximum daily loss** | -5.48% | -2.24% | -2.22% | -4.51% |
| **Maximum daily gain** | 5.41% | 4.27% | 1.80% | 3.40% |
| **Maximum cumulative loss** | -19.40% | -25.60% | -12.20% | -30.08% |
| **% Time in position** | 29.88% | 32.54% | 13.51% | 18.17% |
| **% Winning days** | 54.78% | 47.95% | 50.70% | 50.79% |

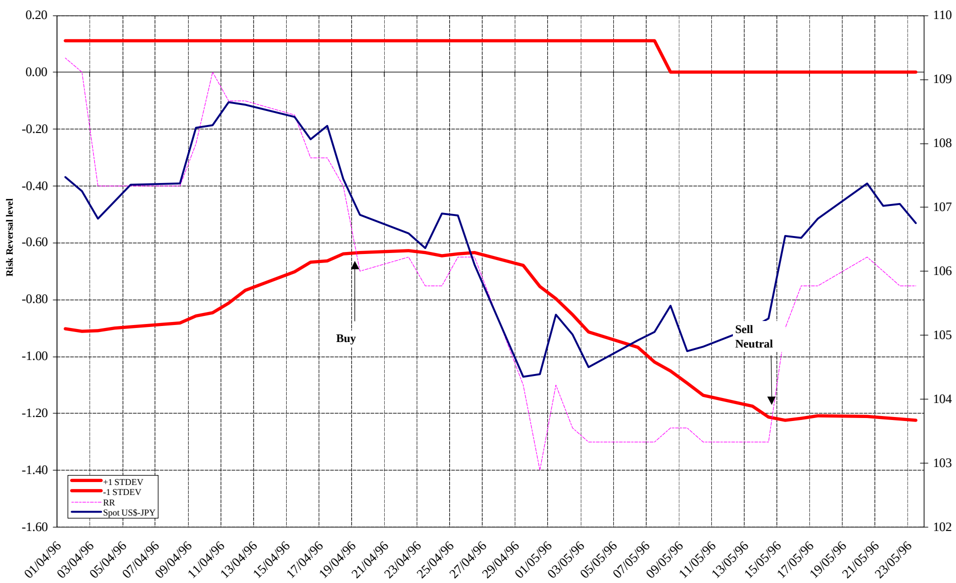


**Figure 11:** Example of Rolling 21-Day Band RR Strategy S4 on the USD/JPY

**Table 9:** Summary Statistics of the 21-Day Rolling Bands Strategy (S4)

| | USD/JPY | AUD/USD | USD/CHF | GBP/SD |
|---|---|---|---|---|
| **Annualised Return** | 0.88% | -2.39% | 3.82% | -4.42% |
| **Annualised Volatility** | 10.44% | 6.81% | 7.71% | 6.21% |
| **Return/Volatility ratio** | 0.08 | -0.35 | 0.50 | -0.71 |
| **Maximum daily loss** | -5.48% | -2.29% | -4.51% | -2.71% |
| **Maximum daily gain** | 5.02% | 5.66% | 3.40% | 2.22% |
| **Maximum cumulative loss** | -31.33% | -25.08% | -12.23% | -22.11% |
| **% Time in position** | 28.16% | 23.22% | 26.26% | 29.40% |
| **% Winning days** | 53.72% | 47.13% | 54.35% | 47.25% |

As is shown by Table 9 above, both the S3 and S4 strategies generate returns that compare poorly with those obtained using the simple moving average on the spot exchange rate[9].

## 5. CONCLUDING REMARKS

In this paper, we have investigated whether there is any informational value that can be derived from risk reversals (RR) and used to assess the future evolution of exchange rates. We have analysed RRs both from a statistical and a market practitioner's point of view. In the end, the disappointing results from the various econometric tests conducted on our sample were well reflected in the poor economic value generated by our set of four technical trading rules when benchmarked to a more traditional approach.

Clearly, for the period and currencies considered, we were not able to show that there is any embedded information in RR data that could be used profitably within a directional forecasting context.

[9] Consistent positive returns could only be achieved by applying our mean-reverting strategies on the basis of bands calculated *ex post* for the entire data sample, something that would obviously not be actionable in reality.

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