Technical Strategies

Part II

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In Defense of Technical Analysis

- In a previous presentation on technical strategies, I suggested that technical analysis is really just a practical way of using nonlinear information in prices to trade.
- Much of the criticism of technical analysis from academics stems from naïvely (but incorrectly) associating the lack of serial correlation in prices with unpredictability.
- The success of statistical tests of the “weak form” of the Efficient Market Hypothesis, which are largely tests of serial correlations in returns, is cited as cause for rejecting technical analysis.
- However, it is easily shown that two random variables can be uncorrelated but still be dependent on each other. In this case, they have independent second moments but dependent higher order moments.
- Moreover, a *nonlinear* process can appear to be random when diagnosed with linear statistics but in reality be completely deterministic and therefore completely predictable. In this case, it exhibits *deterministic chaos*.

In Defense of Technical Analysis

- We will show that dependence in prices which is not detected at the linear level can in fact lead to profitable trading strategies.
- A few popular technical trading rules are also studied from two points of view, viz.
    1. As diagnostics for detecting nonlinearity in prices
    2. As strategies implemented in practice with ad hoc conditions and provisions imposed by practitioners.
- We will also study some nonlinear techniques for prediction and noise reduction and suggests ways in which technical trading rules can be enhanced using these techniques.
- To improve continuity of presentation, I included some pages from my previous presentation.

Proof that Uncorrelated Does Not Imply Independent

- Consider two random variables x_i and x_j where

  $x_i = \sigma_i \varepsilon_i$
  $x_j = \sigma_j \varepsilon_j$ where ε_i and ε_j are iid innovations such that $\langle \varepsilon_i \varepsilon_j \rangle = 0$ and $\langle \varepsilon_i^2 \rangle = 1$.

- σ_i and σ_j are themselves random variables with non-zero correlation.

- Suppose ε_i and σ_i are independent so that the probability density $P(x_i,\sigma_i)$ is equal to $P(x_i)P(\sigma_i)$ (note that σ_i is randomly chosen but once it is chosen, the value of x_i depends only on ε_i).

- For example, if ε_i is gaussian, then $P(x_i,\sigma_i) = P(\sigma_i) \cdot \frac{1}{\sqrt{2\pi\sigma_i^2}} \exp\left(-\frac{x_i^2}{2\sigma_i^2}\right)$.

- Denoting averaging over x's by $\langle \cdots \rangle$ and averaging over σ's by $\overline{\cdots}$, we have

  $\overline{\langle x_i x_j \rangle} = \overline{\sigma_i \sigma_j} \langle \varepsilon_i \varepsilon_j \rangle = \delta_{ij} \overline{\sigma_i \sigma_j}$ where δ_{ij} is the Kronecker delta

  and thus there is no correlation between x_i and x_j.

- However the correlation of x_i^2 and x_j^2 is

$$\overline{\left\langle \left(x_i^2 - \langle x_i^2 \rangle\right)\left(x_j^2 - \langle x_j^2 \rangle\right) \right\rangle} = \overline{\langle x_i^2 x_j^2 \rangle} - \overline{\langle x_i^2 \rangle \langle x_j^2 \rangle} = \overline{\sigma_i^2 \sigma_j^2} \langle \varepsilon_i^2 \varepsilon_j^2 \rangle - \overline{\sigma_i^2} \langle \varepsilon_i^2 \rangle \overline{\sigma_j^2} \langle \varepsilon_j^2 \rangle = \overline{\sigma_i^2 \sigma_j^2} - \overline{\sigma_i^2}\,\overline{\sigma_j^2}$$
$$= \text{correlation of } \sigma_i^2 \text{ and } \sigma_j^2$$

  which is in general not zero, i.e. x_i and x_j are not independent in that their higher moments are related.

Nonlinear Forecasting is Key

- Many tests of the EMH were essentially tests of serial correlation in returns and have been largely supportive of the hypothesis (Ross 1989).
- The lack of correlation of price changes at all lags implies that *linear* forecasting rules will be ineffective.
- Linear forecasting models such as ARMA models (autoregressive moving averages, vector autoregressions, etc), and cycle analysis (Fourier transforms) contain the same information as the autocorrelation coefficients.
- Insofar as no information about the future is contained in the autocorrelation coefficients, none is contained in any other linear model.
- Linear models can only handle price patterns that are fully characterized by the first- and second-order moments, i.e. those that have smooth curvatures.
- But technical analysis involves patterns containing sequences of local minima and maxima (e.g. support and resistance, head and shoulders) and discontinuous jumps (e.g. breakouts and gaps) which are far from smooth.
- **Therefore technical analysis is a practical way of using nonlinear information in prices.**

The Channel Rule

- The channel rule is a disarmingly simple rule that
  - replaces a long position with a short position when the price is less than or equal to the minimum price during the preceding N days; and
  - replaces a short position with a long position when the price is greater than or equal to the maximum price during the preceding N days.
- The rule is always either long or short the market and N is the only parameter.
- A detailed study can be found in Taylor, S.J., *The Journal of Futures Markets* 14(2), 215-235 (1994).

A 20-day channel rule applied to the daily prices of KLAC.

Basic Variations of the Channel Rule

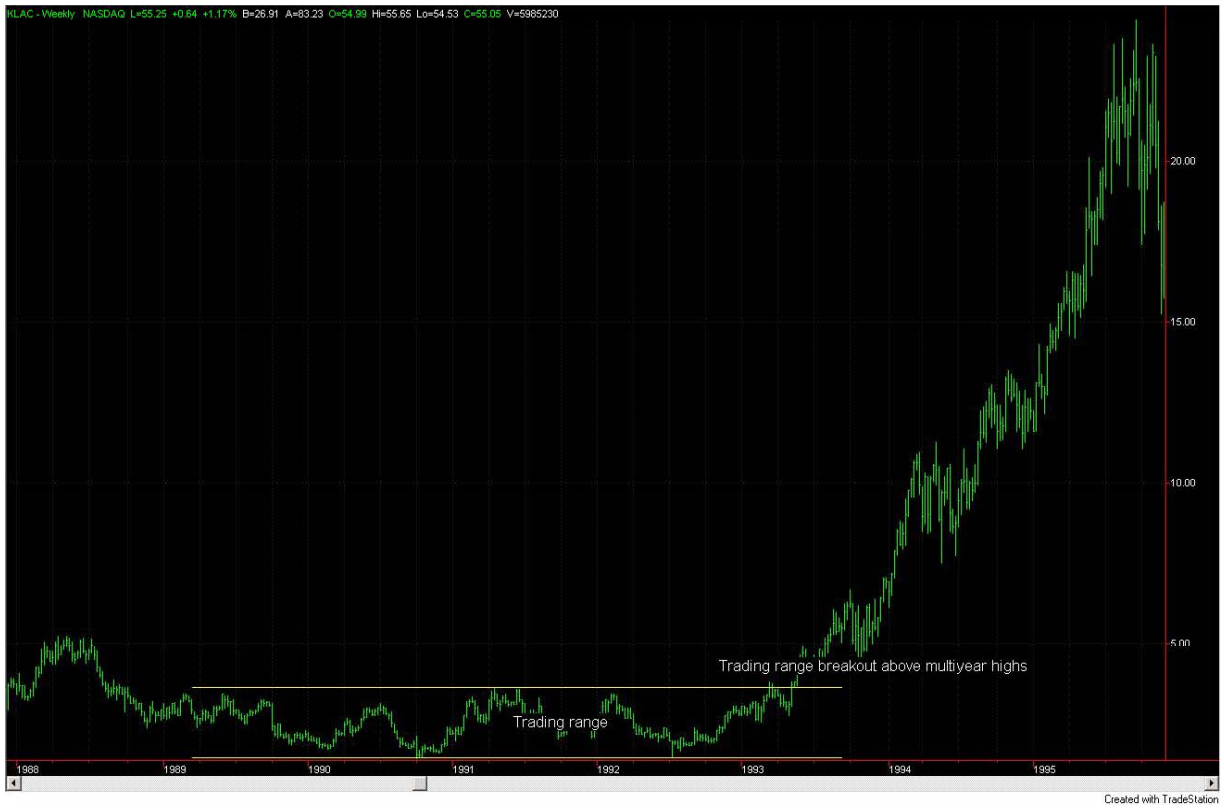
- Define a *trading range* as a set of two numbers (P_L, P_H), where $P_L(N)$ and $P_H(N)$ are the minimum and maximum prices observed in a window of length N. The trading range is now regarded as a function of the channel length N.
- Parametrize the rule with 4 possibly different channel lengths suggestively denoted by N_B, N_S, N_{BC}, and N_{SS}. This produces 4 possibly different trading ranges $(P_L(N_B), P_H(N_B))$, $(P_L(N_S), P_H(N_S))$, $(P_L(N_{BC}), P_H(N_{BC}))$, and $(P_L(N_{SS}), P_H(N_{SS}))$.
- Use the trading ranges in the following way:
  - Buy when the price P is higher than or equal to $P_H(N_B)$.
  - Sell when the price P is lower than or equal to $P_L(N_S)$.
  - Buy to cover when the price P is higher than or equal to $P_H(N_{BC})$.
  - Sell short when the price P is lower than or equal to $P_L(N_{SS})$.
- In the original channel rule, $N_B = N_S = N_{BC} = N_{SS} = N$.
- Simple variations of the original rule are obtained by values of N_B, N_S, N_{BC} and N_{SS} that are possibly different from each other. For example,
  - Hard to get in, easy to get out rule: $N_B > N_S$ and $N_{BC} < N_{SS}$.
  - Easy to get in, hard to get out rule: $N_B < N_S$ and $N_{BC} > N_{SS}$.
  - Asymmetric rule: $N_B \neq N_{SS}$ and $N_{BC} \neq N_S$.

Basic Variations of the Channel Rule

- Define a *trading range* as a set of two numbers (P_L, P_H), where $P_L(N)$ and $P_H(N)$ are the minimum and maximum prices observed in a window of length N. The trading range is now regarded as a function of the channel length N.
- As an indication of prevailing prices, the trading range can be distorted by isolated price outliers
- The following definitions of the trading range is robust to price outliers:
  - Interquantile Trading Range: rank prices within the specified look-back window and take, for example, prices corresponding to the 2nd percentile and the 98th percentile to define the trading range.
  - 10% Around Median Trading Range: the trading range is defined by prices within the specified look-back window *and* within 5% on either side of the median price in the window (this definition is due to Jack D. Schwager in *Getting Started in Technical Analysis, 1999*)

Basic Variations of the Channel Rule

- Certain characteristics of the trading range can be used to determine if the breakout is a reliable trading signal (headings follow Jack D. Schwager, 1999):
  - Duration of the Trading Range: When a breakout occurs to the upside, the current price P is such that $P \geq P_H(N)$, where N is the specified channel length. It is likely that P is also higher than or equal to $P_H(N_1)$ where $N_1 > N$. Let $N_{\max}$ denote the largest value of N_1 for which $P \geq P_H(N_1)$. Then the duration of the trading range out of which the break has occurred is $N_{\max}$. The breakout is more reliable if $N_{\max} >> N$. An example of a multiyear breakout is shown below:



Basic Variations of the Channel Rule

- Narrowness of Range: Let the width of the channel when a breakout to the upside occurs be $P_H(N_{\max}) - P_L(N_{\max})$. A comparison can be made between this width and the widths of previous channels out of which previous breaks occurred. The narrower the width of the channel, the more reliable the breakout. (Note that the last statement is merely suggestive and is meant to provide a catalyst for datamining).

- Confirmation of Breakout: Sometimes a false breakout, i.e. one which is not followed by a sustained price move, occurs because stop orders at important support and resistance levels are triggered by a price move slightly beyond the trading range. A fall back into the range occurs after the flurry of stop orders are filled and no follow through trend develops.

- Practitioners therefore apply a variety of confirmation conditions when using the trading ranges to generate trading signals. Some of these conditions (cf. Jack D. Schwager, 1999) are listed on the next page.

Confirmation Conditions for Breakout

- Require the breakout to exceed the boundary of the trading range by a minimum amount (e.g. 1% of the price level) in order to be valid.

- Require several closes above or below the trading range in order for the breakout to be valid.

- Require prices to stay beyond the trading range after a given time period has elapsed following the initial breakout from the range.

- Require a number of *thrust days* to occur before the breakout is considered to be valid. A *thrust day* is one which closes above the high of the previous day ("upthrust" day) or which closes below the low of the previous day ("downthrust" day).

- Sample real life charts of these conditions can be found in Jack D. Schwager, *Getting Started in Technical Analysis, 1999.*

Comparison of Channel Rule and Variations

- The performance of the channel rule and some of its variations is presented below:

Simulation	Average Profit Per Trade	Std Dev Profit Per Trade	Average/ Std Dev	t-statistic	Avg # trades/ market/ year	% Prof	Average Winner	Average Loser	Winner/ Loser	Worst 2.5% of Losers	Total Profit	Avg Trd Duration (Trading Days)	# Markets in Sample	First Date	Last Date
Original	$150,278	$605,819	0.25	4.9	3	47%	$590,793	($233,868)	253%	($545,800)	$59,359,749	39	10	14-May-91	17-Nov-03
Channel	$821	$338,493	0.00	0.1	4	38%	$326,922	($198,342)	165%	($499,234)	$393,931	22	10	14-May-91	18-Nov-03
Rule	$68,290	$483,513	0.14	4.2	7	42%	$459,579	($213,069)	216%	($522,848)	$59,753,681	30	10	14-May-91	18-Nov-03
"Penetration"	$176,653	$661,681	0.27	5.0	3	48%	$649,979	($252,218)	258%	($553,371)	$60,945,135	44	10	5-Jun-91	18-Nov-03
Channel	($3,144)	$425,509	-0.01	-0.1	3	37%	$421,903	($255,455)	165%	($631,359)	($1,097,360)	36	10	30-May-91	18-Nov-03
Rule	$86,236	$562,446	0.15	4.0	6	42%	$549,129	($253,990)	216%	($592,353)	$59,847,774	40	10	30-May-91	18-Nov-03
"Thrust Day"	$264,758	$1,012,987	0.26	4.0	2	48%	$863,605	($289,176)	299%	($804,389)	$61,158,988	68	10	16-May-91	7-Nov-03
Channel	$681	$523,395	0.00	0.0	2	34%	$548,643	($286,172)	192%	($713,737)	$154,589	54	10	9-May-91	18-Nov-03
Rule	$133,872	$818,158	0.16	3.5	4	41%	$733,621	($287,512)	255%	($745,221)	$61,313,576	61	10	9-May-91	18-Nov-03

Notes: 1st row of each simulation block contains statistics for long trades; 2nd row contains statistics for short trades; 3nd row contains statistics for all trades.
The bet size for each trade is $100000 divided by the dollar volatility defined as the contract point dollar value times the average true range over the last 100 trading days.
Markets traded are U.S. Dollar Index, Euro FX, Japanese Yen, Swiss Franc, Eurodollar, U.S. 5 Year Treasury Note, U.S. 10 Year Treasury Note, U.S. Treasury Bond, S&P 500 Index, Nasdaq 100 Index, and Crude Oil.

- These rules are applied to 10 futures markets between May 1990 and Nov 2003. A $10 per contract commission is applied. Execution slippage is assumed to be zero.
- The “original” channel rule is just a rule that buys at a 20-day high and sells at a 20-day low.
- The “penetration” channel rule requires the price to move beyond the 20-day high or 20-day low by 20% of the daily price volatility (defined as the average true range over the prior 100 trading days) before taking the trade.
- The “thrust day” channel rule requires the price to close beyond the initial 20-day high or initial 20-day low within 5 days after the high or low is made. Trade entry or exit occurs at the first closing price at which this condition is met.

Comparison of Channel Rule and Variations

- Like other trend following strategies, the channel rule and it variations have a low hit ratio (proportion of trades that are profitable).
- The original channel rule has more trades per market per year. It has better fills on trade entry but makes less per trade on average compared to the penetration and thrust day rules.
- This is because the latter rules prevent price fluctuations from causing premature exits from trends.
- Fewer trades also mean less transaction costs.
- Other variations of the channel rule are suggested in Jack D. Schwager, 1999, including ones that use volume and price patterns as confirming conditions. These variations are harder to backtest precisely.
- It is common wisdom among practitioners that breakouts should not be taken at face value. Some kind of noise control strategy should be applied in tandem.

Bull and Bear Traps

- "A failed signal is among the most reliable of all chart signals", says Jack D. Schwager in *Getting Started in Technical Analysis, 1999*.
- Anecdotes abound of such "failed" signals which typically occur when the market has moved anticipatively and then failed to follow through on news that are apparently even more bullish or bearish than anticipated.
- While it does appear casually that a "failed" signal is a set up for a trend reversal, it is hard to systematically identify such "failed" signals.
- These "failed" signals usually correspond to major tops and bottoms and are called "bull" and "bear" traps respectively.
- A related price pattern is the famous "head and shoulders" which is a 3-part pattern in which the middle high (low) is above (below) the high (low) points on either side. This pattern and its sister pattern, the "rounded head and shoulders", is usually formed after a major price move has occurred and a reversal is about to start.
- There exists a whole school of technical analysts that tries to identify the ultimate bull or bear trap (multi-year high and low) that would result in the ultimate "capitulation" trade.

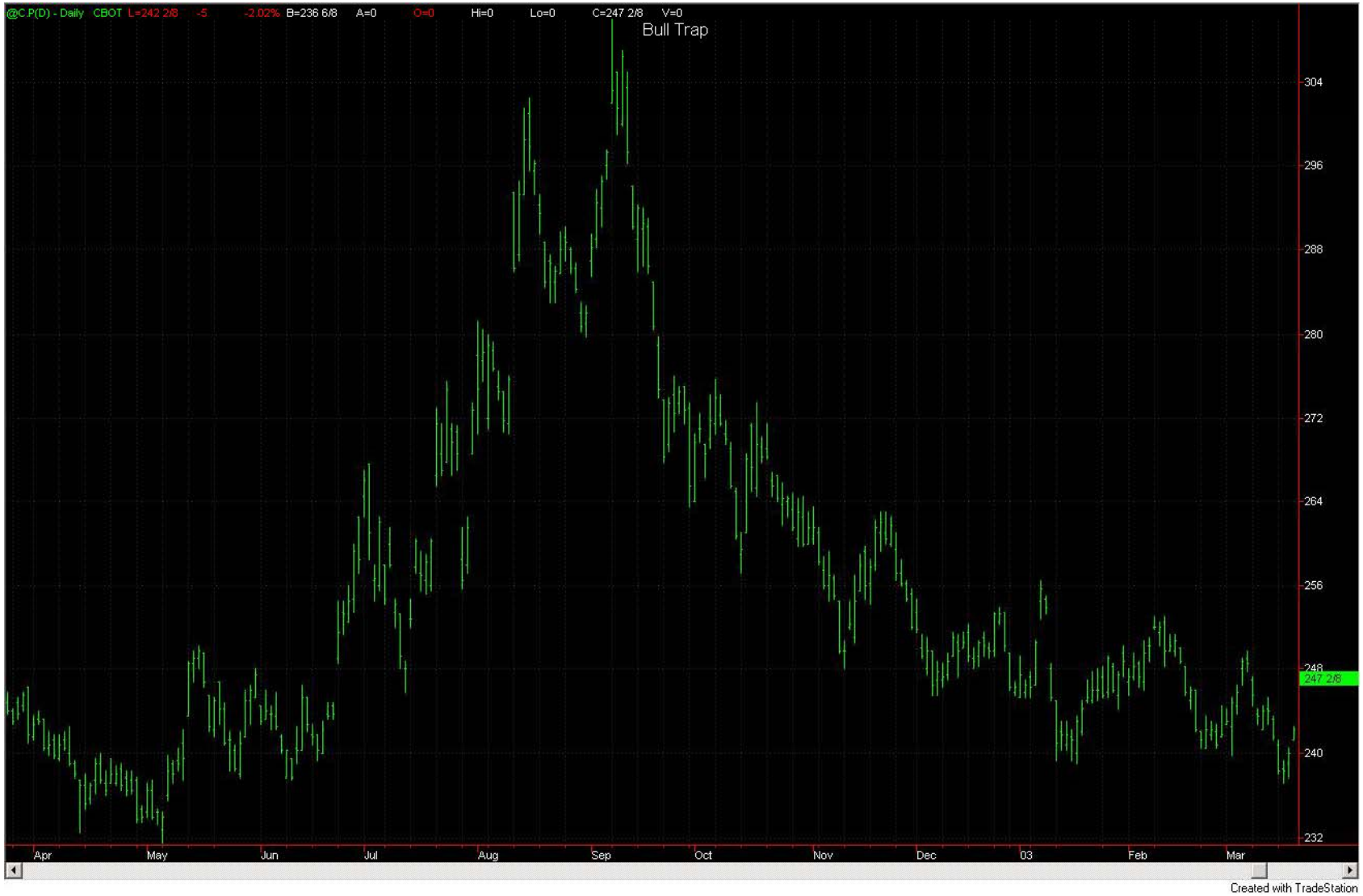
The Channel Rule as a Contrarian Strategy

- Below is an attempt to use the channel rule as a contrarian indicator:

- This strategy requires the price to break a 100-day trading range recently in the *opposite* direction before a standard 20-day channel rule can be followed. In other words, the price must have broken a 100-day high within the past 30 days before a short trade can be taken on a 20-day low. The price must break a 100-day low within the past 30 days before a long trade can be taken on a 20-day high. A price objective of 2 times the 100-day average true range is also applied.

Examples of Common Chart Patterns

- Bull trap

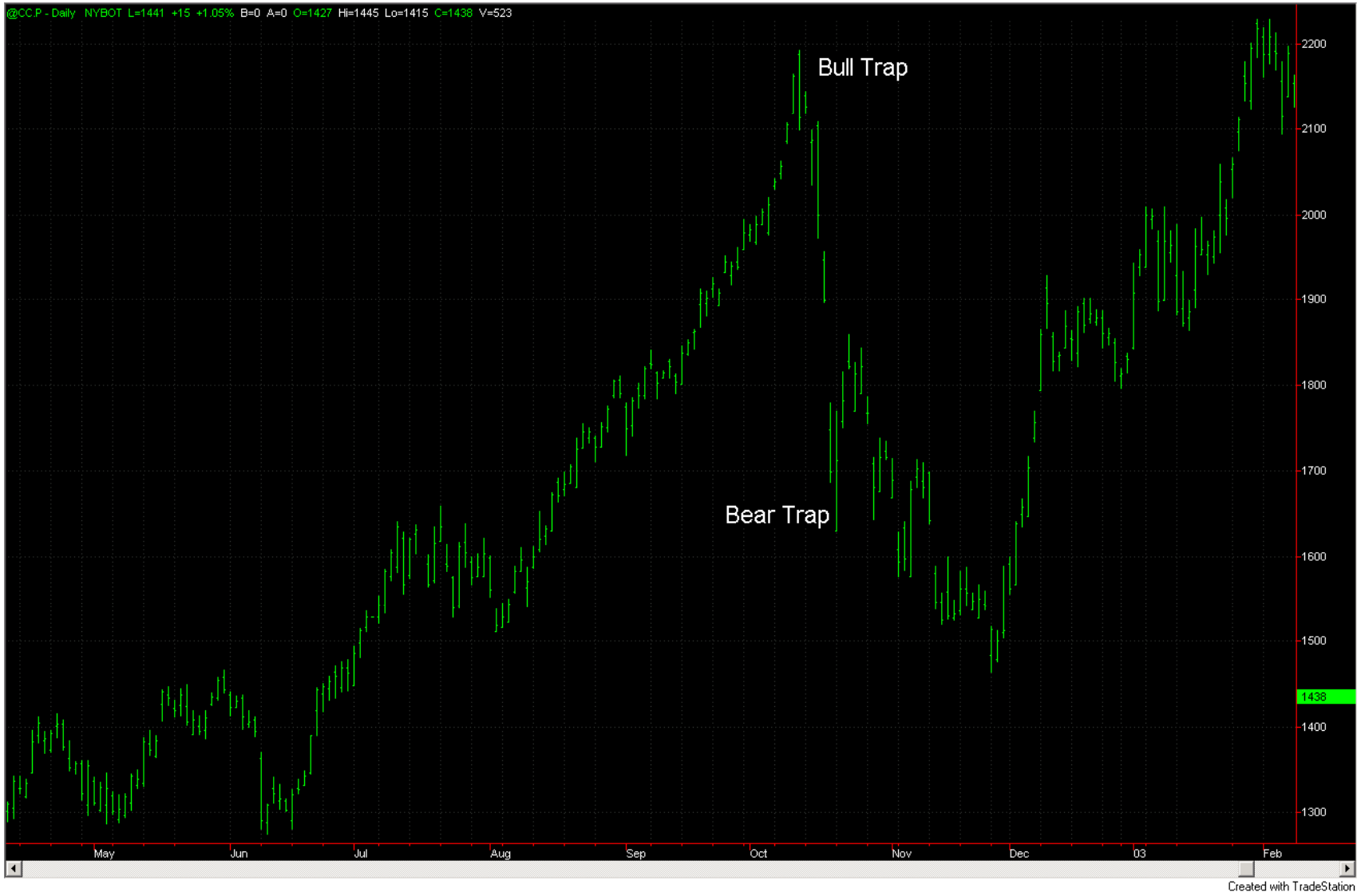


Examples of Common Chart Patterns

- Bear trap

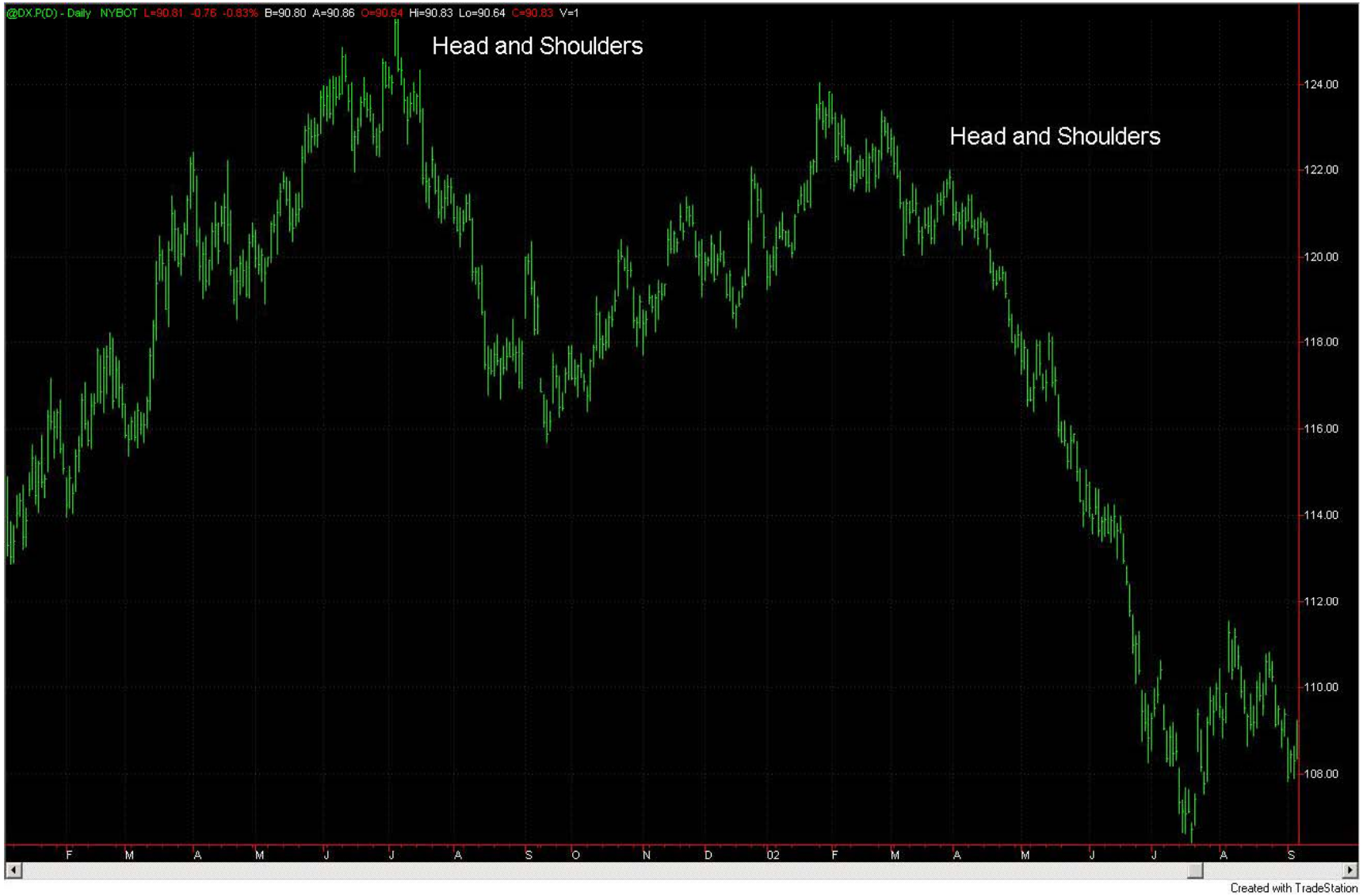
Examples of Common Chart Patterns

- Bull and bear traps



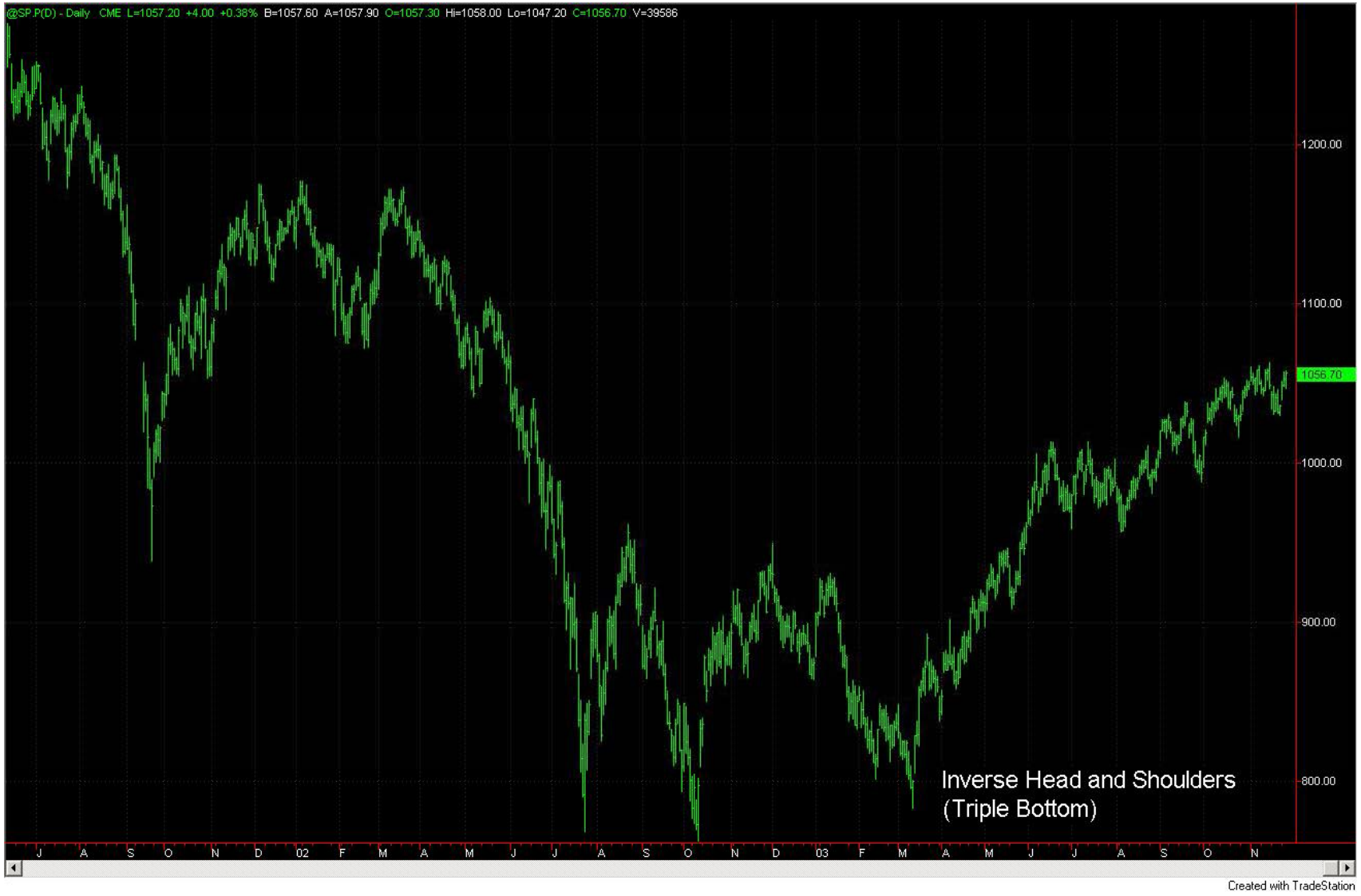
Examples of Common Chart Patterns

- Head and shoulders



Examples of Common Chart Patterns

- Triple tops and triple bottoms usually do not hold.



Trend Lines

- Trend lines are defined as straight lines connecting a series of *relative highs* or a series of *relative lows*.
- Relative highs and lows are local extrema determined *ex post*.
- On a daily chart a relative high is a daily high price that is higher than the daily highs of the previous *and* the following M days. A relative low is defined in an analogous way.
- Typical values for M range between 1 and 10.
- Recent relative highs and lows (defined with M = 10) in the S&P 500 Index:

Relative highs and relative lows are also called *pivot highs* and *pivot lows*.

Failed Trend Line Breakouts

- To precisely define a trend line, we need to specifiy the number U of previous relative highs or lows used to draw it.

- Typical values of U are 2 or 3. In the case of $U > 2$, a linear regression can be used to determine the straight line that goes through the relative extrema.

- Depending on its slope, a trend line through relative highs or relative lows can be either an *uptrend* or *downtrend* line.

- Several strategies are possible using trend lines:

  – *Contrarian trade entry in direction of major trend*

    Buy when prices approach relative low uptrend line; sell when prices approach relative high downtrend line.

  – *Reversal of major trend*

    Buy when prices penetrade relative high downtrend line; sell when prices penetrade relative low uptrend line.

- Note the distinction between “approach” and “penetrade”.