Further evidence on technical analysis and profitability of foreign exchange intervention

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1. Introduction

Technical analysis involves using charts of financial price movements in order to infer the likely course of future prices and therefore construct forecasts and determine trading decisions. Recent research have discovered that excess returns from extrapolative technical trading rules in foreign exchange markets are high during periods of central bank intervention [see, e. g., LeBaron (1996) and Neely and Weller (1997)].

This empirical evidence has largely limited its attention to the moving average (MA) rule, which is easily expressed algebraically. Nevertheless, practitioners relay heavily on many other techniques, including a broad category of graphical methods ("heads and shoulders", "resistance/support levels", etc.), which are highly nonlinear and complex to be expressed algebraically. Clyde and Osler (1997) show that the nonlinear nearest neighbour (NN) forecasting technique, based on the literature on complex dynamic systems, can be viewed as a generalization of these graphical methods. The basic idea behind these predictors is that pieces of time series sometime in the past might have a resemblance to pieces in the future (see Fernández-Rodríguez, et al., 1998).

In this paper we try to provide some additional evidence on the positive correlation between returns from technical trading rules and periods of central bank intervention. To that end, in contrast with the previous papers, the predictions from NN forecasting methods are transformed into a simple trading strategy, whose profitability is evaluated both over the entire sample period and after removing those days where intervention takes place. Furthermore, unlike previous empirical evidence, when evaluating trading performance, we will consider both interest rates and transaction costs, as well as a wider set of profitability indicators than those usually examined.

We have applied this investment strategy to the US Dollar exchange rate, vis-à-vis the Deustchmark and the Japanese yen. When evaluating returns in excess of nominal interest rates, we use daily overnight interest rates. Finally, we utilize daily US intervention data, in millions of US dollars. Our data set covers the 1 March 1973-31 December 1996 period, except for the interest rate data that refers to the 1 February 1982-31 December 1996 period.

2. Empirical results

We consider a simple technical trading strategy in which positive returns are executed as long positions and negative returns are executed as short positions. The estimated total return of such strategy is given by:

$$R^{t}_{T} = 3^{n}_{i=1} \, y_t \;\; r_t \qquad (1)$$

where r_t is the return from a foreign currency position over the period (t, t+1), y_t is a variable interpreted as the recommended position which takes either a value of -1 (for a short position) or +1 (for a long position), and n is the number of observations.

Given that trading in spot foreign exchange market requires consideration of interest rates when evaluating trading performance, we use overnight interest rates to compute r_t as follows:

$$r_t = \ln (E_{t+1}) - \ln(E_t) - \ln (1+i_t) + \ln (1+i^*_t) \qquad (2)$$

where E represents the spot dollar price of foreign exchage, i is the US daily interest rate and i* is the foreign daily interest rate.

On the other hand, with one-way proportional transaction cost c, the net return of the technical trading strategy is given by:

$$R^n_T = 3^n_{i=1}\, y_t\, r_t - nrt\, \{\ln(1-c) - \ln(1+c)\} \qquad (3)$$

where nrt is the number of round-trip trades.

To compare the performance of this simple technical trading strategy, the net returns on a simple buy-and-hold strategy:

$$R^n_B = \ln (E_{t+h}) - \ln(E_t) - \{\ln(1-c) - \ln(1+c)\} \qquad (4)$$

is used as the benchmark, where h indicates the holding period.

The estimated total and net returns are calculated by:

$$R^t_T = 3^{n+h+1}_{i=n+1}\, \hat{y}_t\, r_t \qquad (5)$$

and

$$R^n_T = 3^n_{i=1}\, \hat{y}_t - nrt\, \{\ln(1-c) - \ln(1+c)\} \qquad (6)$$

where $\hat{y}_t$ is the estimated recommended position for the tth observation. The estimation of $\hat{y}_t$ is carried out by the NN predictors. Regarding the transaction costs, following Levich and Thomas (1995) and Osler and Chang (1995), we consider a one-way cost of 0.025%.

Besides the total and net returns, we also consider other three profitability indicators: the sign predictions, the ideal profit and the Sharpe ratio. The sign predictions measure the percentage of times the trading rule assigns the correct buy or sell decision in accord with the sign of the corresponding return of a given period. A value higher than 50 would indicate a better accuracy than the random walk in predicting the direction of exchange rate movements. The ideal profit measures the returns of the trading system against a perfect predictor and is calculated by:

$$R_I = \frac{\sum_{t=n+1}^{n+\eta+1} \hat{y}_t r_t}{\sum_{t=n+1}^{n+\eta+1} | rsubt |} \quad (7)$$

According to equation (7), R_I= 1 if the indicator variable $\hat{y}_t$ takes the correct trading position for all observations in the sample. If all trade positions are wrong, then the value of this measure is R_I= -1. An R_I= 0 value is considered as a benchmark to evaluate the performance of an investment strategy. Regarding the Sharpe ratio, it is simply the mean return of the trading strategy divided by its standard deviation:

$$S_R = \frac{\mu_{\hat{R}_T}}{\sigma_{\hat{R}_T}} \quad (8)$$

According to equation (8), the higher the Sharpe ratio, the higher the return and the lower the volatility.

Table 1 reports the estimated results over the entire forecasting period. As can be seen, the technical strategy generates 35% net returns for the US Dollar-Deustchmark exchange rate, whereas the buy-and-hold net return remains at -1.4%. For the US Dollar-Japanese yen case, the trading strategy net return and the buy-and-hold net return are 28% and -0.4%, respectively. Therefore, it seems technical trading returns dominate the buy-and-hold returns, showing the potential usefulness of nearest neighbour predictors for technical trading rules to forecast daily exchange data. As shown in Table 1, the sign predictions for the recommended positions are 53% and 52% for the US Dollar-Deustchmark and the US Dollar-Japanese yen exchange rates, respectively, clearly outperforming the random walk directional forecast. Regarding the ideal profit measure, it is always greater than zero and approximately 0.07 for both exchange rates. As for the Sharpe ratio, they are also similar in order (around 0.05), suggesting that risk/return ratios are similar across these exchange rates.

To investigate the claim that central bank intervention in foreign exchange markets is a potential explanation for the profitability of technical trading rules, we follow LeBaron (1996)'s procedure and selectively examine the trading rule results after removing those returns from day t to t+1 for which intervention was non-zero on day t. Table 2 shows the results of the rule when excluding days of US intervention.

As can be seen by comparing Tables 1 and 2, there is some evidence that the returns are lower when there is not intervention in day t: the net returns from the trading strategy is now negative (-10% for the US Dollar-Deustchmark case and -28% for the US Dollar-Japanese yen case) whereas the buy-and-hold net return remains the same. In addition, there is a significant reduction in both the ideal profit measure and the Sharpe ratio (-37% for the US Dollar-Deustchmark case, and -49% for the US Dollar-Japanese yen case). As for the sign predictions, there is also a reduction in the accuracy in predicting the direction of exchange rate movements, grater in the US Dollar-Deustchmark case (-2.26 percentage points) than in the US Dollar-Japanese yen case (-0.19 percentage points).

Therefore, our results indicate that there is a positive correlation between returns from technical trading rules and periods of central bank intervention, suggesting that central bank intervention in foreign exchange markets may be a potential explanation for the profitability of technical trading rules.

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TABLE 1: Results for the entire forecasting period (1)

Tests	US Dollar-Deustchmark exchange rate	US Dollar-Japanese yen exchange rate
Total return (2)	1.2799	1.2008
Net return (3)	0.3504	0.2793
Sign predictions (4)	52.88	51.60
Ideal profit ratio (5)	0.0666	0.0697
Sharpe ratio (6)	0.0496	0.0503
Buy and hold return (7)	-0.0139	-0.0044

Notes: (1) Forecasting period: 1-2-1982 to 31-12-1996.
(2) Returns generated by the trading rule over the forecast sample, before transaction fees are taken into account [see equation (5) in the text].
(3) Returns generated by each forecasting method over the forecast sample, after transaction fees are taken into account [see equation (6) in the text].
(4) Percentage of correct forecast direction.
(5) The ideal profit measures the returns of the trading system against a perfect predictor [see equation (7) in the text].
(6) The Sharpe ratio is obtained dividing the mean return of the trading system by its standard deviation [see equation (8) in the text].
(7) Returns generated using equation (4) in the text, where transaction fees are taken into account

TABLE 2: Results when excluding days of US intervention (1)

Tests	US Dollar-Deustchmark exchange rate	US Dollar-Japanese yen exchange rate
Total return (2)	0.7706	0.5879
Net return (3)	-0.1012	-0.2836
Sign predictions (4)	50.62	51.41
Ideal profit ratio (5)	0.0420	0.0357
Sharpe ratio (6)	0.0308	0.0250
Buy and hold return (7)	-0.0139	-0.0040

Notes: (1) Forecasting period: 1-2-1982 to 31-12-1996.
(2) Returns generated by the trading rule over the forecast sample, before transaction fees are taken into account [see equation (11) in the text].
(3) Returns generated by each forecasting method over the forecast sample, after transaction fees are taken into account [see equation (12) in the text].
(4) Percentage of correct forecast direction.
(5) The ideal profit measures the returns of the trading system against a perfect predictor [see equation (13) in the text].
(6) The Sharpe ratio is obtained dividing the mean return of the trading system by its standard deviation [see equation (14) in the text].
(7) Returns generated using equation (10) in the text, where transaction fees are taken into account.