When Support/Resistance Levels are Broken, Can Profits be Made? Evidence from the Foreign Exchange Market

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Abstract

We investigate on three exchange rate series the profitability of signals generated by the breaking of levels of support and resistance identified and supplied by Chartists. Such profitability is assessed, and then compared to ones obtained with other technical rules. We confirm previous findings that trading range breaks do generate profitable signals, even after the inclusion of transaction costs, and we show that signals generated using Chartists' inputs are more frequent and profitable. Supports and resistances may work by warning traders against holding currencies subject to adverse trends.

Keywords: Technical Analysis, Chartism, Trading Rules

1 - Introduction

There has recently been a renewed interest in academic circles about technical analysis and its ability to predict future prices. The latest works in the field (Brock, Lakonishok & LeBaron 1991; Levich & Thomas 1991; Curcio & Goodhart 1991) have tried to remedy two main weaknesses of previous empirical tests on the effectiveness of technical analysis: the absence of a proper determination of the significance of the results obtained, and the fact that profitable strategies are bound to emerge in a finite sample even in the presence of a random walk (Tomek & Querin 1984), and that these strategies cannot be expected to work out of sample.

In order to avoid the assumptions of normality of returns, which is easily rejected by formal tests, and the specification of the data generation process, Levich & Thomas (1991) use a bootstrap technique to measure the significance of their results. Their work, which finds that certain technical rules can earn abnormal profits falls, though, under the other criticism, since their rules have been arbitrarily chosen. The same applies to Brock, Lakonishok & LeBaron (1991) who also apply the bootstrap technique; in their work they also consider the possibility that the data generating process is an AR(1), a GARCH-M process or an E-GARCH process. They find that the abnormal profits which they detect cannot be explained by the possibility that their price series follows any of these processes.

Technical analysts do not claim that their technical rules, in so far as they can be expressed in the form of an algorithm, can be profitable

for all time periods and for all assets; what they claim is that some rules work for some assets in certain periods of time, and that they can predict which rule is going to work in a specific situation.

Curcio & Goodhart (1991) have undertaken an experiment to test a specific product which is supposed to help earn abnormal profits by using technical analysis; although some of the tests employed there require distributional assumptions which may not be true, it avoids the criticism that the particular product tested uses techniques that technical analysts may not believe appropriate, since the product is marketed to be used precisely in the way the test has taken place. The main drawback of this work is that it is a test of a single product so that the (mixed) results obtained cannot be generalized to the whole market of Chartist products.

In the present work we test one prediction which most technical analysts tend to accept: this is that particular levels of the exchange rate, called supports and resistances, can provide useful buying and selling signals. The literature on technical analysis reports several ways of computing where support and resistance levels are going to appear, but they all seem to agree on one prediction, that once a support or resistance level has been broken, this is a sign that a trend in that direction has started and that it is likely to continue.

We are able to use data on support and resistance levels provided by technical analysts themselves and we apply simple trading rules based on crossings of support and resistance levels, which we believe would be accepted by the majority of technical analysts, to three exchange rate series. We hope to minimize in this way the criticism from economists that we use arbitrary rules among a potentially infinite set, and from

technical analysts that we do not use models that they themselves believe are relevant.

In the next section we present the data we use and the test devised, while in the following one the results are presented. The final section contains our conclusions.

2 - Support and Resistance levels

One part of technical analysis is concerned with breakings of support and resistance levels and of trading ranges. In the work of Edwards and Magee (1966), which is considered the "bible" of technical analysts, we find a definition of support and resistance which we believe is widely accepted by the technical analysts profession:

> [W]e may define support as buying, actual or potential, sufficient in volume to halt a down trend in prices for an appreciable period. Resistance is the antithesis of support; it is selling, actual or potential, sufficient in volume to satisfy all bids and hence stop prices from going higher for a time (p 211).

Support is found under the current price of an asset, while resistance above it; a breaking of a support or resistance level occurs when the price of an asset penetrates through one of them. Given the above definition of support and resistance, a breaking of either of them can be interpreted as a sign that the demand or the supply of that particular asset has shifted substantially and that the new equilibrium level is to be found beyond the previous support or resistance level.

One of the fundamental claims of technical analysis is that investor psychology is important and that the level at which an investor has bought an asset is an important determinant of the level at which he will sell it. We will try to illustrate this with a typical example:

> Imagine yourself, for the moment in the place of those new owners [who bought at 50]. They see prices turn up, reach 55, 58, 60. Their judgement appears to have been vindicated. They hang on. Then the rally peters out and the prices start to drift off again, slipping to 57, 55, 52, finally 50. They are mildly concerned but still convinced that the stock is a bargain at that price. Probably there is a momentary hesitation in the decline at 50 and then prices break on down. Briefly

> there is a hope that the break is only a shake-out to be recovered quickly, but that hope vanishes as the down trend continues. Now our new owners begin to worry. Something has gone wrong. When the stock gets down below 45, the former bargain doesn't look so good. "Well, I guess I picked a lemon that time but I won't take a loss in it. I'll just wait until it gets back up to 50 some day where I can get out even (expect for expenses) and then they can have it. (Does it sound familiar by any chance?)" (Edwards & Magee 1966 p 213)

A trading range may be defined as the price range within which an asset has traded in the past and can be characterized by the maximum and minimum of the series (of various length) of latest prices. Although support and resistance levels bear some relationship with the boundaries of a trading range, they are not the same thing. Supports and resistances arise at levels where a substantial volume of transaction has taken place: it is this high turnover which creates what are called "vested interests" at that level of price.

Technical analysts tend to differ in the way they compute the levels of resistance and support, but not on the effects they expect once these levels are broken. One of the technical rules which seems to be accepted by all technical analysts is that the breaking of a support or a resistance level, or of a trading range, represents the beginning of a trend in that direction.

In the present work we test this prediction by using hourly data on the exchange rate of three currencies, the Deutsche Mark, Sterling and Yen, against the dollar, over a period of 12 weeks (minus 1 day) from 10 April 1989 to 29 June 1989. The data are mid-points (average of ask and bid prices) of the latest price which appeared in the page FXFX of Reuters screens at the end of each hour during our sample period (due to the thinness of the market at weekends, only weekdays are considered).

From a different page (FXNB) on Reuters screens, we also have data on support and resistance levels for the three exchange rates, as well as their likely future trading range. The values of the support and resistance levels are obtained by Reuters through a telephone survey of a small number of major institutions (around five, but not always the same ones) and are updated two or three times a day: at the opening of the London and Tokyo markets, plus occasionally during the day if some event (in the judgement of Reuters) has significantly changed expectations. The values reported are the modes of the distributions of the survey values.

3 - Results

In order to test for the possibility of earning abnormal profits by looking at breakings of support and resistance levels we have devised 6 technical trading rules and applied them to our three hourly exchange rate series for the Deutsche Mark (DEM), Sterling (GBP) and Yen (JPY), all against the dollar; Table 1 contains summary statistics for these series. Each rule consists of a range within which the exchange rate is expected to fluctuate: if the exchange rate moves above the higher end of the range, a buy signal is generated, while a sell signal is generated if the exchange rate moves below the lower end of the range. The position opened following a signal is then kept open until either the exchange rate moves back into the range, or the range is revised to include the actual value of the exchange rate.

In the first rule we use the values of the support and resistance levels as they appear on Reuters screens as the lower and upper bounds of the range, while in our second rule we apply an outer band of 0.1% to these values in order to take into account the possibility that the exchange rate has to fall outside of the range by a substantial amount in order to be perceived as a break. The third rule uses forecasts of the likely trading range as reported by Reuters as our lower and upper bounds, and in the fourth rule we apply a 0.1% band to these values. The fifth rule requires the exchange rate to fall outside both of the ranges of the first and third rule in order to generate a signal, and the sixth rule applies a 0.1% band to the boundaries of the previous one.

For each of the rules we separately compute the average returns

earned by following the buy and sell signals, and we test whether the difference between the average return obtained following signals and the average return during the whole sample period is significant (we do not test whether the average return earned by following signals is greater than 0).

In Tables 2A, 3A and 4A below we report the results obtained by applying the six rules to our three exchange rate series: in the column labelled N. buy (N. sell) we report the number of buy (sell) signals generated by the rule, while under the buy (sell) column we report the mean return from following the buy (sell) signals together with the t statistic for the test of the hypothesis that this mean return is equal to the mean return of the whole series. The buy-sell column reports the mean return and t statistic obtained by following both the buy and sell signals.

A few interesting results can be immediately noted by looking at these tables: 1) the average returns from following both buy and sell signals are always positive and higher than the average returns for the whole series (the t statistic for the hypothesis of equal returns varies from 1.27 to 2.85); 2) the average returns from following both signals are substantially higher than the average returns of the whole series by an order of magnitude of at least 5 for the DEM series, positive instead of negative for the GBP series, and between 3 and 8 times higher for the JPY series; 3) for the DEM and the JPY series, only the buy signals are profitable while for the GBP series only the sell signals are profitable; 4) the number of total signals generated varies from a minimum of 149 for the JPY series to a maximum of 527 for the GBP series out of a possible maximum of 1408.

Brock, Lakonishok and LeBaron (1991) test the significance of trading ranges breaks by using as upper and lower bounds of the ranges the maximum and minimum of the previous 50, 150 and 200 daily values of the Dow Jones Industrial Average with and without a band. We test similar rules on our data for two reasons: one is to confirm their results by using different series (exchange rates instead of a stock market index), the other is to compare the performance of these technical rules with the one obtained by using data supplied directly by technical analysts.

In Tables 2B, 3B and 4B we report the results obtained by following the technical rules suggested by Brock, Lakonishok & LeBaron (1991). The results from applying these rules can be summarized as follows: 1) the average returns from following both the buy and sell signals are always positive and higher than the average returns of the series, but with generally lower t statistics (ranging from 0.41 to 2.21) than those obtained with rules constructed with Reuters data; 2) the average returns per signal are substantially higher than the average returns for the whole sample and also somewhat higher than those obtained with our rules above; 3) again, for the DEM and JPY series only the buy signals are profitable, while for the GBP series only the sell ones are; 4) the number of total signals is much lower than that obtained with the previous rules, ranging from 39 to 208 (the maximum number of possible signals with these rules is lower since we lose the first 50, 150 and 200 observations in order to compute the ranges). Consequently, despite the somewhat higher return per signal obtained with these rules, the total return from following signals is greater with the previous rules which generate a higher number of signals.

These results clearly show that on average positive abnormal returns can be made by opening and closing positions according to signals generated by range breaks, with more significant results obtained by using Chartists' predictions rather than technical rules. There is, however, an important asymmetry to consider: breakings of supports and resistances do not seem to give symmetric results. In our sample period, all three exchange rates trended considerably, with the dollar appreciating by between 5% and 10% against the other currencies. Remembering that the Sterling exchange rate is quoted in the opposite way as the other two currencies, so that an appreciation of the dollar is reflected in a lowering of the exchange rate, it appears that in our samples upper bounds tend to work with rising prices and lower bounds with falling prices. This is not merely a tautology since we always compare returns obtained by following signals with the average returns of the series; in other words, if the exchange rate was generated by a random walk with drift process, we would obtain, by following any of the previous rules, average returns per signal equal to the drift parameter, which is also the average return of the series.

It is important, from the point of view of market traders, for trading range breaks to give the correct buy signal in rising markets and the correct sell signal in falling ones since it can enable them to avoid being systematically on the wrong side of the market. In order to illustrate this, we consider two strategies that can be adopted in order to decide which of the two currencies of an exchange rate to hold: the first one is to buy one currency and hold it unless a sell signal is given by a trade range break; the second one is to sell that currency (buy the other currency) and stay short unless a buy signal is given by a trade range

break. In the absence of buy and sell signals, the returns of these two strategies are equal and of opposite signs: for the DEM series these are equal (in absolute value) to 5.331, for the GBP to 10.151 and for the JPY to 8.513. In Tables 5, 6 and 7 below, we report the returns obtained by applying all the trading rules considered above to the two strategies.

As can be seen from Tables 5, 6 and 7, on average the returns obtained by each couple of strategies are greater than zero (this is simply the result that the returns in the buy-sell column are positive), and, more importantly we can see that supports and resistances work when they are most needed, when the trend is going in the opposite direction than our strategy. Thus, in the DEM case, the strategy of holding DMs gives a return of -5.331%, but when it is supplemented by any of the Reuters-derived rules, the loss is converted into a profit which varies between 1.37% and 7.85%. In the case of the GBP, the loss of 10.151% is not converted into a profit, but cut to at worst 2.94% saving at least 7% in lower losses. In the JPY case, the loss of -8.513% is turned into a profit of at least 2.7%. On the other hand, the returns to the strategy of holding the currency appreciating, the dollar, are somewhat lowered but still always positive in the case of the Reuters-derived rules. For the technical rules involving maxima and minima of past prices the results are less strong: the strategies fail to turn the losses by holding DMs and Yens into profits and the losses in the Sterling case are not cut by as much as with the other rules.

We now take into account transaction costs to see if the strategies are still profitable after including them into the computation of the returns. We assumed that transaction costs are 0.03% of the amount of

the transaction (this implies a spread which is higher than 99% of those registered for the three currencies during the first week of our dataset), and that these are paid every time that a position is changed. In Tables 5, 6 and 7 we also report the returns from following each strategy, net of our transaction costs: the results are not altered in their substance, and the returns from following our six rules are still positive on average (the losses incurred by holding Sterling are outweighted by the higher returns from holding dollars).

Finally, De Grauwe & Decupere (1992), using 11 years of daily data for the DEM and JPY exchange rates claim that psychological barriers exist at round numbers. They look at the frequency of observations around decimal and unit barriers, which are defined respectively as levels of the exchange rate with the last 3 and 4 digits (out of 5) equal to zero, and they reject the hypothesis that the frequency of the distribution is uniform, concluding that this anomaly might be profitably exploited by foreign exchange dealers. Their interpretation of the results would imply that whenever an exchange rate crosses through a psychological barrier, it is more likely that the next move is in the same direction as the previous one, away from the barrier. We, therefore, used our own data to test this hypothesis and by applying our trading rule to decimal and hundredth (last two digits equal to zero) barriers and our results are reported in Tables 8 and 9; we were not able to test what happens with breakings of unit barriers since there are too few of them in our samples. As can be seen from Tables 8 and 9, rules based on decimal and hundredths barriers are not profitable in general, and generated losses in the case of the JPY, which had showed the strongest effect in De Grauwe & Decupere's (1992) own work.

4 - Conclusions

The role of support and resistance levels in technical analysis is widely understood. In this study we use data on such levels, made publicly available by Reuters, which had been provided by Chartists. Our test is, therefore, replicable, potentially extensible to other periods, and cannot be rejected by Chartists as an invalid measure of their approach.

We find that abnormal returns could be made in our period by following such technical signals. But all these abnormal returns were obtained from following the signals on one side of the market (buy signals for DEM and JPY, sell for GBP) during a data period during which the $ was trending/drifting quite strongly. By comparing the results of following these signals with a simple buy and hold strategy, it appears that support and resistances work to warn traders against holding currencies subject to adverse trends.

It remains a subject of further research to discover whether the asymmetric abnormal returns, shown here, reverse when the trend reverses, and to examine further how these abnormal returns are related to the statistical characteristics of the underlying series.

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TABLE 1
SUMMARY STATISTICS FOR DAILY RETURNS

	DEM	GBP	JPY
MEAN	0.003151	-0.0065054	0.0057267
STD.DEVIATION	0.158396	0.172137	0.171235
VARIANCE	0.025089	0.029631	0.029321
SKEWNESS	0.13422	0.12888	-0.75413
KURTOSIS	11.04728	7.88556	13.22628
N.	1415	1415	1415

TABLE 2A
DEM: MEAN RETURNS FROM FOLLOWING RULE

rule	N. buy	N. sell	buy	sell	buy-sell
SUP-RES	189	181	0.025912 (1.85)	0.011772 (0.69)	0.018995 (1.71)
SUP-RES 0.1	140	120	0.035046 (2.27)	0.004012 (0.06)	0.020722 (1.64)
LR-HR	190	170	0.033105 (2.45)	-0.00114 (-0.33)	0.016936 (1.47)
LR-HR 0.1	147	126	0.039692 (2.66)	0.005647 (0.17)	0.023979 (1.99)
BOTH	120	122	0.035519 (2.15)	0.010781 (0.51)	0.023048 (1.81)
BOTH 0.1	91	89	0.035268 (1.91)	0.010422 (0.42)	0.02326 (1.62)

TABLE 2B
DEM: MEAN RETURNS FROM FOLLOWING RULE

rule	N. buy	N. sell	buy	sell	buy-sell
50	118	73	0.020498 (1.14)	-0.00082 (-0.21)	0.01235 (0.75)
50 0.1	44	35	0.04934 (1.90)	-0.03975 (-1.52)	0.010665 (0.41)
150	96	30	0.019993 (1.01)	-0.02501 (-0.96)	0.009278 (0.42)
150 0.1	33	14	0.081672 (2.81)	-0.05668 (-1.41)	0.04046 (1.59)
200	78	22	0.016711 (0.74)	0.002209 (-0.03)	0.013521 (0.63)
200 0.1	27	12	0.082637 (2.58)	-0.01523 (-0.40)	0.052525 (1.92)

TABLE 3A
GBP: MEAN RETURN FROM FOLLOWING RULE

rule	N. buy	N. sell	buy	sell	buy-sell
SUP-RES	204	251	-0.01062 (-0.32)	0.018151 (2.09)	0.005251 (1.27)
SUP-RES 0.1	147	188	-0.00099 (0.37)	0.019187 (1.92)	0.010333 (1.61)
LR-HR	221	306	-0.01007 (-0.29)	0.015394 (2.02)	0.004714 (1.28)
LR-HR 0.1	227	165	-0.00894 (-0.17)	0.01758 (1.96)	0.006419 (1.32)
BOTH	152	189	0.00058 (0.48)	0.019729 (1.97)	0.011193 (1.70)
BOTH 0.1	113	140	0.014448 (1.24)	0.028777 (2.31)	0.022377 (2.46)

TABLE 3B
GBP: MEAN RETURN FROM FOLLOWING RULE

rule	N. buy	N. sell	buy	sell	buy-sell
50	56	125	0.018616 (1.07)	0.022766 (1.82)	0.021482 (2.06)
50 0.1	26	54	0.016879 (0.69)	0.021134 (1.16)	0.019751 (1.33)
150	10	103	0.038276 (0.82)	0.028314 (1.98)	0.029195 (2.12)
150 0.1	6	42	-0.0798 (-1.04)	0.046288 (1.96)	0.030527 (1.47)
200	6	94	-0.00422 (0.03)	0.029426 (1.96)	0.027407 (1.90)
200 0.1	4	40	-0.09912 (-1.07)	0.04831 (1.99)	0.034908 (1.57)

TABLE 4A
JPY: MEAN RETURN FROM FOLLOWING RULE

rule	N. buy	N. sell	buy	sell	buy-sell
SUP-RES	179	111	0.032337 (1.96)	0.005298 (-0.03)	0.021988 (1.47)
SUP-RES 0.1	121	86	0.066373 (3.74)	0.007993 (0.12)	0.042119 (2.85)
LR-HR	188	121	0.038528 (2.47)	0.010541 (0.30)	0.027568 (2.03)
LR-HR 0.1	127	100	0.051268 (2.87)	-0.00371 (-0.53)	0.027049 (1.74)
BOTH	120	75	0.052711 (2.88)	0.015384 (0.48)	0.038355 (2.49)
BOTH 0.1	88	61	0.063721 (3.08)	0.022457 (0.75)	0.046828 (2.79)

TABLE 4B
JPY: MEAN RETURN FROM FOLLOWING RULE

rule	N. buy	N. sell	buy	sell	buy-sell
50	145	63	0.032823 (1.81)	-0.01832 (-1.09)	0.017331 (0.91)
50 0.1	60	36	0.064038 (2.58)	-0.02741 (-1.15)	0.029745 (1.33)
150	111	21	0.038047 (1.91)	0.004158 (-0.04)	0.032656 (1.73)
150 0.1	48	16	0.063098 (2.28)	-0.01487 (-0.48)	0.043606 (1.73)
200	102	13	0.0398 (1.94)	0.005589 (0.00)	0.035933 (1.83)
200 0.1	48	16	0.063098 (2.28)	-0.022 (-0.56)	0.046079 (1.79)

TABLE 5
DEM: TOTAL RETURN FROM FOLLOWING RULE

	NO TRANSACTION COSTS		TRANSACTION COSTS	
rule	holding $	holding DM	holding $	holding DM
S-R	9.033	4.464	6.933	2.034
S-R 0.1	6.681	4.482	5.001	2.562
LR-HR	4.405	7.846	2.065	6.046
LR-HR 0.1	5.947	6.339	4.327	4.899
BOTH	7.154	3.194	5.234	1.814
BOTH 0.1	7.576	1.370	6.256	0.170
50	3.929	-0.493	2.009	-3.733
50 0.1	2.245	-0.989	0.745	-2.849
150	3.852	-1.492	3.012	-4.192
150 0.1	3.743	0.060	3.083	-1.140
200	5.428	-2.724	4.768	-5.064
200 0.1	4.965	-0.868	4.425	-1.768

TABLE 6
GBP: TOTAL RETURN FROM FOLLOWING RULE

	NO TRANSACTION COSTS		TRANSACTION COSTS	
rule	holding GBP	holding $	holding GBP	holding $
S-R	-1.039	6.794	-3.649	4.814
S-R 0.1	-2.937	10.64	-4.767	9.156
LR-HR	-0.720	6.917	-3.040	4.997
LR-HR 0.1	-2.169	7.700	-4.239	6.143
BOTH	-2.693	11.38	-4.463	10.06
BOTH 0.1	-2.093	13.53	-3.263	12.51
50	-4.459	12.26	-7.999	10.88
50 0.1	-7.868	10.95	-10.03	9.988
150	-4.318	10.85	-7.138	10.55
150 0.1	-6.236	9.089	-7.763	8.789
200	-4.619	10.10	-7.139	9.860
200 0.1	-6.826	9.358	-7.666	9.118

TABLE 7
JPY: TOTAL RETURN FROM FOLLOWING RULE

	NO TRANSACTION COSTS		TRANSACTION COSTS	
rule	holding $	holding JPY	holding $	holding JPY
S-R	11.38	3.307	9.759	1.327
S-R 0.1	11.55	7.549	10.11	6.409
LR-HR	12.49	5.872	10.63	3.592
LR-HR 0.1	9.201	4.661	7.761	3.401
BOTH	12.25	4.168	11.11	2.788
BOTH 0.1	12.91	2.702	12.13	1.922
50	8.875	1.306	7.255	-2.414
50 0.1	8.321	-0.892	7.061	-2.869
150	8.504	-0.067	7.964	-3.067
150 0.1	8.083	-2.456	7.543	-4.076
200	8.659	-0.394	8.299	-3.154
200 0.1	7.985	-2.456	7.565	-4.076

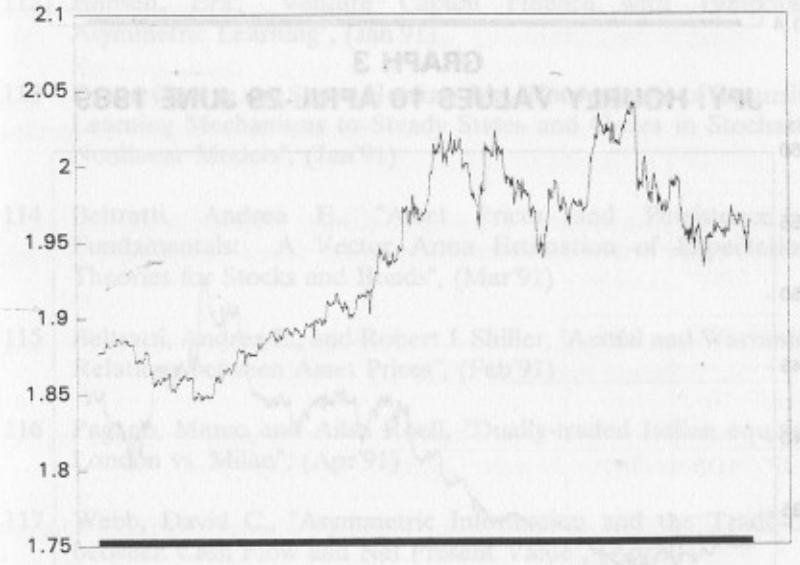
TABLE 8
MEAN RETURN FROM FOLLOWING RULE

rule	N. buy	N. sell	buy	sell	buy-sell
DEM 100	136	122	0.014418 (0.79)	0.000976 (-0.15)	0.008062 (0.46)
DEM 10	7	7	0.124744 (2.03)	-0.03945 (-0.71)	0.042649 (0.93)
GBP 100	107	119	0.008006 (0.84)	0.035005 (2.53)	0.022222 (2.33)
GBP 10	7	10	0.11768 (1.90)	-0.04276 (-0.66)	0.023304 (0.71)
JPY 100	113	101	0.002365 (-0.20)	-0.02449 ('1.71)	-0.01031 (-1.28)
JPY 10	7	6	0.03316 (0.42)	-0.07677 (-1.18)	-0.01758 (-0.49)

TABLE 9
TOTAL RETURNS FROM FOLLOWING RULE

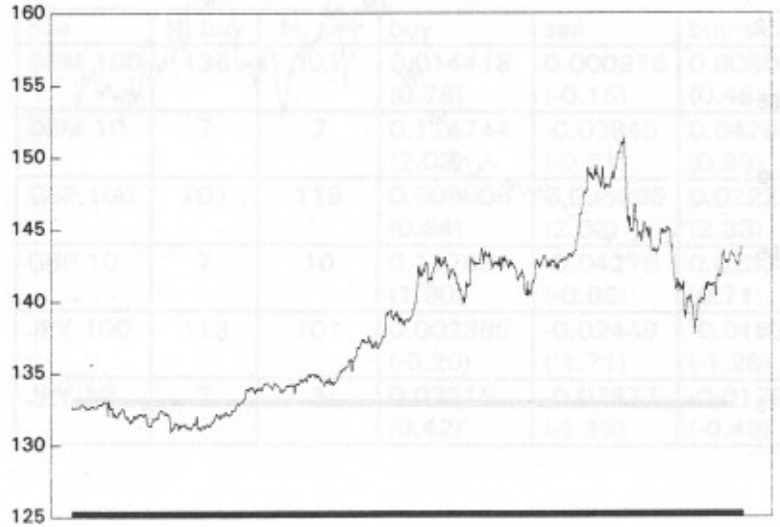
	NO TRANSACTION COSTS		TRANSACTION COSTS	
rule	holding $	holding FC	holding $	holding FC
DEM 100	4.956	-1.473	-1.764	-9.003
DEM 10	4.778	-3.584	4.358	-4.004
GBP 100	10.68	-1.936	4.992	-8.476
GBP 10	11.28	-11.34	10.98	-11.82
JPY 100	5.828	-7.874	0.608	-13.87
JPY 10	7.952	-8.049	7.232	-8.469

GRAPH 1
DEM: HOURLY VALUES 10 APRIL-29 JUNE 1989



GRAPH 2
GBP: HOURLY VALUES 10 APRIL-29 JUNE 1989

GRAPH 3
JPY: HOURLY VALUES 10 APRIL-29 JUNE 1989



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