

The British Pound Cubed

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The British Pound(BP) is a major currency traded world wide by corporations, institutions, banks, commodity funds and futures traders. The BP is traded 24 hours per day and most of the worlds largest banks make a two sided market in the BP and its associated derivatives. Small traders however, are constrained to trade the BP futures on the Chicago Mercantile Exchange(CME). The BP futures are traded from 7:20am to 2pm on the CME and from 2:30pm to 7:05am Monday through Thursday 5:30 P.M. to 7:05 AM Sundays and holidays on the CME Globex system. While the CME BP futures trading volume is small when compared to total world wide bank and institutional trading volume, arbitrage keeps the future prices in line with the bigger markets.

Data Discussion

The BP futures contract on the CME trades in the quarterly cycles of March, June, September and December. The current active BP futures contract is the DM Sep/98. This is the CME futures contract that expires on the second business day before the third Wednesday of September 1998. The BP Dec/98 will become the active contract one week before the Sep/98 expiration day.

The British Pound is the currency of The United Kingdom. Each BP futures contract is worth the dollar value of 62,500 British Pounds. On May 29th, 1998 the BP Jun/98 closed at 1.6302 Dollars per BP making one BP contract worth \$101887.50 ($1.6302 \times 62,500$). The BP future trades in units of \$0.0002 per BP. Thus a move of one tick of \$0.0002 is worth \$12.50 per contract ($\$0.0002 \text{ \$/BP} \times 62,500 = \$12.50$).

The BP futures started trading on 1975. However, for this article we will limit our study to the price history from 1/1/89 to today. Here we will use a BP futures continuous contract. Since BP future contracts expire each quarter, a continuous contract is constructed by switching to the active contract on rollover day and back adjusting the difference in prices between the new contract and old contract thus creating a smooth continuous contract.

The performance results from systems using continuous contracts cannot match actual results from trading real contracts because of the costs of actually having to rollover, and execution slippage. Execution slippage is the differences in prices from actually executing an order when a buy or sell signal is given and the price the computer system assumes that the order was executed at. When rolling over in real time via actual executions, the difference in prices between the new contract and the old contract on rollover day may not be the same as the closing prices the computer uses to construct the continuous contract.

Another problem with continuous contracts is that the past data is back adjusted by the difference in prices between the two contracts on rollover day. Systems developed on continuous contracts that use some form of percentage of prices will be impacted somewhat by this difference

adjustment to past prices. Despite these qualifiers, system results based upon continuous contracts are still indicative of the worth of the trading system.

The Least Squares Cubic System.

In a previous article I used the technique of least Squares to fit a straight line through 30+ closing prices to create a curve that served as a proxy for the market trend. When the curve moved up by a certain percent from its previous local low, the trend was assumed to have changed to the upside and a buy signal was given. When the curve moved down by a certain percent from its previous local high, the trend was assumed to have changed to the downside and a sell signal was given. Here I will use the least squares technique to fit a cubic polynomial of the form $a_0 + b_0 * t + c_0 * t^2 + d_0 * t^3$ to create a curve that will serve as a better proxy for the market trend. The cubic polynomial should respond faster to changes in the underlying trend and model the trend changes more accurately than the straight line version.

What is Least Squares?

Least squares is a mathematical technique where the squared vertical distance between the data and the curve that is being fit to the data is minimized. When the net squared distance (also called the sum of the squared errors) is minimized, a unique set of coefficients a_0, b_0, c_0 , and d_0 for the polynomial is determined.

For the cubic equation, the least squares coefficients are obtained from the solution of the following matrix equation.

$$\begin{vmatrix} T & \sum t & \sum t^2 & \sum t^3 \\ \sum t & \sum t^2 & \sum t^3 & \sum t^4 \\ \sum t^2 & \sum t^3 & \sum t^4 & \sum t^5 \\ \sum t^3 & \sum t^4 & \sum t^5 & \sum t^6 \end{vmatrix} \begin{vmatrix} a_0 \\ b_0 \\ c_0 \\ d_0 \end{vmatrix} = \begin{vmatrix} \sum p(t) \\ \sum (p(t) * t) \\ \sum (p(t) * t^2) \\ \sum (p(t) * t^3) \end{vmatrix}$$

where

$p(T)$ is today's price, $p(T-1)$ is yesterday's price and $p(1)$ is the price T days ago.

$\sum p(t)$ is the summation of prices from $t=1$ to T days

$\sum p(t) * t$ is the summation of prices times t from $t=1$ to T

$\sum t$ is the summation of the integer t from $t=1$ to T days

$\sum t^2$ is the summation of the integer squared from $t=1$ to T days etc.

Programs that solve for the solution to matrix equations can be found in the book "Numerical Recipes" by W. Press, et. al. which is currently available in book stores. The programs in this book can be translated into TradeStation's EasyLanguage™.

Once the coefficients to the cubic polynomial have been solved for we generate the forecast for the next day's close which is given by the equation

$$P_f = a_0 + b_0*(T+1) + c_0*(T+1)^2 + d_0*(T+1)^3$$

The Least Squares Cubic System Defined

The least squares forecast is constructed by solving for the least squares coefficients each day using the last T days of closing prices. Then P_f is constructed from the equation above and plotted under the price chart. In general what we will be doing is following the plotted curve of P_f . When the curve increases by a percentage amount *pctup* from the previous prior low of the curve we will go long. When the curve falls by the percentage amount *pctdn* from the previous prior high of the curve we will go short. In addition we want to be able to jump aboard fast moving *major* changes in price direction. Thus if P_f is greater than P_f two days ago by the percentage amount *%jmpup* we will go long. If P_f is less than P_f two days ago by the percentage amount *%jmpdn* we will go short.

Buy Rule:

- IF P_f has moved up by more than the percentage amount of *pctup* from the lowest low recorded in P_f while short then buy the BP futures at tomorrows open.

OR

- IF P_f is greater than P_f two days ago by the percentage amount of *%jmpup* then buy the BP futures at tomorrows open.

Sell Rule:

- IF P_f has moved down by more than the percentage amount *pctdn* from the highest high recorded in P_f while long then sell the BP futures at tomorrows open.

OR

- IF P_f is less than P_f two days ago by the percentage amount of *%jmpdn* then sell the BP futures at tomorrows open.

Walk Forward Optimization

Walk forward optimization will be used here as a result of the nature of the British Pound. The BP vs Dollar relationship in general represents the political and economic differences between the economies of Great Britain and the U.S. as they relate to the world economies. This is a constantly changing relationship. As such, conditions that prevailed 5 years ago may no longer be representative of today's relationship.

The walk forward procedure will be applied as follows. A period of 5 years from the start of the data, January 1, 1989 through December 31, 1993, is chosen and system parameter values are found through optimization on this daily data segment. The parameter values found are then applied to the out-of-sample data in the year following the test segment which in this case is year 1994. The out-of-sample results are then tabulated and saved for year 1994.

Next, the data testing window is now moved forward one year to January 1, 1990 through December 31 1994, and new optimum parameter values are found. The new optimum

parameters are applied to the out-of-sample year 1995 and the out-of-sample results are tabulated for year 1995. etc.

The moving data test window walks forward one year at a time creating optimum values for each 5 year window data segment. The optimum parameters derived from these windows are applied to the year outside the test data window. At the end, all tabulated one year out-of-sample results are merged to create one big out-of-sample results segment. The theory behind this computationally intensive method is that price dynamics available for modeling and finding parameters will change slowly over time. It is assumed that enough data is available to predict a short time into the future before things change and the model falls apart. It takes time for events and technology to change things, so it is *assumed* that using the optimum values based upon the previous five years will be adequate to use in the year forward.

Why 5 year data segments? Why not 10 years or 3 years? Well the answer is that there is no correct ratio of test data needed to produce good one year out-of-sample results. By experimenting with different window lengths, the five to one ratio seemed to work well. In walk forward testing enough data is needed to model most of the price dynamics that will be encountered in the out-of-sample segment, but not so much data that when the price dynamics start to change they are swamped by the weight of distant past data price dynamics that are no longer are valid. An important unspoken point in walk forward testing is that if you can not get good results in the out-of-sample segments, then the price dynamics cannot be modeled with the system. This means that real time performance will be random using the model. Traders observe this type of random performance (that is it looks great on paper but falls apart in real time) when trying systems based on curve fitting or anecdotal “proof” without any out-of-sample testing.

Finding The System Parameters Using Walk Forward Optimization

There are five system parameters to find T , $pctup$, $pctdn$, $\%jmpup$, and $\%jmpdn$. The best parameters will be defined as those values that give the best Net Profits with the highest percentage of wins, the minimum drawdown and minimum largest losing trades. In addition, the results should be stable, e.g. the profits, wins, and drawdowns should not change by much as the parameters move by a small amount away from their optimum values. Also in choosing the “best” parameters, I considered only those parameters sets whose maximum consecutive losses were 4 or less. Optimization is defined as the search for the parameter values that give the best results as defined above. It should be noted that in this stage of system development, the only thing indicated by the optimum values that are found is that the data has been *curve fitted* as best it can with this system. Without further testing on out-of-sample data there is no way to tell if the system will work in the future.

As explained above, the walk forward testing will be done on moving 5 year data windows. Those data windows are:

Test Data Window 1. 1/1/89 to 12/31/93

Test Data Window 2. 1/1/90 to 12/31/94

Test Data Window 3. 1/1/91 to 12/31/95

Test Data Window 4. 1/1/92 to 12/31/96

Test Data Window 5. 1/1/93 to 12/31/97

Results

Figure 1 presents a table of the 5 window data segments and their corresponding optimum parameter values. Most of the parameter values do not change much from segment to segment verifying that five years is enough data to produce parameter values that are stable over the next out of sample year and that capture most of the price dynamics.

Figures 2 through 6 present the performance summary using the derived optimum values for the six data window segments shown in Figure 1.

Figure 7 presents the performance summary of the merged out-of-sample one year data segments from 1/1/94 to 5/29/98. This performance represents what would have happened in *real time* if one followed the walk forward testing procedure. Slippage, commissions and rollover costs not included.

Figure 8 presents a comparison performance summary table for each of the 5 time segments. This table also presents the best optimized one year performance and the out-of-sample performance for that same year produced from the optimized parameters of the previous 5year time segment.

Figure 9 presents a specialized percentage trade by trade summary from 1/1/89 to 5/29/98. Note that the trades from 1/1/89 to 12/31/93 are generated from the optimized parameters from that period but the trades from 1/1/94 to 5/29/98 are from the merged out-of-sample one year data segments.

Figure 10 presents the trade by trade Risk/Reward summary for 1/1/89 to 5/1/98.

Figure 11 presents the trade by trade Risk/Reward summary for the out-of-sample segment only from 1/1/94 to 5/1/98.

Figures 12A through 12K present the charts of the daily continuous British Pound future with the Least Squares Cubic system and all the buy and sell signals from the trade by trade summary of Figure 9 indicated on the charts. Each buy trade and sell trade *percent* drawdown and *percent* gain is plotted along the bottom of the charts.

Discussion of System Performance

As can be observed from the test sample Performance summaries in Figures 2 through 6, the percent profitable trades and dollar drawdowns are nearly the same as the test windows move toward the current date. The largest drawdowns and the largest losing trades were all generated from the bad buy trade on 9/30/92 which lost -\$8988. The British Pound had an unusual 2 day jump in price from 1.5900 on Friday 9/25/98 to 1.6592 on Tuesday 9/29/98. This jump was unusual and was probably caused by some news event. However, whatever the cause, the event generated the worst trade for the total time period analyzed by the system. As soon as 1992 was

dropped out of the 5 year time window, the drawdowns dropped to the -\$5000 level and the worst trades were in the -\$2000 range. Another interesting observation from figures 2 through 6 was that the net profit dropped a high of \$65000 to a low of \$29000 as the test windows moved forward. This means that trends in the British Pound's price were larger in magnitude in the past than they are now. Hence larger profits were generated in the past than are generated currently.

Figure 6 presents the out-of-sample performance of the walk forward BP Least Squares Cubic System. The out of sample performance is good. On a one contract basis, the average winning trade is \$1529 and the average losing trade is -\$994...a more than 1.5 to one ratio. The largest losing trade is -\$2562 and the largest winning trade is \$5762. Slippage and commissions have not been taken into account. With commissions and slippage of \$100 round trip, 61 round trip trades decrease the total net profits by \$6100 or 27%. This system generates a lot of trades causing slippage and commissions to take away a large percentage of the total net profits. However on the positive side, because the number of total trades is large more confidence is gained that walk forward system performance will hold for future trades.

Examining the trade by trade summary in Figure 9 we can see that the out-of-sample trades from 1/1/94 to 5/29/98 performed similar to the curve fitted test segment trades from 1/1/89 to 12/31/93, but were smaller in magnitude. The test segment had losses in the 0% to 4% range (excluding the 8.68% loss on 10/20/92), while the OOS had losses in the 0 to 2% range. The profits of the curve fitted test segment were in the 0 to 8% range (excluding the 14.15% profit on 9/4/90) and the profits in the OOS segments were in the 0 to 5% range.

Examining the trade by trade Risk/Reward summary for the out of sample trades in Figure 10, we can see that the compounded return of the buy and sell signals beat the compounded return of buy & hold by 7% per annum. Examining the buy only compounded return we can see that most of the return came from the buy signals. As we can see from the worst loss and worst drawdown statistics all the bad trades occurred in 1992. The best closed trade % win occurred on 9/4/90 and was 14.15%. The trade had been as high as 19.628% on 8/23/90. In the out-of-sample segment Risk/Reward summary of Figure 11 the worst trade occurred on 5/8/98 and was -2.44% and the best closed trade % win occurred on 12/4/96 and was 6.04%. The trade had been as high as 9.11% on 11/21/96. The compounded buy and sell returns were smaller for the out-of-sample segment indicating less big trends when compared to the numbers in Figure 10. All these percentage figures are based on 100% margin.

From the charts in Figures 12A through 12K we can observe that 1989-1992 had very large trends and few whipsaw type markets. However 1993 through the first half of 1996 consisted mainly of whipsaw markets with only few good trends. The second half of 1996 through 1997 had some good trends with a few whipsaw markets. These observations confirm why the 5 year sliding window of net profits decreased as we moved from 1994 to today. As we can see from Figure 1, the walk forward Least Squares Cubic system adapted fairly fast to these sudden changes in price dynamics of the British Pound. From the charts we can observe that the British Pound has many sudden reversals and gaps. This type of jerking movement caused the majority of losses in the system. However, the system did quite well in staying with the trend when it was established and minimizing the losses due to the sudden reversals. Almost all the

drawdowns in the out-of-sample segment from 1994 forward were contained within 2% with the majority around the 1.5% level. On the profit side, trade run-ups of 2 to 4% were quite common.

The drawdown and gain percentages discussed above are based on 100% margin. If the margin on the futures contract was 10% a 3% of equity drawdown loss would become a 30% of equity drawdown loss.

Info on Dennis Meyers

Dennis Meyers has a doctorate in applied mathematics in engineering. He is a member of the Chicago Board Options Exchange(CBOE), a private trader, and president of Meyers Analytics. His firm specializes in consulting for financial institutions and developing publicly available analytical software for traders. He can be reached (312) 280-1687, via his Web site at <http://www.MeyersAnalytics.com> or via E-mail at meyersx@MeyersAnalytics.com.

Figure 1 Optimum Parameter Values For Each Walk Forward Data Segment

Start Date	End Date	T	Pctup	Pctdn	%jmpup	%jmpdn
1/1/89	12/31/93	44	1.0%	1.8%	0.80%	1.10%
1/1/90	12/31/94	44	0.9%	0.5%	0.80%	0.40%
1/1/91	12/31/95	40	0.5%	1.1%	0.50%	0.90%
1/1/92	12/31/96	40	0.4%	1.1%	0.20%	0.90%
1/1/93	12/31/97	40	0.4%	1.1%	0.20%	1.10%

Figure 2 Walk Forward Performance Summary for BP LSqrCubic System 01/03/89-12/30/93

LSqrCubic British Pound - CME-Daily 01/03/89 - 12/31/93

Performance Summary: All Trades

Total net profit	\$ 63675.000	Open position P/L	\$ 0.000
Gross profit	\$122712.500	Gross loss	\$-59037.500
Total # of trades	66	Percent profitable	53%
Number winning trades	35	Number losing trades	31
Largest winning trade	\$ 11950.000	Largest losing trade	\$ -8987.500
Average winning trade	\$ 3506.071	Average losing trade	\$ -1904.435
Ratio avg win/avg loss	1.841	Avg trade(win & loss)	\$ 964.773
Max consec. winners	3	Max consec. losers	4
Avg # bars in winners	23	Avg # bars in losers	13
Max intraday drawdown	\$ -9300.000		
Profit factor	2.079	Max # contracts held	1
Account size required	\$ 9300.000	Return on account	685%

Performance Summary: Long Trades

Total net profit	\$ 36900.000	Open position P/L	\$ 0.000
Gross profit	\$ 67937.500	Gross loss	\$-31037.500
Total # of trades	33	Percent profitable	61%
Number winning trades	20	Number losing trades	13
Largest winning trade	\$ 11950.000	Largest losing trade	\$ -8987.500
Average winning trade	\$ 3396.875	Average losing trade	\$ -2387.500
Ratio avg win/avg loss	1.423	Avg trade(win & loss)	\$ 1118.182
Max consec. winners	5	Max consec. losers	2
Avg # bars in winners	30	Avg # bars in losers	16
Max intraday drawdown	\$ -9950.000		
Profit factor	2.189	Max # contracts held	1
Account size required	\$ 9950.000	Return on account	371%

Performance Summary: Short Trades

Total net profit	\$ 26775.000	Open position P/L	\$ 0.000
Gross profit	\$ 54775.000	Gross loss	\$-28000.000
Total # of trades	33	Percent profitable	45%
Number winning trades	15	Number losing trades	18
Largest winning trade	\$ 10150.000	Largest losing trade	\$ -3425.000
Average winning trade	\$ 3651.667	Average losing trade	\$ -1555.556
Ratio avg win/avg loss	2.348	Avg trade(win & loss)	\$ 811.364
Max consec. winners	4	Max consec. losers	5
Avg # bars in winners	15	Avg # bars in losers	10
Max intraday drawdown	\$ -9762.500		
Profit factor	1.956	Max # contracts held	1
Account size required	\$ 9762.500	Return on account	274%

Figure 3 Walk Forward Performance Summary for BP LSqrCubic System 01/02/90-12/30/94

LSqrCubic British Pound - CME-Daily 01/02/90 - 12/30/94

Performance Summary: All Trades

Total net profit	\$ 65050.000	Open position P/L	\$ 0.000
Gross profit	\$127175.000	Gross loss	\$-62125.000
Total # of trades	83	Percent profitable	57%
Number winning trades	47	Number losing trades	36
Largest winning trade	\$ 11975.000	Largest losing trade	\$ -9162.500
Average winning trade	\$ 2705.851	Average losing trade	\$ -1725.694
Ratio avg win/avg loss	1.568	Avg trade(win & loss)	\$ 783.735
Max consec. winners	4	Max consec. losers	4
Avg # bars in winners	18	Avg # bars in losers	11
Max intraday drawdown	\$ -9687.500		
Profit factor	2.047	Max # contracts held	1
Account size required	\$ 9687.500	Return on account	671%

Performance Summary: Long Trades

Total net profit	\$ 41537.500	Open position P/L	\$ 0.000
Gross profit	\$ 68137.500	Gross loss	\$-26600.000
Total # of trades	41	Percent profitable	59%
Number winning trades	24	Number losing trades	17
Largest winning trade	\$ 6700.000	Largest losing trade	\$ -9162.500
Average winning trade	\$ 2839.063	Average losing trade	\$ -1564.706
Ratio avg win/avg loss	1.814	Avg trade(win & loss)	\$ 1013.110
Max consec. winners	4	Max consec. losers	3
Avg # bars in winners	20	Avg # bars in losers	11
Max intraday drawdown	\$-11962.500		
Profit factor	2.562	Max # contracts held	1
Account size required	\$ 11962.500	Return on account	347%

Performance Summary: Short Trades

Total net profit	\$ 23512.500	Open position P/L	\$ 0.000
Gross profit	\$ 59037.500	Gross loss	\$-35525.000
Total # of trades	42	Percent profitable	55%
Number winning trades	23	Number losing trades	19
Largest winning trade	\$ 11975.000	Largest losing trade	\$ -3962.500
Average winning trade	\$ 2566.848	Average losing trade	\$ -1869.737
Ratio avg win/avg loss	1.373	Avg trade(win & loss)	\$ 559.821
Max consec. winners	3	Max consec. losers	4
Avg # bars in winners	16	Avg # bars in losers	10
Max intraday drawdown	\$-11612.500		
Profit factor	1.662	Max # contracts held	1
Account size required	\$ 11612.500	Return on account	202%

Figure 4 Walk Forward Performance Summary for BP LSqrCubic System 01/02/91-12/31/95

LSqrCubic British Pound - CME-Daily 01/02/91 - 12/29/95

Performance Summary: All Trades

Total net profit	\$ 45550.000	Open position P/L	\$ 0.000
Gross profit	\$ 97325.000	Gross loss	\$-51775.000
Total # of trades	74	Percent profitable	50%
Number winning trades	37	Number losing trades	37
Largest winning trade	\$ 11612.500	Largest losing trade	\$ -8575.000
Average winning trade	\$ 2630.405	Average losing trade	\$ -1399.324
Ratio avg win/avg loss	1.880	Avg trade(win & loss)	\$ 615.541
Max consec. winners	3	Max consec. losers	4
Avg # bars in winners	20	Avg # bars in losers	12
Max intraday drawdown	\$ -9100.000		
Profit factor	1.880	Max # contracts held	1
Account size required	\$ 9100.000	Return on account	501%

Performance Summary: Long Trades

Total net profit	\$ 22362.500	Open position P/L	\$ 0.000
Gross profit	\$ 49825.000	Gross loss	\$-27462.500
Total # of trades	37	Percent profitable	54%
Number winning trades	20	Number losing trades	17
Largest winning trade	\$ 5062.500	Largest losing trade	\$ -8575.000
Average winning trade	\$ 2491.250	Average losing trade	\$ -1615.441
Ratio avg win/avg loss	1.542	Avg trade(win & loss)	\$ 604.392
Max consec. winners	4	Max consec. losers	3
Avg # bars in winners	26	Avg # bars in losers	18
Max intraday drawdown	\$ -9987.500		
Profit factor	1.814	Max # contracts held	1
Account size required	\$ 9987.500	Return on account	224%

Performance Summary: Short Trades

Total net profit	\$ 23187.500	Open position P/L	\$ 0.000
Gross profit	\$ 47500.000	Gross loss	\$-24312.500
Total # of trades	37	Percent profitable	46%
Number winning trades	17	Number losing trades	20
Largest winning trade	\$ 11612.500	Largest losing trade	\$ -3725.000
Average winning trade	\$ 2794.118	Average losing trade	\$ -1215.625
Ratio avg win/avg loss	2.299	Avg trade(win & loss)	\$ 626.689
Max consec. winners	4	Max consec. losers	4
Avg # bars in winners	14	Avg # bars in losers	8
Max intraday drawdown	\$ -7562.500		
Profit factor	1.954	Max # contracts held	1
Account size required	\$ 7562.500	Return on account	307%

Figure 5 Walk Forward Performance Summary for BP LSqrCubic System 01/02/92-12/31/96

LSqrCubic British Pound - CME-Daily 01/02/92 - 12/31/96

Performance Summary: All Trades

Total net profit	\$ 37475.000	Open position P/L	\$ 0.000
Gross profit	\$ 78975.000	Gross loss	\$-41500.000
Total # of trades	69	Percent profitable	54%
Number winning trades	37	Number losing trades	32
Largest winning trade	\$ 11612.500	Largest losing trade	\$ -8575.000
Average winning trade	\$ 2134.459	Average losing trade	\$ -1296.875
Ratio avg win/avg loss	1.646	Avg trade(win & loss)	\$ 543.116
Max consec. winners	4	Max consec. losers	3
Avg # bars in winners	22	Avg # bars in losers	13
Max intraday drawdown	\$ -9100.000		
Profit factor	1.903	Max # contracts held	1
Account size required	\$ 9100.000	Return on account	412%

Performance Summary: Long Trades

Total net profit	\$ 23412.500	Open position P/L	\$ 0.000
Gross profit	\$ 46062.500	Gross loss	\$-22650.000
Total # of trades	35	Percent profitable	57%
Number winning trades	20	Number losing trades	15
Largest winning trade	\$ 5800.000	Largest losing trade	\$ -8575.000
Average winning trade	\$ 2303.125	Average losing trade	\$ -1510.000
Ratio avg win/avg loss	1.525	Avg trade(win & loss)	\$ 668.929
Max consec. winners	4	Max consec. losers	2
Avg # bars in winners	30	Avg # bars in losers	19
Max intraday drawdown	\$-10362.500		
Profit factor	2.034	Max # contracts held	1
Account size required	\$ 10362.500	Return on account	226%

Performance Summary: Short Trades

Total net profit	\$ 14062.500	Open position P/L	\$ 0.000
Gross profit	\$ 32912.500	Gross loss	\$-18850.000
Total # of trades	34	Percent profitable	50%
Number winning trades	17	Number losing trades	17
Largest winning trade	\$ 11612.500	Largest losing trade	\$ -3725.000
Average winning trade	\$ 1936.029	Average losing trade	\$ -1108.824
Ratio avg win/avg loss	1.746	Avg trade(win & loss)	\$ 413.603
Max consec. winners	4	Max consec. losers	3
Avg # bars in winners	11	Avg # bars in losers	7
Max intraday drawdown	\$ -6137.500		
Profit factor	1.746	Max # contracts held	1
Account size required	\$ 6137.500	Return on account	229%

Figure 6 Walk Forward Performance Summary for BP LSqrCubic System 01/02/93-12/31/97

LSqrCubic British Pound - CME-Daily 01/04/93 - 12/31/97

Performance Summary: All Trades

Total net profit	\$ 29262.500	Open position P/L	\$ 0.000
Gross profit	\$ 57450.000	Gross loss	\$-28187.500
Total # of trades	67	Percent profitable	52%
Number winning trades	35	Number losing trades	32
Largest winning trade	\$ 5800.000	Largest losing trade	\$ -2087.500
Average winning trade	\$ 1641.429	Average losing trade	\$ -880.859
Ratio avg win/avg loss	1.863	Avg trade(win & loss)	\$ 436.754
Max consec. winners	3	Max consec. losers	3
Avg # bars in winners	22	Avg # bars in losers	14
Max intraday drawdown	\$ -5062.500		
Profit factor	2.038	Max # contracts held	1
Account size required	\$ 5062.500	Return on account	578%

Performance Summary: Long Trades

Total net profit	\$ 22000.000	Open position P/L	\$ 0.000
Gross profit	\$ 37087.500	Gross loss	\$-15087.500
Total # of trades	34	Percent profitable	56%
Number winning trades	19	Number losing trades	15
Largest winning trade	\$ 5800.000	Largest losing trade	\$ -2087.500
Average winning trade	\$ 1951.974	Average losing trade	\$ -1005.833
Ratio avg win/avg loss	1.941	Avg trade(win & loss)	\$ 647.059
Max consec. winners	3	Max consec. losers	2
Avg # bars in winners	30	Avg # bars in losers	19
Max intraday drawdown	\$ -4300.000		
Profit factor	2.458	Max # contracts held	1
Account size required	\$ 4300.000	Return on account	512%

Performance Summary: Short Trades

Total net profit	\$ 7262.500	Open position P/L	\$ 0.000
Gross profit	\$ 20362.500	Gross loss	\$-13100.000
Total # of trades	33	Percent profitable	48%
Number winning trades	16	Number losing trades	17
Largest winning trade	\$ 4112.500	Largest losing trade	\$ -1787.500
Average winning trade	\$ 1272.656	Average losing trade	\$ -770.588
Ratio avg win/avg loss	1.652	Avg trade(win & loss)	\$ 220.076
Max consec. winners	4	Max consec. losers	3
Avg # bars in winners	12	Avg # bars in losers	9
Max intraday drawdown	\$ -4150.000		
Profit factor	1.554	Max # contracts held	1
Account size required	\$ 4150.000	Return on account	175%

Figure 7 Walk Forward Performance Summary for BP LSqrCubic System

Out Of Sample Performance LSqrCubic WF British Pound Daily 1/1/94 - 05/29/98

LSqrCubic WF British Pound - CME-Daily 1/1/94 - 05/29/98

Performance Summary: All Trades

Total net profit	\$ 22637.500	Open position P/L	\$ 0.000
Gross profit	\$ 50462.500	Gross loss	\$-27825.000
Total # of trades	61	Percent profitable	54%
Number winning trades	33	Number losing trades	28
Largest winning trade	\$ 5762.500	Largest losing trade	\$ -2562.500
Average winning trade	\$ 1529.167	Average losing trade	\$ -993.750
Ratio avg win/avg loss	1.539	Avg trade(win & loss)	\$ 371.107
Max consec. winners	5	Max consec. losers	4
Avg # bars in winners	21	Avg # bars in losers	15
Max intraday drawdown	\$ -5850.000		
Profit factor	1.814	Max # contracts held	1
Account size required	\$ 5850.000	Return on account	387%

Performance Summary: Long Trades

Total net profit	\$ 17900.000	Open position P/L	\$ 0.000
Gross profit	\$ 31662.500	Gross loss	\$-13762.500
Total # of trades	31	Percent profitable	61%
Number winning trades	19	Number losing trades	12
Largest winning trade	\$ 5762.500	Largest losing trade	\$ -2562.500
Average winning trade	\$ 1666.447	Average losing trade	\$ -1146.875
Ratio avg win/avg loss	1.453	Avg trade(win & loss)	\$ 577.419
Max consec. winners	3	Max consec. losers	2
Avg # bars in winners	26	Avg # bars in losers	18
Max intraday drawdown	\$ -3625.000		
Profit factor	2.301	Max # contracts held	1
Account size required	\$ 3625.000	Return on account	494%

Performance Summary: Short Trades

Total net profit	\$ 4737.500	Open position P/L	\$ 0.000
Gross profit	\$ 18800.000	Gross loss	\$-14062.500
Total # of trades	30	Percent profitable	47%
Number winning trades	14	Number losing trades	16
Largest winning trade	\$ 4112.500	Largest losing trade	\$ -1787.500
Average winning trade	\$ 1342.857	Average losing trade	\$ -878.906
Ratio avg win/avg loss	1.528	Avg trade(win & loss)	\$ 157.917
Max consec. winners	4	Max consec. losers	4
Avg # bars in winners	15	Avg # bars in losers	13
Max intraday drawdown	\$ -3700.000		
Profit factor	1.337	Max # contracts held	1
Account size required	\$ 3700.000	Return on account	128%

Figure 8 Walk Forward Performance Summary for Least Squares BP System 01/04/88-12/31/97

		T	pctup	pctdn	%jmpup	%jmpdn	TNPft	%P	MaxDD	LBgLTd	SBgLTd	1YrOpt	1YrOOS
1/1/89	12/31/93	44	1.0%	1.8%	0.8%	1.1%	\$63675	52%	-\$9300	-8987	-3425		
1/1/90	12/31/94	44	0.9%	0.5%	0.8%	0.4%	\$65050	55%	-\$9688	-9162	-3962	\$4925	\$3800
1/1/91	12/31/95	40	0.5%	1.1%	0.5%	0.9%	\$45550	50%	-\$9100	-8575	-3725	\$3913	\$3388
1/1/92	12/31/96	40	0.4%	1.1%	0.2%	0.9%	\$37475	54%	-\$9100	-8575	-3725	\$9925	\$8500
1/1/93	12/31/97	40	0.4%	1.1%	0.2%	1.1%	\$29263	51%	-\$5063	-2087	-1787	\$12163	\$12163

Where:

- *TNPft* = Total Net Profit for the 4 year optimized test segment.
- *%P* = Percent Profitable for the optimized test segment.
- *MaxDD* = Max Intraday Drawdown in the optimized test segment.
- *LBgLTd* = Long Largest Losing Trade in the optimized test segment.
- *SBgLTd* = Short Largest Losing Trade in the optimized test segment.
- *1YrOpt* = The one year dollar profit for the curve fitted time segment generated from the optimum parameters derived for that time segment. That is this is the curve fitted profit of the last year of the 4 year time segment.
- *1YrOOS* = The walk forward **one year** dollar profit or loss generated from the optimum parameters derived from the *previous* time segment. This is the out-of-sample profit for that year.

Figure9 Trade by Trade Summary For BP LSqrCubic System 01/01/89 - 05/21/98

Date:Day	Price		DaysIn Trade	Exit \$P&L	Exit %P&L	PrevSig Max%Pft	Date	PrevSig Max%DD	Date
890320:1	125.50	Sell	0	0.00	0.00%	0.00%	0	0.00%	0
890406:4	124.34	Buy	17	725.00	0.92%	2.28%	890328	-1.00%	890321
890502:2	122.76	Sell	26	-987.50	-1.27%	1.48%	890420	-1.50%	890501
890605:1	113.66	Buy	34	5687.50	7.41%	9.37%	890523	-0.02%	890502
890613:2	106.88	Sell	8	-4237.50	-5.97%	1.78%	890605	-5.97%	890613
890622:4	110.98	Buy	9	-2562.50	-3.84%	0.60%	890614	-3.84%	890622
890807:1	116.48	Sell	46	3437.50	4.96%	10.27%	890731	-1.08%	890629
890825:5	113.52	Buy	18	1850.00	2.54%	3.49%	890817	-1.87%	890809
890906:3	111.52	Sell	12	-1250.00	-1.76%	1.41%	890829	-2.71%	890905
890914:4	113.10	Buy	8	-987.50	-1.42%	0.66%	890908	-1.42%	890914
891010:2	113.86	Sell	26	475.00	0.67%	5.39%	890926	0.00%	890914
891020:5	116.34	Buy	10	-1550.00	-2.18%	1.79%	891011	-2.65%	891019
891121:2	114.92	Sell	32	-887.50	-1.22%	2.20%	891025	-2.15%	891120
891206:3	116.02	Buy	15	-687.50	-0.96%	0.63%	891127	-0.96%	891206
900302:5	127.22	Sell	86	7000.00	9.65%	13.64%	900221	-0.17%	891206
900321:3	120.46	Buy	19	4225.00	5.31%	5.31%	900321	-1.19%	900302
900423:1	125.90	Sell	33	3400.00	4.52%	5.31%	900419	-0.27%	900321
900507:1	129.20	Buy	14	-2062.50	-2.62%	0.11%	900426	-2.67%	900504
900605:2	131.22	Sell	29	1262.50	1.56%	2.88%	900530	-0.26%	900507
900614:4	135.16	Buy	9	-2462.50	-3.00%	0.69%	900605	-3.00%	900614
900904:2	154.28	Sell	82	11950.00	14.15%	19.62%	900823	-0.22%	900615
900918:2	157.98	Buy	14	-2312.50	-2.40%	1.83%	900910	-2.41%	900917
901023:2	162.88	Sell	35	3062.51	3.10%	4.89%	901011	-4.29%	900921
901108:4	164.48	Buy	16	-999.99	-0.98%	0.05%	901031	-1.87%	901105
901203:1	162.02	Sell	25	-1537.49	-1.50%	1.47%	901127	-1.50%	901203
910102:3	163.80	Buy	30	-1112.50	-1.10%	3.43%	901224	-1.68%	901207
910220:3	166.52	Sell	49	1700.00	1.66%	4.52%	910206	-2.47%	910108
910403:3	150.28	Buy	42	10150.00	9.75%	12.07%	910327	-0.44%	910221
910422:1	143.72	Sell	19	-4100.00	-4.37%	1.50%	910415	-4.37%	910422
910509:4	144.76	Buy	17	-650.00	-0.72%	0.82%	910426	-2.06%	910430
910531:5	145.60	Sell	22	525.01	0.58%	3.19%	910515	-0.69%	910509
910621:5	138.08	Buy	21	4700.00	5.16%	6.68%	910618	-0.99%	910531
910816:5	143.14	Sell	56	3162.50	3.66%	6.79%	910806	-1.94%	910702
910823:5	145.46	Buy	7	-1450.00	-1.62%	3.12%	910819	-1.68%	910822
911007:1	150.68	Sell	45	3262.49	3.59%	4.58%	911003	-0.78%	910827
911028:1	147.72	Buy	21	1849.99	1.96%	2.31%	911015	-0.20%	911007
911127:3	155.54	Sell	30	4887.50	5.29%	7.12%	911119	0.00%	911028
911209:1	159.06	Buy	12	-2200.00	-2.26%	0.33%	911129	-2.93%	911206
920110:5	161.28	Sell	32	1387.50	1.40%	5.21%	911226	-0.30%	911209
920127:1	158.40	Buy	17	1800.00	1.79%	4.35%	920115	-2.00%	920110
920218:2	155.56	Sell	22	-1775.00	-1.79%	3.65%	920207	-1.79%	920218
920312:4	152.94	Buy	23	1637.50	1.68%	1.85%	920305	-0.98%	920227
920529:5	165.64	Sell	78	7937.50	8.30%	9.05%	920519	-0.61%	920313
920615:1	169.36	Buy	17	-2325.00	-2.25%	0.31%	920529	-2.25%	920615
920722:3	175.26	Sell	37	3687.50	3.48%	6.02%	920717	-0.02%	920615
920810:1	177.80	Buy	19	-1587.51	-1.45%	0.66%	920724	-1.72%	920807
920911:5	180.48	Sell	32	1675.00	1.51%	5.02%	920908	-0.29%	920810
920930:3	165.66	Buy	19	9262.50	8.21%	12.70%	920922	-1.10%	920911
921020:2	151.28	Sell	20	-8987.50	-8.68%	0.16%	920930	-8.68%	921020
921112:4	141.58	Buy	23	6062.50	6.41%	7.15%	921109	-0.04%	921022
921214:1	146.40	Sell	32	3012.50	3.40%	5.81%	921208	-0.83%	921120
930106:3	144.56	Buy	23	1150.00	1.26%	4.95%	921228	-0.85%	921217
930129:5	140.40	Sell	23	-2600.00	-2.88%	0.97%	930125	-2.88%	930129
930218:4	133.50	Buy	20	4312.50	4.91%	5.71%	930212	-0.85%	930129
930315:1	134.38	Sell	25	550.00	0.66%	2.49%	930222	-1.53%	930218

930322:1	139.86	Buy	7	-3425.00	-4.08%	0.31%	930315	-4.58%	930319
930512:3	145.66	Sell	51	3625.00	4.15%	7.41%	930426	-0.86%	930325
930524:1	145.00	Buy	12	412.50	0.45%	1.17%	930513	-1.46%	930520
930614:1	144.86	Sell	21	-87.50	-0.10%	2.19%	930528	-1.54%	930604
930630:3	143.34	Buy	16	950.00	1.05%	3.88%	930624	-0.03%	930614
930730:5	140.72	Sell	30	-1637.50	-1.83%	1.30%	930630	-2.19%	930712
930818:3	141.98	Buy	19	-787.50	-0.90%	1.17%	930813	-1.75%	930802
930922:3	145.08	Sell	35	1937.50	2.18%	4.54%	930910	-1.86%	930818
931007:4	146.10	Buy	15	-637.50	-0.70%	1.42%	930930	-0.70%	931007
931020:3	142.46	Sell	13	-2275.00	-2.49%	0.77%	931008	-2.63%	931018
931116:2	142.78	Buy	27	-200.00	-0.22%	1.24%	931109	-0.55%	931112

WALK-FORWARD OUT-OF-SAMPLE TRADES BELOW

940209:3	140.48	Sell	85	-1437.50	-1.61%	1.91%	940127	-1.61%	940209
940225:5	143.28	Buy	16	-1750.00	-1.99%	0.11%	940209	-2.02%	940214
940330:3	142.52	Sell	33	-475.00	-0.53%	1.34%	940310	-0.53%	940330
940419:2	142.76	Buy	20	-149.99	-0.17%	0.88%	940405	-0.73%	940331
940512:4	145.00	Sell	23	1400.00	1.57%	3.04%	940429	-0.25%	940419
940603:5	145.90	Buy	22	-562.50	-0.62%	0.17%	940512	-1.35%	940601
940722:5	148.06	Sell	49	1350.00	1.48%	4.65%	940711	0.00%	940603
940805:5	149.08	Buy	14	-637.50	-0.69%	0.14%	940726	-1.07%	940803
941108:2	157.14	Sell	95	5037.50	5.41%	6.95%	941025	-0.38%	940805
941202:5	152.22	Buy	24	3075.00	3.13%	3.39%	941128	0.00%	941108
941227:2	150.14	Sell	25	-1300.00	-1.37%	0.29%	941202	-1.54%	941221
950116:1	152.62	Buy	20	-1550.00	-1.65%	0.07%	941227	-2.05%	941228
950202:4	154.12	Sell	17	937.50	0.98%	1.80%	950124	-0.18%	950117
950221:2	153.52	Buy	19	374.99	0.39%	2.08%	950208	-0.18%	950202
950313:1	153.88	Sell	20	225.00	0.23%	4.31%	950307	-0.74%	950310
950330:4	155.12	Buy	17	-774.99	-0.81%	0.64%	950313	-2.18%	950328
950413:4	155.70	Sell	14	362.50	0.37%	1.81%	950331	-0.48%	950330
950526:5	156.66	Buy	43	-600.00	-0.62%	2.47%	950511	-1.49%	950417
950623:5	155.46	Sell	28	-750.00	-0.77%	0.29%	950614	-1.25%	950602
950713:4	155.12	Buy	20	212.51	0.22%	1.26%	950628	-0.28%	950706
950811:5	154.26	Sell	29	-537.50	-0.55%	0.98%	950801	-0.55%	950811
950901:5	151.22	Buy	21	1900.00	1.97%	3.12%	950822	-0.69%	950811
951011:3	153.74	Sell	40	1575.00	1.67%	3.09%	950921	-0.36%	950901
951107:2	154.08	Buy	27	-212.50	-0.22%	0.43%	951018	-0.60%	951026
951114:2	152.10	Sell	7	-1237.50	-1.29%	0.19%	951109	-1.74%	951113
951215:5	150.46	Buy	31	1025.00	1.08%	1.76%	951201	-0.36%	951122
960111:4	150.84	Sell	27	237.49	0.25%	1.34%	951226	-0.23%	951220
960202:5	148.54	Buy	22	1437.50	1.52%	2.64%	960126	-0.19%	960112
960228:3	150.42	Sell	26	1175.00	1.27%	1.95%	960216	-0.27%	960202
960318:1	149.62	Buy	19	500.00	0.53%	0.98%	960308	-0.27%	960228
960411:4	148.20	Sell	24	-887.50	-0.95%	0.72%	960320	-0.95%	960411
960424:3	148.18	Buy	13	12.50	0.01%	0.40%	960415	-0.34%	960418
960614:5	150.72	Sell	51	1587.51	1.71%	2.79%	960603	-1.48%	960501
960702:2	152.52	Buy	18	-1125.00	-1.19%	0.15%	960621	-1.37%	960701
960806:2	150.98	Sell	35	-962.51	-1.01%	0.47%	960703	-1.01%	960806
960815:4	152.06	Buy	9	-675.00	-0.72%	0.00%	960806	-0.72%	960812
961204:3	161.24	Sell	111	5737.50	6.04%	9.11%	961121	-0.38%	960819
961216:1	162.98	Buy	12	-1087.49	-1.08%	0.61%	961205	-1.08%	961216
970113:1	164.28	Sell	28	812.50	0.80%	3.47%	961231	-0.38%	961216
970205:3	160.16	Buy	23	2575.00	2.51%	4.32%	970131	-0.73%	970115
970305:3	158.38	Sell	28	-1112.50	-1.11%	0.82%	970210	-1.37%	970218
970320:4	157.12	Buy	15	787.51	0.80%	1.36%	970317	-0.34%	970306
970411:5	159.98	Sell	22	1787.50	1.82%	3.69%	970401	0.00%	970320
970430:3	160.40	Buy	19	-262.50	-0.26%	0.23%	970411	-0.68%	970422
970528:3	161.10	Sell	28	437.51	0.44%	1.77%	970520	-0.61%	970507
970618:3	161.46	Buy	21	-225.00	-0.22%	0.27%	970528	-0.37%	970530

970718:5	164.94	Sell	30	2175.00	2.16%	3.36%	970711	-0.02%	970618
970818:1	158.36	Buy	31	4112.50	3.99%	5.70%	970812	-0.39%	970722
970904:4	155.96	Sell	17	-1500.00	-1.52%	1.00%	970829	-1.52%	970904
970919:5	158.82	Buy	15	-1787.50	-1.83%	0.17%	970904	-1.94%	970918
971120:4	168.04	Sell	62	5762.49	5.81%	6.36%	971112	-0.24%	970922
971218:4	164.28	Buy	28	2350.00	2.24%	3.74%	971215	-0.44%	971120
980106:2	161.86	Sell	19	-1512.50	-1.47%	1.36%	971226	-1.47%	980105
980120:2	161.84	Buy	14	12.50	0.01%	1.17%	980109	-0.37%	980106
980211:3	161.84	Sell	22	0.00	0.00%	2.66%	980123	-0.26%	980210
980225:3	163.84	Buy	14	-1250.00	-1.24%	0.30%	980211	-1.52%	980224
980406:1	165.50	Sell	40	1037.50	1.01%	2.60%	980326	-0.95%	980305
980415:3	167.76	Buy	9	-1412.50	-1.37%	0.33%	980406	-1.50%	980414
980508:5	163.66	Sell	23	-2562.49	-2.44%	0.52%	980416	-2.44%	980508
980522:5	162.98	Buy	14	425.00	0.42%	1.01%	980518	-0.17%	980508
980529:5	163.02	Exit	7	25.01	0.02%	0.29%	980526	-0.26%	980528

Figure 10 BP LSqrCubic System Walk Forward Risk/Reward Summary 01/1/89 - 05/29/98

TotalDays=3357(9.19yrs) LongPosDays=2177(64.8%) SellPosDays=1180(35.2%)
Buy & Hold w/0.0%Div CompndROR= 2.89%/Yr
Buy & Sell Signals CompndROR= 9.92%/Yr
Buy w/0.0%Div & CashOnSells w/0.0%Int CompndROR= 6.63%/Yr

-----ALL TRADES-----

TotalTrades=126 # Wins= 67(53.2%) AvDysLng= 35 AvDysSht= 19
Ave P&L= 0.74% AvWin= 2.82% AvLoss= -1.65%
M T W TH F
Buys 13 7 14 15 14
Sells 12 14 15 7 15

-----LONG TRADES-----

of Trades= 63 # Wins= 38(60.3%) AvDysLng= 35
Ave P&L= 1.00% AvWin= 2.93% AvLoss= -1.94%
BestWin= 14.15% 900904 WorstLoss= -8.68% 921020
BestMax%Pft= 19.62% 900823 WorstDD= -8.68% 921020

-----SHORT TRADES-----

of Trades= 63 # Wins= 29(46.0%) AvDysSht= 19
Ave P&L= 0.48% AvWin= 2.68% AvLoss= -1.39%
BestWin= 9.75% 910403 WorstLoss= -4.08% 930322
BestMax%Pft= 12.70% 920922 WorstDD= -4.58% 930319

Figure 11 BP LSqrCubic System Walk Forward Risk/Reward Summary 10/16/93 - 05/29/98

- Note: the system needs 50 days of past data to begin calculations thus the first buy signal using the 10/16/93 start date was given on 12/31/93.

TotalDays=1610(4.41yrs) LongPosDays=1020(63.4%) SellPosDays= 590(36.6%)
Buy & Hold w/0.0%Div CompndROR= 3.19%/Yr
Buy & Sell Signals CompndROR= 5.15%/Yr
Buy w/0.0%Div & CashOnSells w/0.0%Int CompndROR= 4.24%/Yr

-----ALL TRADES-----
TotalTrades= 61 # Wins= 32(52.5%) AvDysLng= 33 AvDysSht= 19
Ave P&L= 0.38% AvWin= 1.62% AvLoss= -1.03%
M T W TH F
Buys 4 5 6 5 11
Sells 3 5 8 7 7

-----LONG TRADES-----
of Trades= 31 # Wins= 18(58.1%) AvDysLng= 33
Ave P&L= 0.61% AvWin= 1.84% AvLoss= -1.08%
BestWin= 6.04% 961204 WorstLoss= -2.44% 980508
BestMax%Pft= 9.11% 961121 WorstDD= -2.44% 980508

-----SHORT TRADES-----
of Trades= 30 # Wins= 14(46.7%) AvDysSht= 19
Ave P&L= 0.14% AvWin= 1.34% AvLoss= -0.92%
BestWin= 3.99% 970818 WorstLoss= -1.99% 940225
BestMax%Pft= 5.70% 970812 WorstDD= -2.18% 950328

Figure12a BP Daily 10/16/93 - 05/29/98 LSqrCubic System

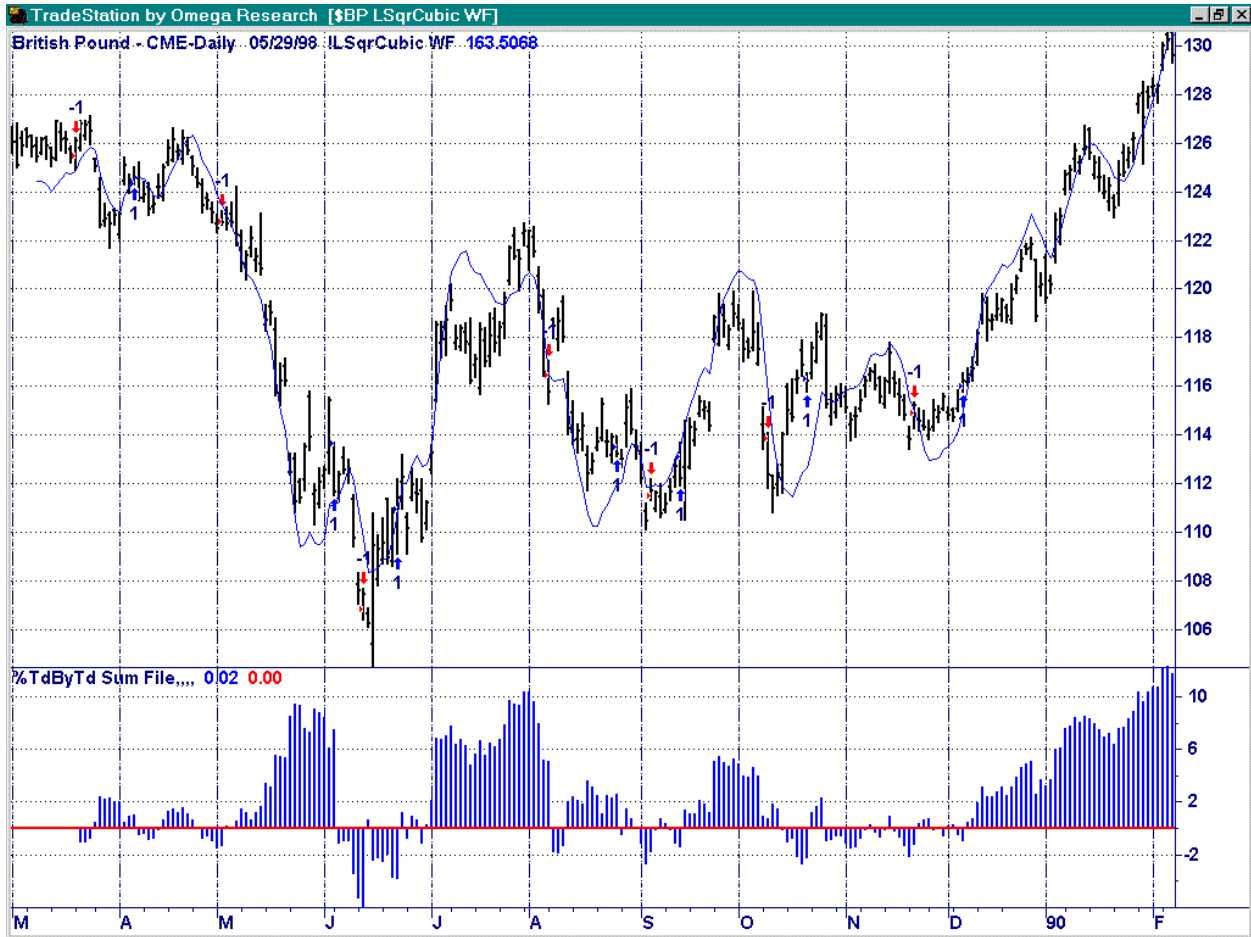


Figure12b BP Daily 10/16/93 - 05/29/98 LSqrCubic System

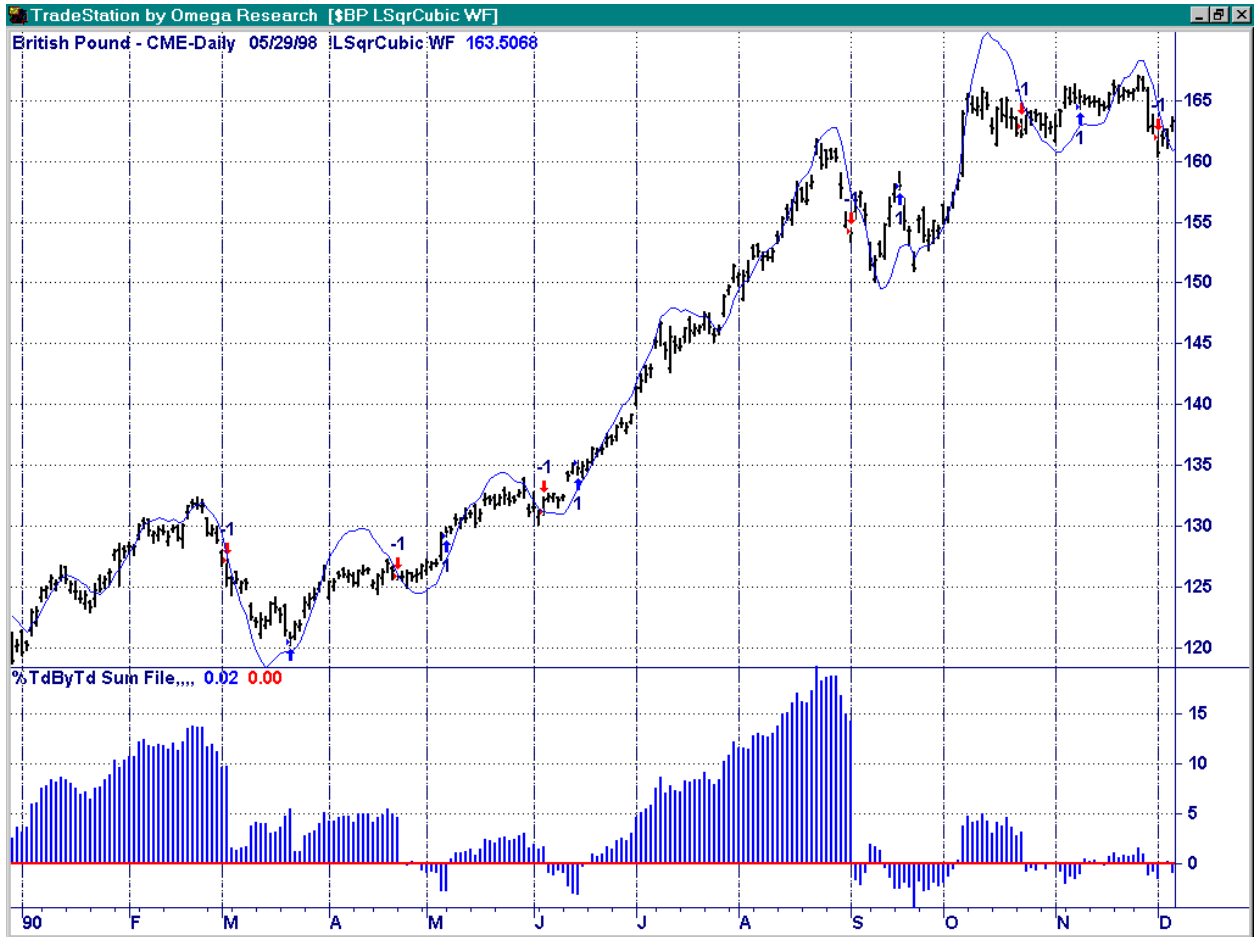


Figure12c BP Daily 10/16/93 - 05/29/98 LSqrCubic System

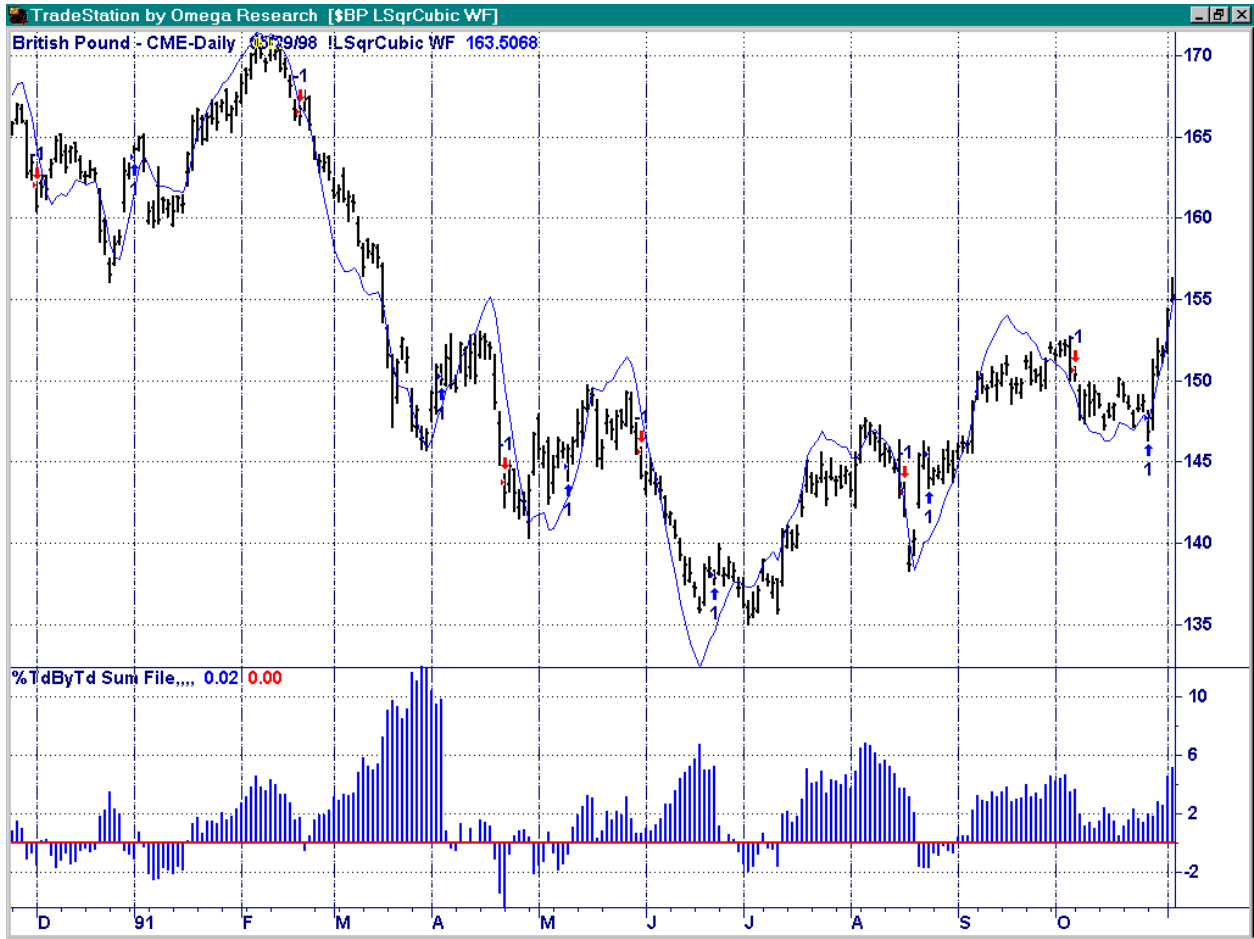


Figure12d BP Daily 10/16/93 - 05/29/98 LSqrCubic System

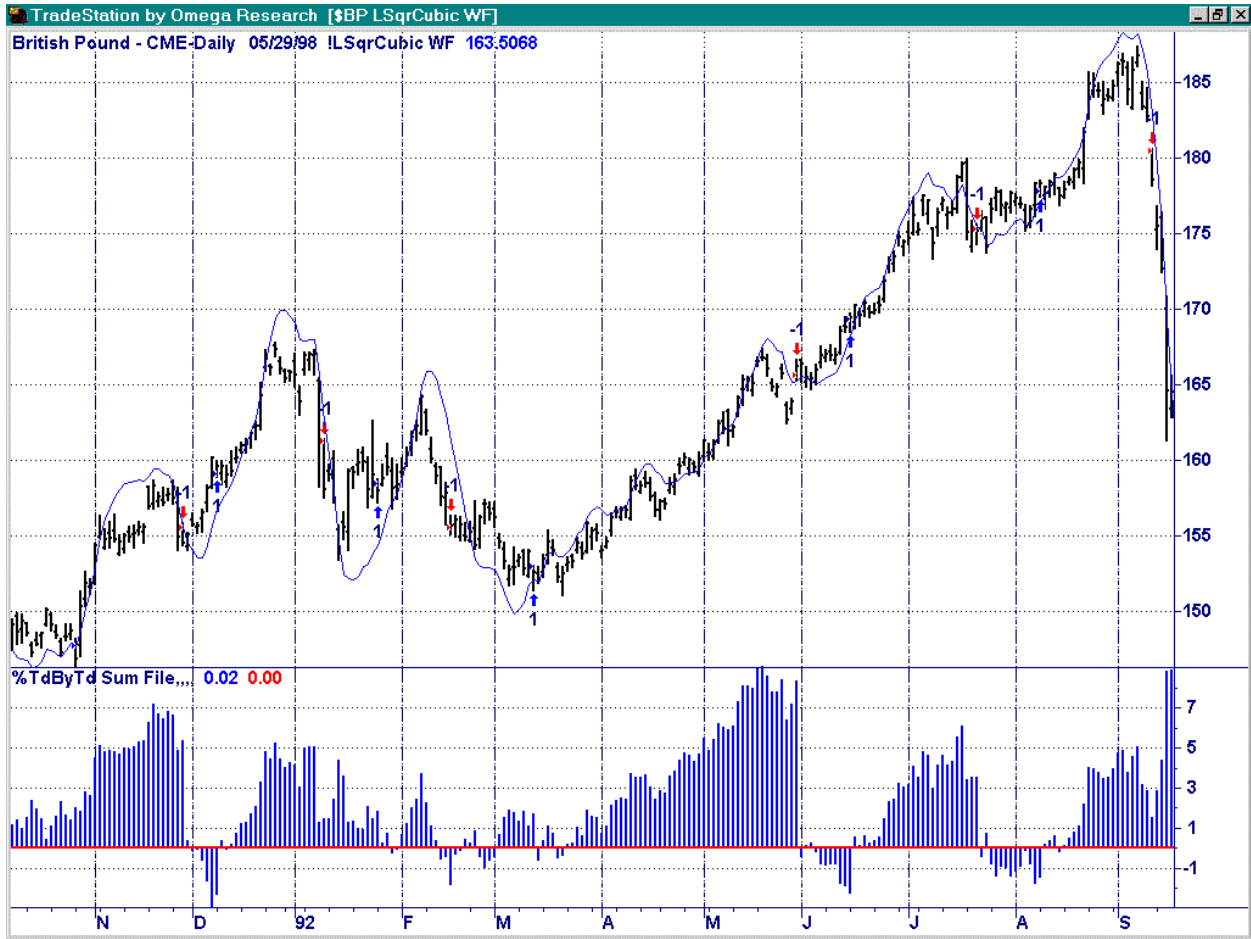


Figure12e BP Daily 10/16/93 - 05/29/98 LSqrCubic System

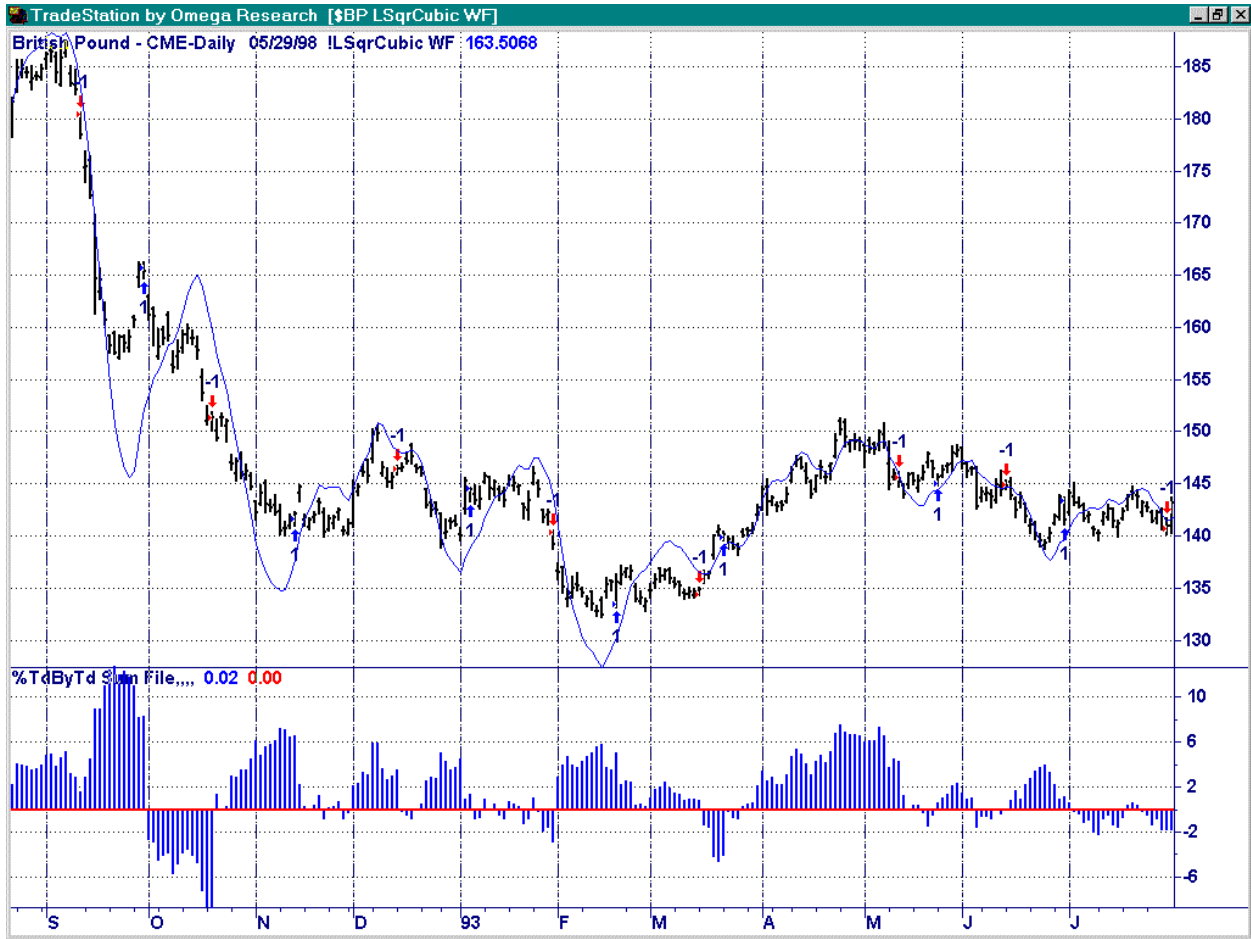


Figure12f BP Daily 10/16/93 - 05/29/98 LSqrCubic System

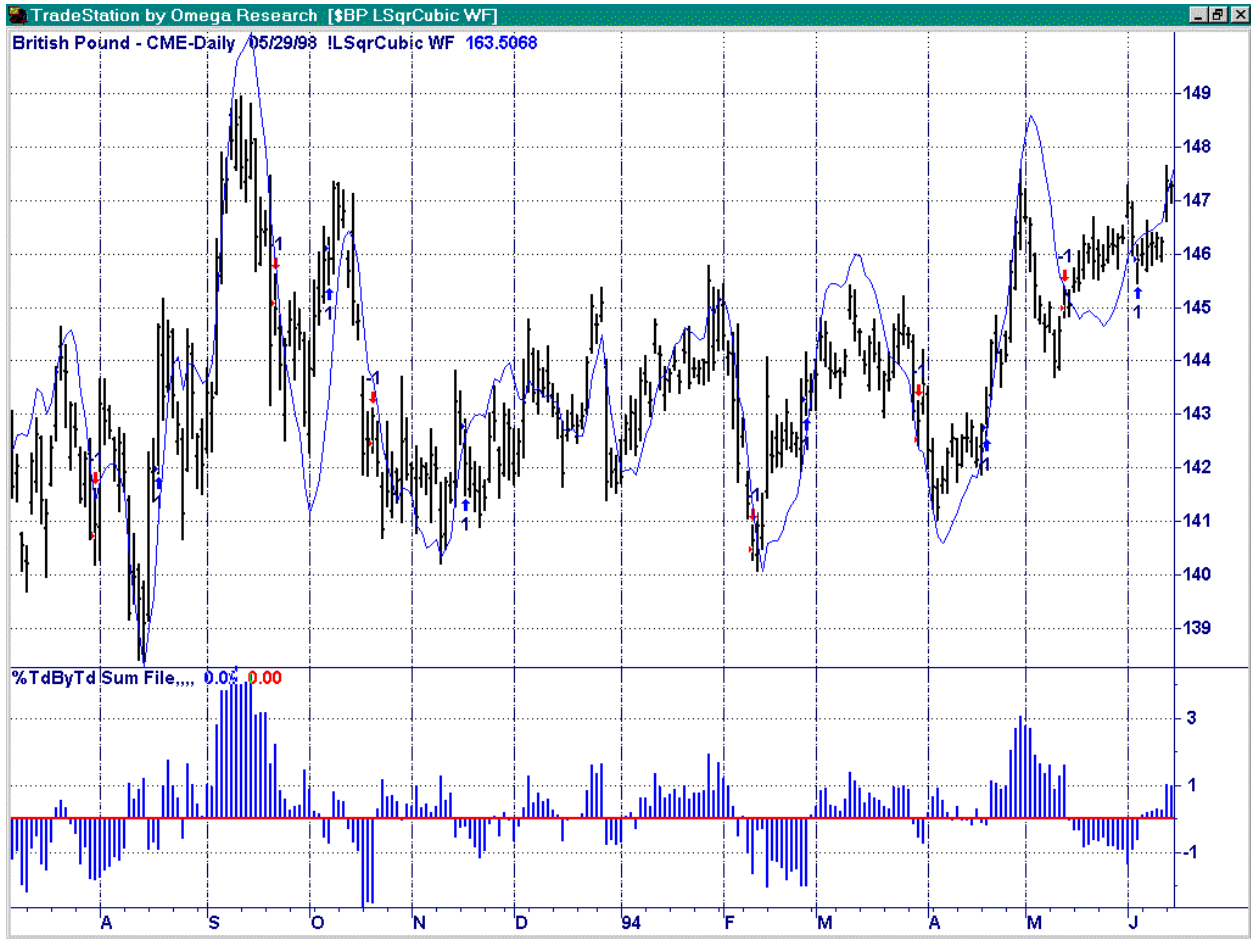


Figure12g BP Daily 10/16/93 - 05/29/98 LSqrCubic System

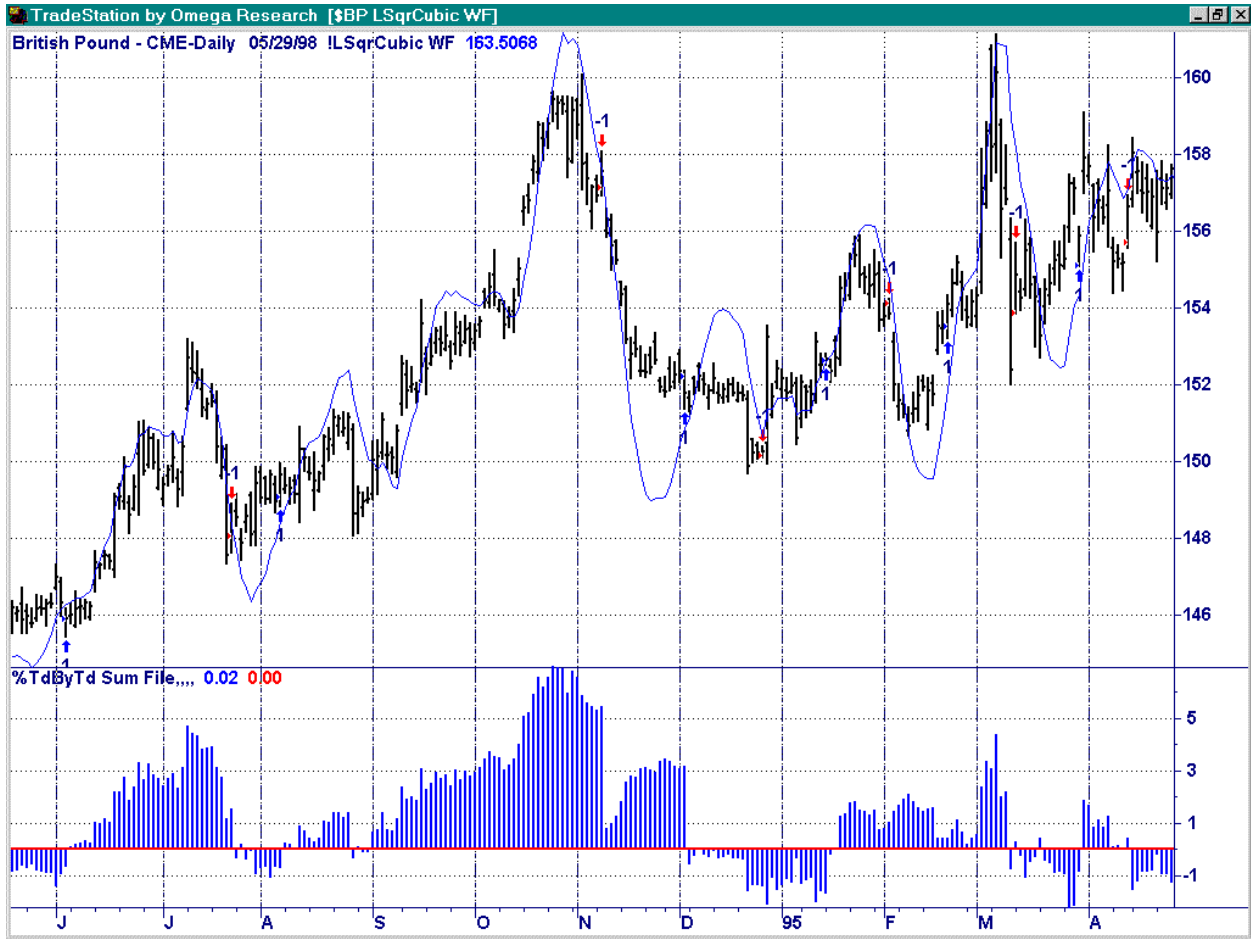


Figure12h BP Daily 10/16/93 - 05/29/98 LSqrCubic System

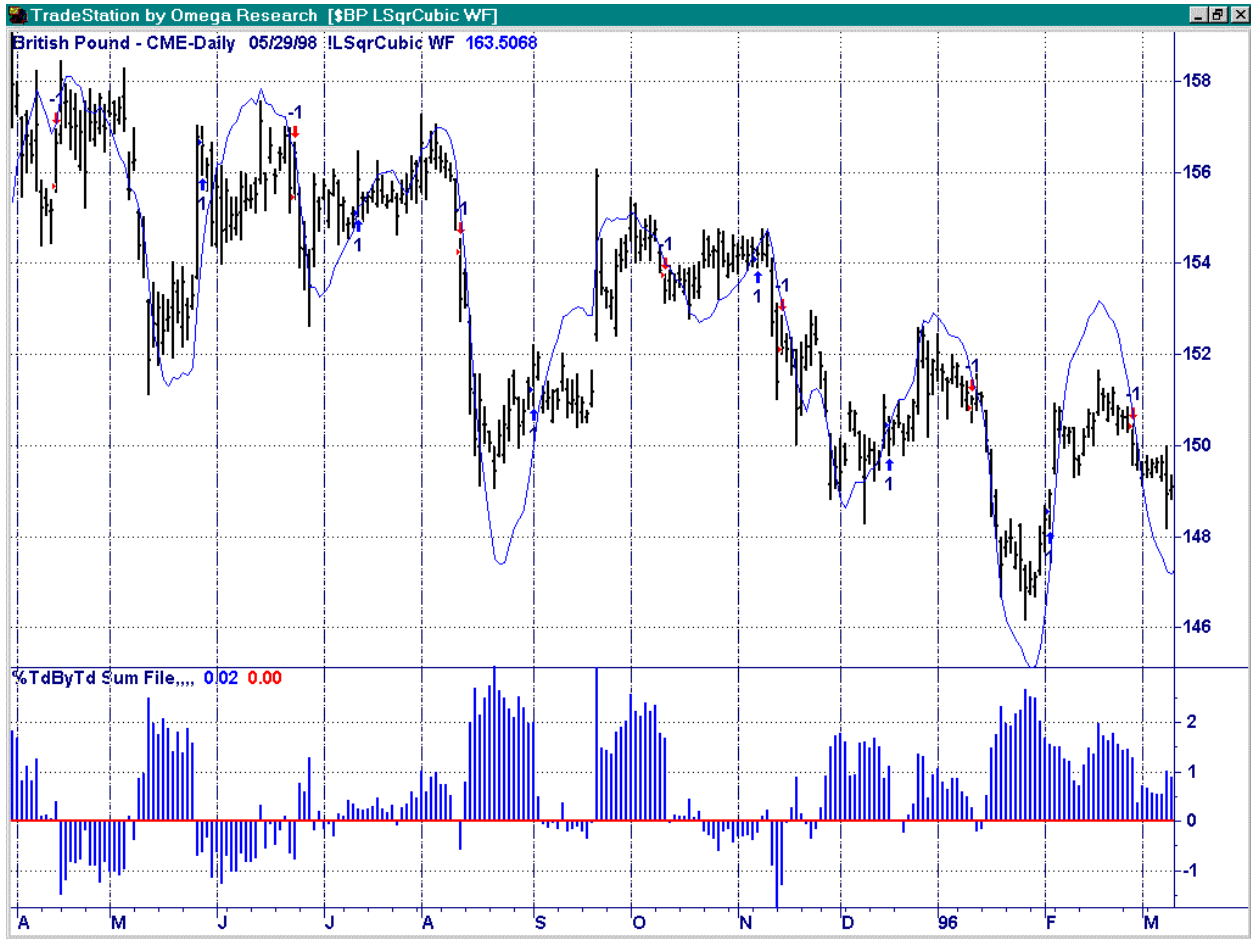


Figure12i BP Daily 10/16/93 - 05/29/98 LSqrCubic System

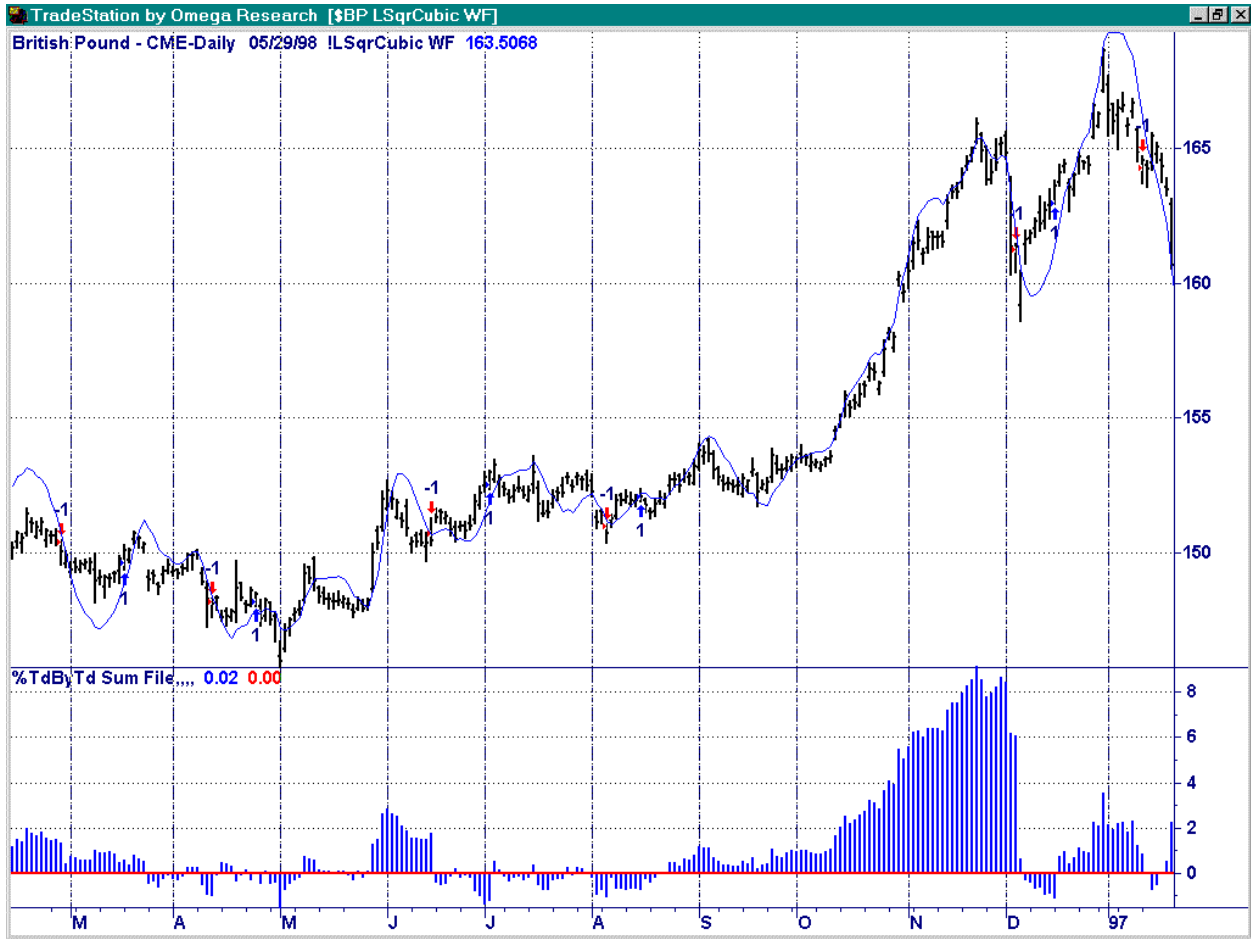


Figure12j BP Daily 10/16/93 - 05/29/98 LSqrCubic System

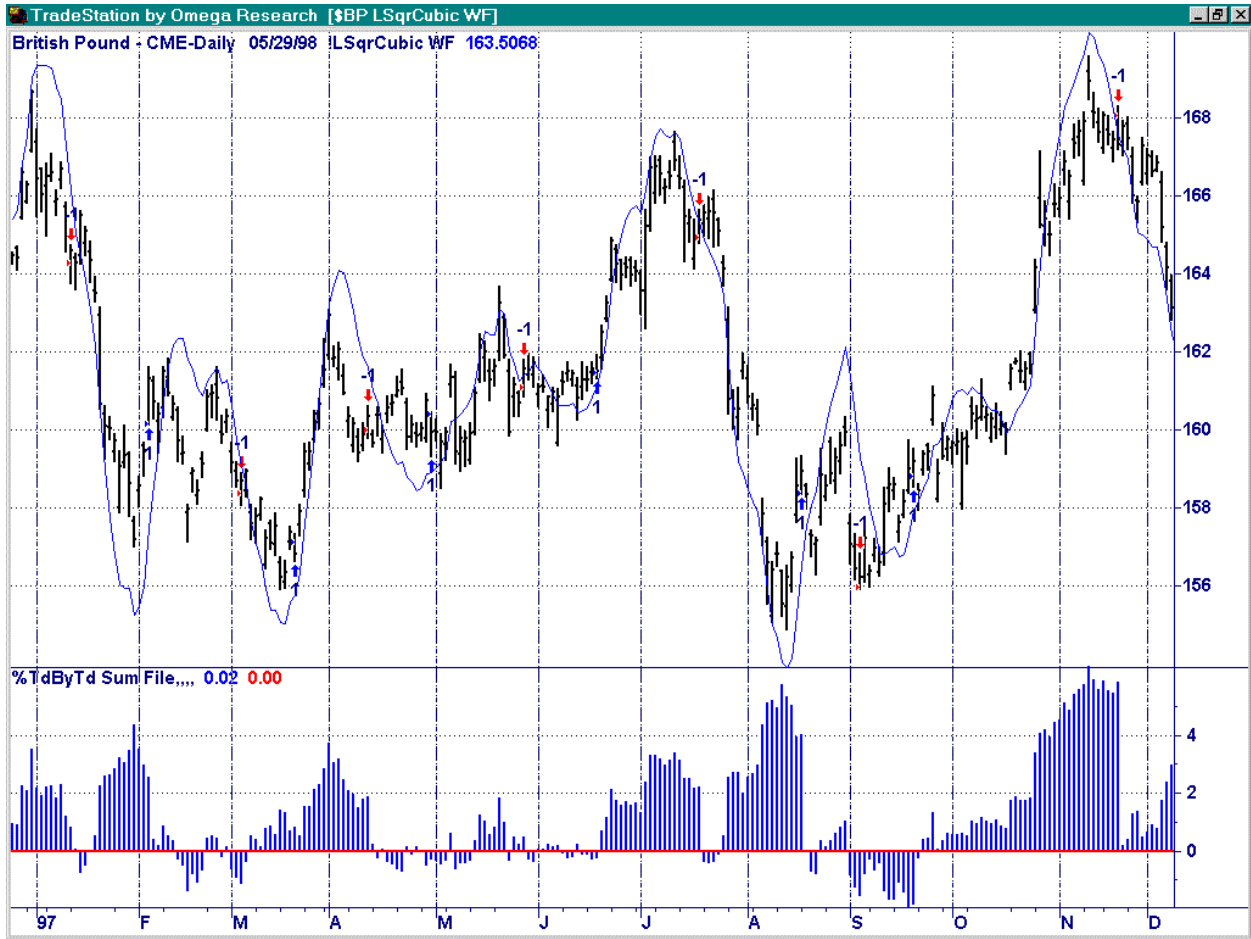


Figure12k BP Daily 10/16/93 - 05/29/98 LSqrCubic System

