# Testing the channel breakout theory on a portfolio of futures

The Channel Breakout is a classic trend following system with a long history. The origins can be traced back to Richard Donchian, who invented this system in the mid 1900s. In more recent times, the infamous group of "Turtle" traders (a group taught by William Eckhardt and Richard Dennis in the 1980s) used a methodology that involved a channel breakout system. Many of the so-called turtles went on to be successful traders, in their own right.

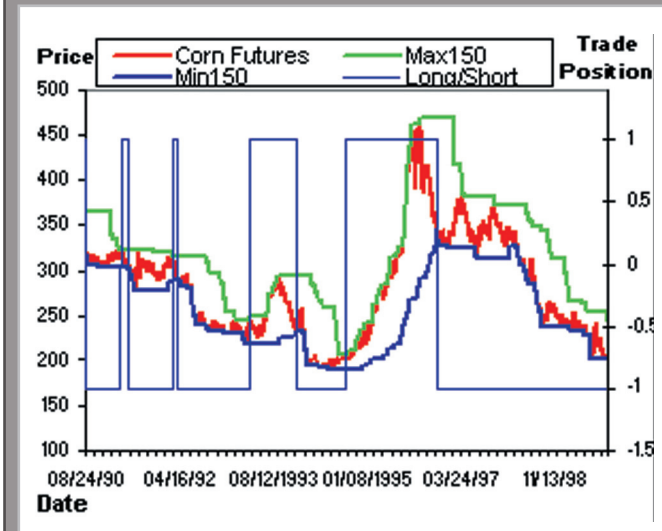
The method is one of the most simple, yet effective systems used by traders. There are innumerable variations, all which follow a common theme, which involves trading when the price "breaks out" from a predefined channel. That channel can be based on price or volatility, in which case it is a *volatility* breakout system.

In its most basic form, the method signals a long (short) trade when the price of a market rises above (falls below) a maximum (minimum) historical price level, over a given lookback period. The trader can use either the close or the high and low to specify the channel. The minimum and maximum prices form a support/resistance channel, which, if broken by the current price, signals a continuance in the current trend. Figure 1 shows a long-term price-based channel breakout using corn futures.

A common variation has one entering the market using one lookback period and then exiting when the price moves in the opposite direction and breaks a channel defined using a shorter lookback period. For example, a trader could enter on a 55-day channel and exit when the price breaks a 20-day channel. In the case of a volatility breakout system, the channels are defined using volatility bands based on a measure of recent volatility, in an attempt to automatically adapt to the current market environment. That is, if the market is exhibiting high volatility we want the bands to widen, so that if either band is broken, the breakout is significant in relation to current price movement.

When volatility decreases, the bands contract, moving closer to the price. This way a trade is only signalled when the price breaks out of a channel that incorporates local volatility, in the hope that this signifies the start of a true trend, and not a "false breakout," thus reducing the problem of whipsaws. Further variations include varying the length of the lookback period based on volatility.

## F1) 150-day channel-breakout




### Does it still work today?

Leaving aside its long history and concomitant minutiae, what we are interested in as traders is whether this technique ever had value and, if it did, whether it still has value today. When testing a methodology it is often a good idea to 'go back to basics', or simply ignore what market folklore has to say regarding a particular technique and test it from the ground up. After all, one can't afford to be overly credulous when money is potentially at stake.

That is not saying one should disregard generally accepted market wisdom but rather, it should be considered as a possible hypothesis that should be tested thoroughly to confirm its efficacy, or lack thereof. A problem facing anyone involved with trading system design is that many of the methods commonly expounded by the numerous books on trading are not properly tested. Or, if they are, it is usually with too little data to allow one to draw any hard conclusions. Matters are further complicated by the fact that if a strategy has been very profitable in the past it will have attracted large capital resources and are unlikely to continue to be as profitable in the future.

### The system relies on the basic concept of trend

Taking the above into consideration, we are not overly concerned with what form this classic system is *supposed* to take, but rather, whether the underlying methodology has any substance and merits further research. When testing any trading strategy it's also good practice to stand back and conceptualise what market characteristic it is trying to exploit. For fear of stating the obvious, the fundamental basis for this method is that markets trend, that is, they tend to continue in the direction they are moving in more often than if they were random walks.

In the language of non-linear dynamics, they exhibit *persistence*, a property that can be measured by the Hurst Exponent. So it is not just a case of getting in on a trend. But, whether in the long run, the return from successful trades will more than offset the losses from losing trades. Moreover, note that a random walk exhibits trends, but no trend following system can profit from one because it is neither persistent nor anti-persistent – on average the profit from winning trades will be offset by the losses from losing trades. With this in mind, we begin with the channel breakout's most basic representation:

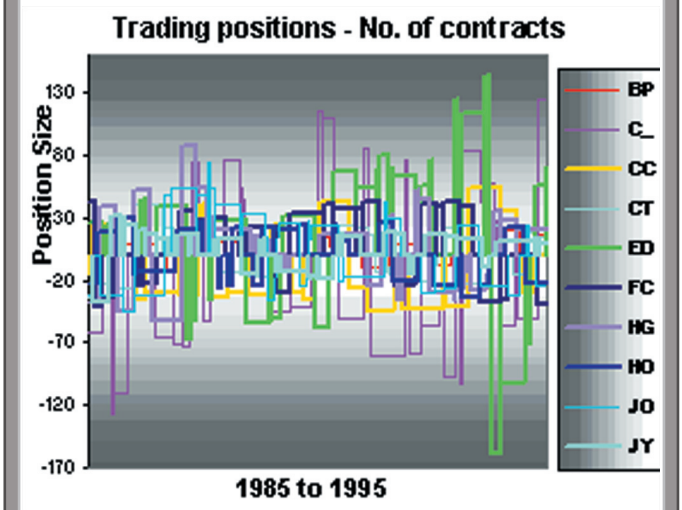
If Close[today]>Max(Close[today-lookback]:Close[today-1]) then enter Long at tomorrow's Open.
If Close[today]<Min(Close[today-lookback]:Close[today-1]) then enter Short at tomorrow's Open.

## T1) Portfolio of 46 futures markets*

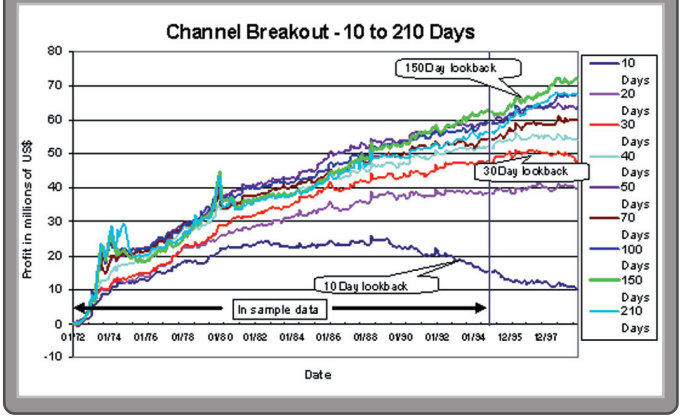
| NAME | SYMBOL | EXCHANGE |
|---|---|---|
| AUS DOLLAR | AD | CME |
| SOYBEAN OIL | BO | CBT |
| BRITISH POUND | BP | CME |
| CORN | C | CBT |
| COCOA | CC | CS&CE |
| CANADIAN DOLLAR | CD | CME |
| CRUDE LIGHT | CL | NYME |
| CRB INDEX | CR | NYFE |
| COTTON #2 | CT | CTN |
| DEUTSCHMARK | DM | CME |
| DOLLAR INDEX | DX | CTN |
| EURODOLLARS 3MO | ED | CME |
| FEEDER CATTLE | FC | CME |
| FIVE YEAR NOTES | FV | CBT |
| GOLD | GC | COMEX |
| GOLDMAN SACHS INDX | GI | CME |
| COPPER #1 | HG | COMEX |
| HEATING OIL #2 | HO | NYME |
| UNLEADED GASOLINE | HU | NYME |
| ORANGE JUICE | JO | CTN |
| JAPANESE YEN | JY | CME |
| COFFEE | KC | CS&CE |
| KANSAS WHEAT | KW | KCBT |
| LUMBER | LB | CME |
| LIVE CATTLE | LC | CME |
| LIVE HOGS | LH | CME |
| MUNICIPAL BONDS | MB | CBT |
| MIDCAP 400 INDEX | MD | CME |
| MINNESOTA WHEAT | MW | MGE |
| NATURAL GAS | NG | NYME |
| NIKKEI INDEX | NK | CME |
| OATS | O | CBT |
| PALLADIUM | PA | NYME |
| PORK BELLIES | PB | CME |
| PLATINUM | PL | NYME |
| SOYBEANS | S | CBT |
| SUGAR #11 | SB | CS&CE |
| SWISS FRANK | SF | CME |
| SILVER | SI | COMEX |
| SOYBEAN MEAL | SM | CBT |
| S&P INDEX | SP | CME |
| T BILLS 90 DAYS | TB | CME |
| TEN YEAR NOTES | TY | CBT |
| T BONDS | US | CBT |
| CHICAGO WHEAT | W | CBT |
| NYSE INDEX | YX | NYFE |

*those in red constitute the 23 mkt portfolio

## F2) Position sizes for 10 contracts




## F3) Equity curves for the channel-breakout from 10-210 days




### The nuts and bolts

It doesn't matter, at this initial stage, whether the system is something we would feel comfortable trading. What counts is the performance results from a test once the system is stripped down to its bare essentials. If the results show promise, we can move on and try to add improvements. In what follows, an initial test is conducted using a portfolio of 46 futures markets (see table 1) in order to estimate the optimal lookback period for the system. A large portfolio is used as this should reduce the danger of over-fitting, or curve fitting, the data and render a robust result.

Once the optimal value for the lookback period is found, a test is conducted to investigate whether an exit strategy using money management stops and profit targets improves the performance. Then, once the optimum values for the exit strategy parameters have been estimated, the number of markets in the portfolio is reduced by half, from 46 to 23, and finally, the system is tested on out of sample data from 1999-2004 to see what would have happened had it been implemented in real-time.

## T2) Three different sets

| Set | Dates | Length |
|---|---|---|
| **In-sample** | Jan. 1972 to Jan. 1995 | 23 Years |
| **Validation** | Jan. 1995 to Nov. 1999 | 5 Years |
| **Out of sample** | Nov. 1999 to Jan. 2004 | 4 Years |

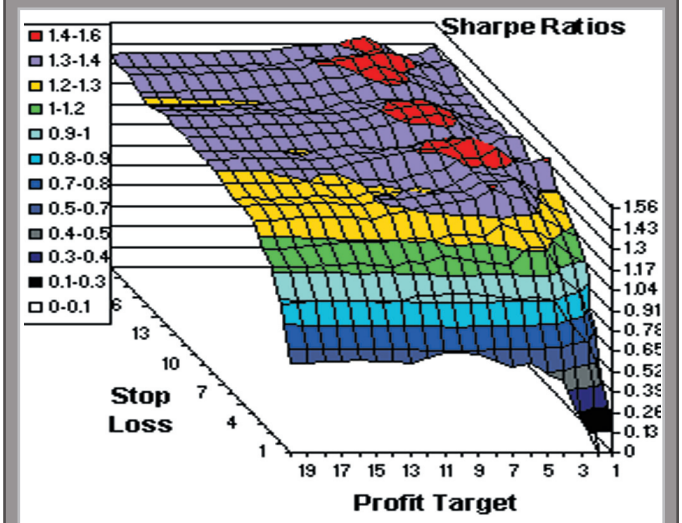
### Normalisation is important

When testing a strategy using a portfolio of futures contracts it is important to take into account the different *dollar* volatilities of the various markets traded. Why? The objective is for each market to contribute equally to the overall portfolio performance. To futures traders the S&P 500 is considered a large contract, whereas oats is considered a small contract, as the notional value of the former is much greater than that of the latter. If we were to simply trade one contract of both markets, the two market portfolio would be dominated by the S&P 500 futures. We need to account for this problem by normalising the number of contracts traded

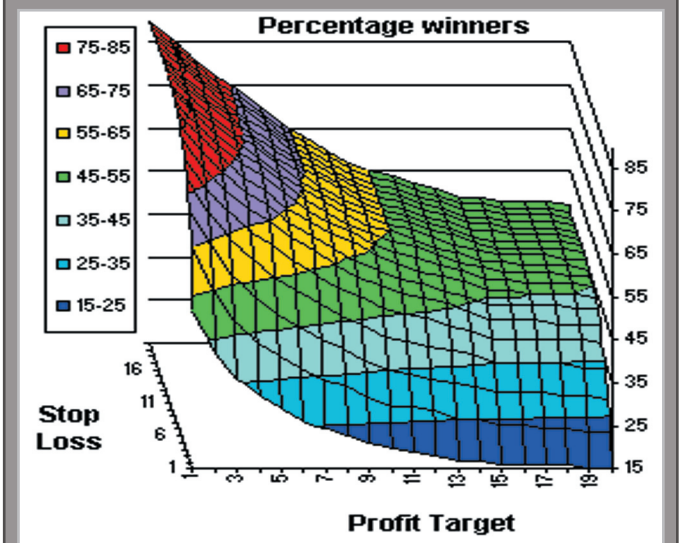
## T3) In-sample results from 1972-1995

| Lookback period | Net Profit in 000's | Net Profit Long in 000's | Net Profit Short in 000's | Profit Factor | Sharpe Ratio | Max Drawdown in 000's | Number of Trades | Percent winners | Average Trade | Avg bars per Trade |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | $14,612 | $22,301 | -$7,689 | 1.09 | -0.33 | $11,638 | 11956 | 34% | $1,222 | 19 |
| 20 | $37,193 | $33,364 | $3,828 | 1.36 | 0.44 | $3,349 | 5938 | 36% | $6,263 | 36 |
| 30 | $46,175 | $39,549 | $6,625 | 1.57 | 0.70 | $2,847 | 3980 | 38% | $11,601 | 53 |
| 40 | $50,310 | $42,482 | $7,827 | 1.75 | 0.70 | $3,048 | 2949 | 40% | $17,060 | 71 |
| 50 | $56,657 | $47,196 | $9,461 | 2 | 0.83 | $4,500 | 2313 | 41% | $24,495 | 90 |
| 70 | $51,521 | $45,218 | $6,302 | 2.08 | 0.76 | $6,455 | 1649 | 42% | $31,243 | 126 |
| 100 | $54,071 | $49,445 | $4,625 | 2.3 | 0.84 | $9,079 | 1125 | 40% | $48,063 | 181 |
| 150 | $57,075 | $51,182 | $5,893 | 2.73 | 1.01 | $12,616 | 721 | 44% | $79,161 | 280 |
| 210 | $51,352 | $46,617 | $4,735 | 2.8 | 0.83 | $12,015 | 519 | 47% | $98,944 | 379 |

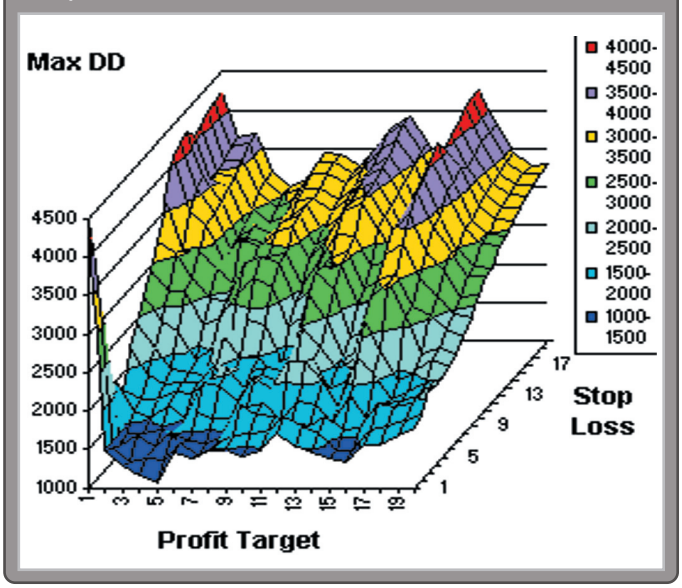
## F4) Sharpe Ratio results



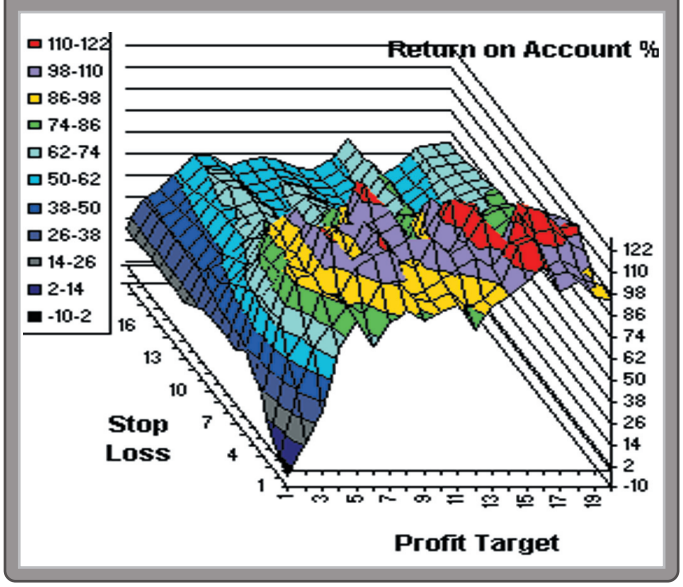

## F5) % of winning trades results




## F6) Maximum drawdown results




## F7) Return on account results




for each market. This normalisation results in trading more contracts of those markets that move less in *dollars* per time period, and fewer contracts of those that have greater movements over the same period.

To do this the dollar value of a point is calculated for each market by dividing the dollar value of a tick – the minimum price movement possible – by its size. For example, using the Chicago Board of Trade (CBOT) wheat contract, the dollar value of a tick is $12.50 and its size is 0.25, so the dollar value of one point is 12.50/0.25=$50. A measure of volatility is then needed and in this case an average of the absolute values of daily close-to-close returns is taken over the last 100 days, although other measures of volatility can be used. The resulting dollar value of one point and the volatility value are then multiplied to obtain the daily dollar volatility. To work out how many contracts a market should trade, the daily dollar volatility is divided into 6000, which means that the number of contracts traded in each market is such that the total position will have a daily dollar volatility of about 6000. For example, in early 1997 the system was trading seven S&P contracts and 26 coffee contracts.

Figure 2 shows the position sizes for a number of markets over a ten-year period using a channel breakout system.

### Data from 1972-2004

The study uses continuously adjusted end of day futures data from 1972 to 2004. The dataset is divided into three different sets:

in-sample, validation, and out of sample (see table 2). The in-sample data is used to test different lookback periods and exit strategies, which are then tested on the validation data. In other words, we want to validate our parameter values. If validation performance is acceptable then the final system is tested on the out of sample data to see what would have happened had it been traded.

This may seem overly complicated, but the idea is to prevent us from curve-fitting or 'torturing the data until it confesses' – if the whole dataset was used from the start it would be uncertain whether we had simply found parameter values that, by chance, resulted in a profitable system, which would probably fail when tested on future data. Formally, we wish to find those parameters that *generalise* on unseen data, the ultimate goal of trading system development

### The optimal lookback period

The lookback period is tested using values between 10-210 days inclusive at increments of ten days. The results of this test can be seen in figure 3, along with trade statistics in table 3 (note that no bet-sizing algorithm is used). Also included are transaction costs of $15 per round turn and three ticks slippage for each trade. What is immediately obvious from the chart is that the breakout system seems to have some value, though the shorter the lookback period, the worse the results, as the data moves into and beyond the 80s. Note that not all markets were trading at the beginning of the data period so fewer markets are traded at the start of the data than at the end. Although this isn't ideal, it should still give us a robust estimate of the optimum parameter values.

From table 3, it can be seen that a lookback period of 150-days results in the highest in-sample Sharpe Ratio (SR) – a measure of risk and return – along with the highest net profit. Therefore, this value will be used for the lookback period (note that the chart of equity curves in figure 2 also includes the performance over the validation data from 1995-1999. However, table 3's figures are based solely on the in-sample period). With a lookback of 150 days, the average bars per trade is 280 days. Most traders would probably prefer a system that trades more often and doesn't expose one to the market 100% of the time; however, based on the SR, we will continue on with the value of 150-days. The point is that it is inadvisable to impose personal trading preferences at this stage; initially we want to know what works, then we can start to re-formulate and match what we would feel comfortable trading.

### Adding stop losses and profit targets

Many traders consider exits to be an integral part of any trading system. A good exit strategy will need to balance the two competing, yet equally important, objectives of cutting losses short and letting profits run. Often when the market moves against a trade, it is important to exit quickly, cutting any losses short, as it is probable that the trade was the result of a failed entry signal. In contrast, it is imperative to allow trades some room to breath as it may be that, after a brief initial reversal, the trade bounces back to produce large profits, in which case exiting early is detrimental. A properly designed exit strategy will allow enough room for a trade to become profitable, yet place a strong emphasis on controlling losses and preserving capital. This will usually result in reduced volatility and drawdowns.

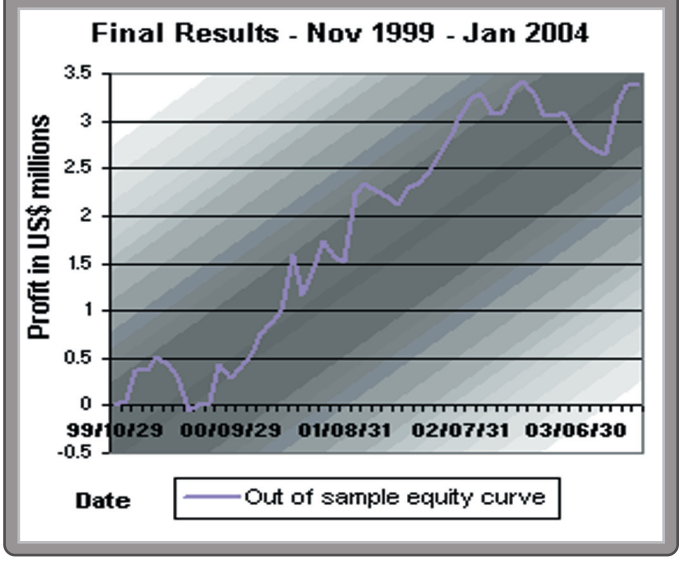
One of the more common strategies for cutting losses is the use of a stop loss order, which in the case of a long (short) trade, involves placing a stop order at a price some distance below (above) the trade entry price. Once a trade is placed and the price hits the stop before any other exit criteria, it is then exited, with a loss equal to the difference between the entry price and the stop price – except in those unfortunately not so rare occasions when the market moves quickly through the stop, in which case the loss can be greater.

It is not only important to know when to take a loss but also when to take a profit. Once a trade has moved into profit it is

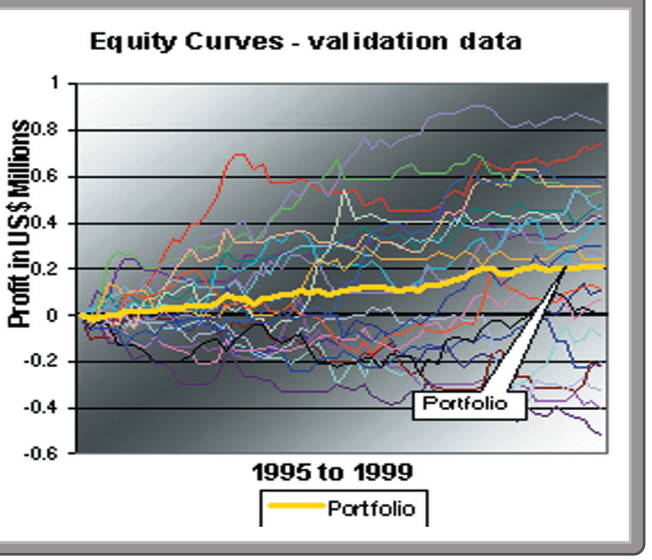
## T4) Results using exit strategy – a stop loss of 6 and a profit target of 8 atr units

| | Lookback period | Net Profit in 000's | Net Profit Long in 000's | Net Profit Short in 000's | Profit Factor | Sharpe Ratio | Max Drawdown in 000's | Number of Trades | Percent winners | Average Trade | Avg bars per Trade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 markets No exit | In-sample | $57,075 | $51,182 | $5,893 | 1.01 | 2.73 | $12,616 | 721 | 44% | $79,161 | 280 |
| | Validation Set | $9,634 | $8,193 | $1,441 | 0.93 | 2.17 | $2,743 | 202 | 46% | $47,697 | 282 |
| 46 markets with exit | In-sample | $46,425 | $34,949 | $11,476 | 1.45 | 1.65 | $1,794 | 2168 | 55% | $21,414 | 74 |
| | Validation Set | $8,523 | $6,091 | $2,431 | 1.16 | 1.47 | $1,775 | 520 | 51% | $16,391 | 91 |
| 23 markets with exit | In-sample | $26,224 | $21,301 | $4,923 | 1.42 | 1.6 | $1,100 | 1306 | 54% | $20,080 | 74 |
| | Validation Set | $4,414 | $2,523 | $1,891 | 1.23 | 1.51 | $844 | 254 | 50% | $17,380 | 94 |
| Final result – Nov 99 to Jan 04 | | $3,536 | $3,027 | $508 | 1.06 | 1.42 | $881 | 237 | 51% | $14,920 | 87 |

## F8) Recent out of sample performance




## F9) Benefits of diversification




quite possible for the price to then retrace, converting what was once a profitable trade into a losing one. One method of addressing this is to set a profit target some distance above (below) the entry price for a long (short) position so that when a trade becomes reasonably profitable, this profit is locked in by exiting the position.

### Improved exit strategy

Thus far, the channel breakout system is a stop and reverse system, and exits a trade when a subsequent entry is signalled in the opposite direction, regardless of the initial trade's performance. This is somewhat simplistic and it is likely that an improved exit strategy can be constructed by bolting on some exit components. To do this, a static stop loss and profit target are added to each trade using a stop order for the former, and a limit order for the latter. They are static in that once the orders have been placed at a certain price they don't change and are either hit/executed or cancelled. In contrast, more adaptive stops, such as trailing stops, are constantly adjusted during the trade.

In order to facilitate meaningful tests of stop losses and profit targets on a portfolio of futures, we have to use a method that can be applied across markets and is adaptive to changes in per contract volatility. It is not a good idea to use fixed-dollar amounts, because the volatility of individual contracts is liable to change over the years, making what might have been a loose stop loss in one period a tight one in another. A good example is the S&P 500 futures. Since this contract was first traded, its volatility has increased, so to have a fixed-dollar stop would make little sense. It would be hit far more often today than 15 years ago. In addition, using the same fixed-dollar amount stops for both the S&P 500 and oats would make little sense for the same reason that trading a similar number of contracts for both markets in the same portfolio isn't advisable.

To deal with this issue, we use stop losses and profit targets based on units of the average true range, as this allows us to test our exit strategy across the whole portfolio of futures.

### Stop loss and profit limit results

Stop losses and profit limits are tested using values ranging from 1-20 units of average true range and the results recorded. It is sometimes useful to create a 3-D surface map to visualize the results from a two-parameter optimisation. These can be seen in figures 4-7, where the hotter the colour, the greater the value on the z-axis. Included are surface maps for the Sharpe Ratio, Net Profit, Maximum Drawdown and Return-on-account results. For visualisation purposes, the Sharpe ratio surface map has been rotated by 180-degrees in comparison to the other three.

When choosing parameters for trading systems using surface maps, one wants to find areas of the parameter space that exhibit smoothness. Or simply, 'good' parameters are those with values that if changed slightly, result in a negligible deterioration in system performance. Caution is advised in this activity, as what can sometimes appear to be smoothness in parameter space can actually be a result of the specific scaling of the map. For example, when testing values for the lookback period from 10-210 days, the change in performance between ten and 20 days will tend to be far greater than that observed between 200 and 210 days, so it's important to take this onboard.

After an analysis of the surface maps, the final values chosen for the exit strategy's stop loss and profit target are six and eight respectively – the results can be seen in table 3, which includes trade statistics for the portfolio with and without the exit.

The portfolio is then reduced from 46 markets to 23. The main objective was to remove those markets that were unlikely to contribute to the diversification of the portfolio and were essentially redundant. For example, all equity index contracts were removed except the S&P 500. The resulting portfolio can be seen in table 1, and consists of those markets shown in red font.