

Choppiness Index filter

BY VOLKER KNAPP

Market: Stocks.

System concept: Markets spend less time in trends than they do in congestion and range-trading phases. And for many systems, the failure to identify and avoid non-trending conditions is a leading cause of whipsaws and poor performance. This system uses a specific indicator to filter signals from a basic swing-trading system to see if it helps eliminate unfavorable trades in non-trending environments.

Related reading

"Active Trader Interview: Bill Dreiss"

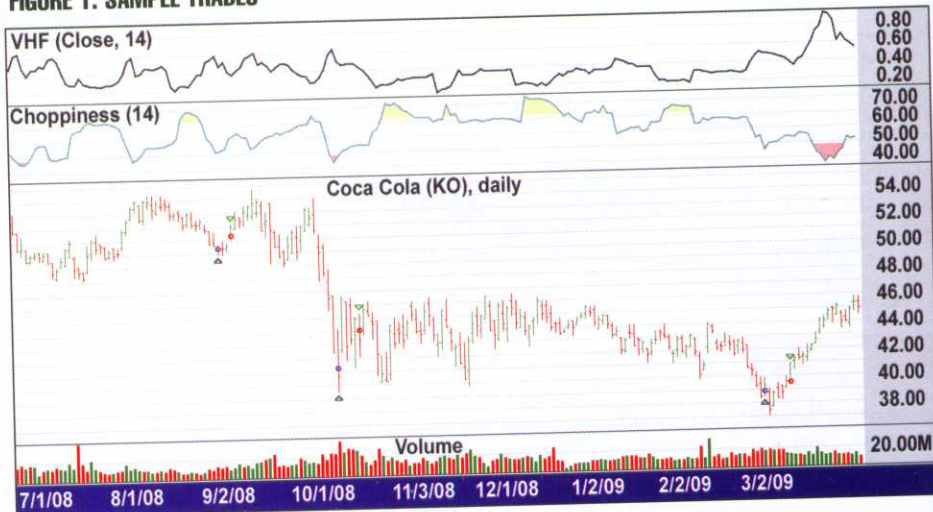
Active Trader, July 2009. An in-depth interview with pioneering CTA Bill Dreiss that includes more information about the Choppiness Index.

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KC For more information about the following concepts, go to "Key concepts" on p. 78.

- Average directional movement index
- Random walk index
- Relative strength index
- Vertical horizontal filter

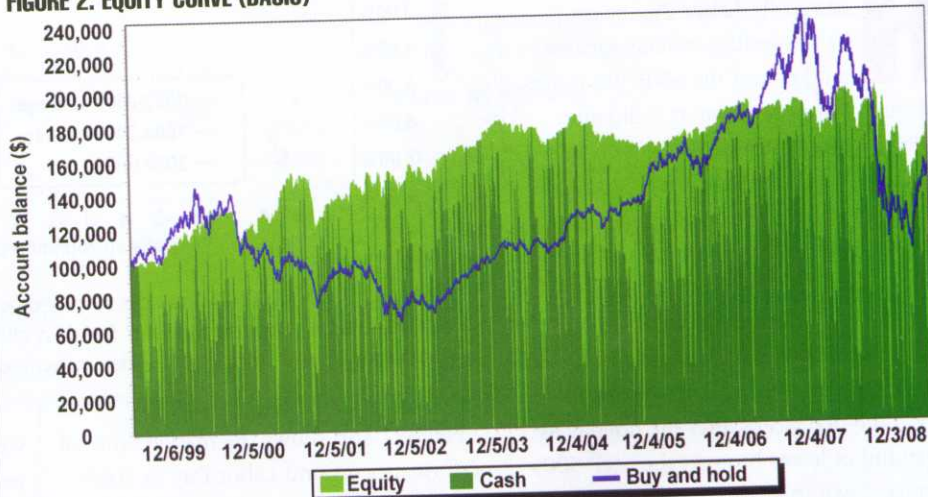
FIGURE 1: SAMPLE TRADES



The Choppiness Index (second from top) is used to filter trade signals that occur in lifeless, non-trending conditions.

Source for all Figures: Wealth-Lab Pro 5.4

FIGURE 2: EQUITY CURVE (BASIC)



This simple countertrend system was surprisingly productive, although it had trouble keeping pace with the strong bull market during the second half of the test period.

The Choppiness Index (CI), created by commodity trading advisor E.W. "Bill" Dreiss, is an indicator designed to determine whether market movement is directional or consolidating. Like similar tools, such as the average directional movement index (ADX), the random walk index (RWI), and the vertical horizontal filter (VHF), the CI represents the degree of trendiness or congestion in price, but not its direction.

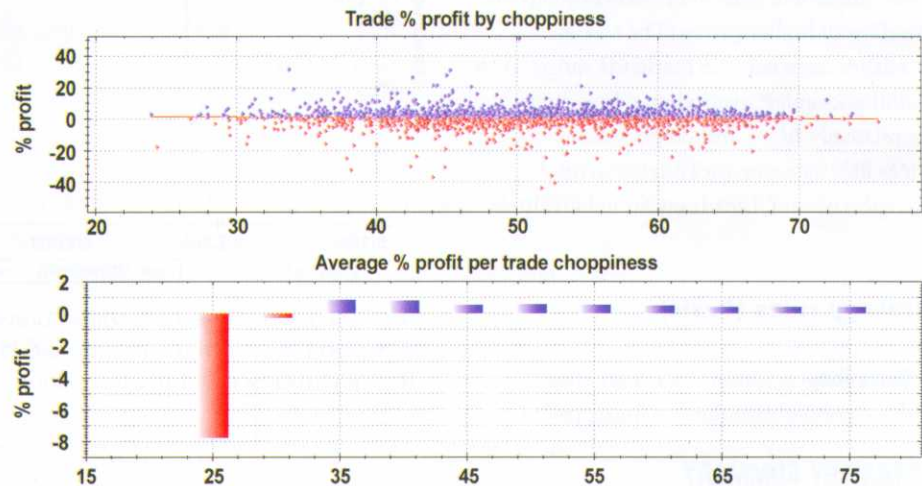
The CI compares the sum of bar-to-bar price activity (derived from true range) during a given look-back period to the high-low range during that period. The higher the reading (the indicator ranges from zero to 100), the choppier the market; the lower the reading, the trendier the market. The CI formula is:

1. Calculate each period's (day, week, hour) true range. (The true high is the higher of this bar's high or the previous bar's close; the true low is the lower of this bar's low or the previous bar's close. The true range is the difference between the two.)
2. Sum the past n true ranges.
3. Calculate the true range for the entire n -bar period.
4. Divide the sum of the n true ranges by the n -day true range.
5. Calculate the logarithm (base 10) of the result from step 4.
6. Divide the result from step 5 by the logarithm of n .
7. Multiply the result by 100.

In an article in the November 1991 *Technical Traders Bulletin*, Dreiss wrote: "Low readings in the CI correspond closely with the end of strong impulsive movements either up or down, while high readings occur after significant consolidations in the price."

The article also advises avoiding

FIGURE 3: ANALYSIS SERIES VIEW



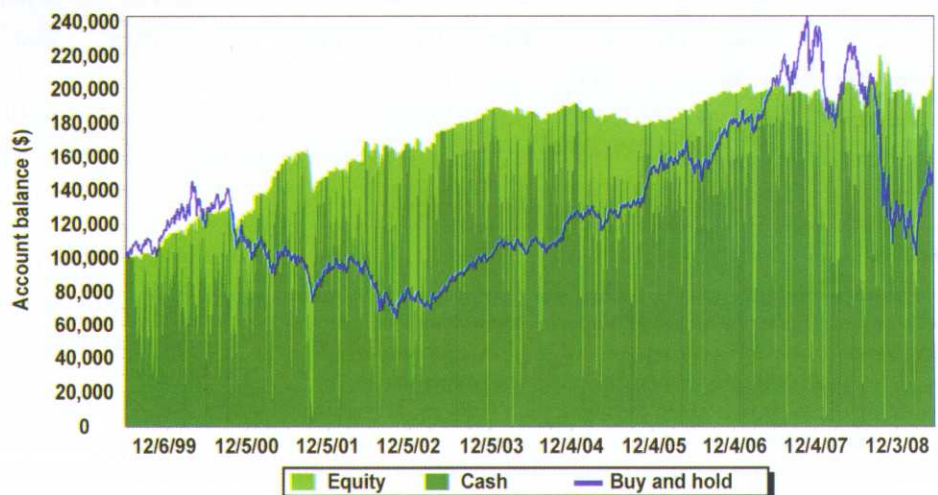
The lower the CI filter value, the larger the average trade.

trades when the CI is in an extended period of above-average readings and instead favors situations in which the indicator fluctuates from one extreme to the other. Higher CI readings can also be a sign of the impending end of a consolidation and a potential breakout, while low CI readings can indicate a possible reversal.

The following tests analyze the impact of the CI as a filter on

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FIGURE 4: EQUITY CURVE (FILTERED)



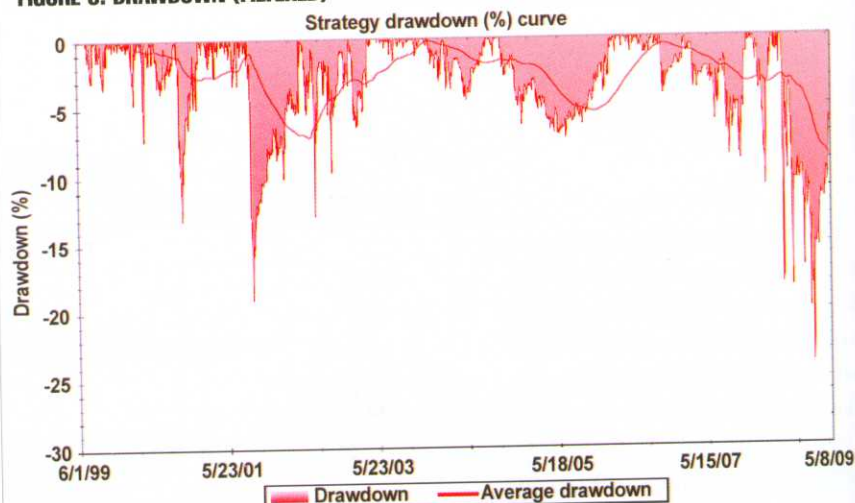
The modified system traded much less frequently and had lower market exposure equity (44 percent to 29 percent), while producing a smoother equity curve.

a basic, generic trading approach that is not overly "tweaked" or loaded with sophisticated exit rules. The strategy simply buys after three consecutive days of lower prices and sells after two consecutive days of higher prices. The system avoids trades when the market is range-bound and indecisive (when CI readings are relatively high) and enters when prices exhibit some measure of trend strength (when CI readings are relatively low).

Strategy rules (basic):

Enter long at tomorrow's open after three consecutive days of lower prices.

FIGURE 5: DRAWDOWN (FILTERED)



The 200-day average here shows drawdowns rarely exceeded -5 percent, although the system is currently experiencing its largest setback. The system closed out the test period with three winning years.

STRATEGY SUMMARY

	Basic	Filtered	Trade statistics	Basic	Filtered
Profitability					
Net profit:	\$79,010	\$106,719	No. trades:	1,871	1,277
Net profit:	79.01%	106.72%	Win/loss:	61.14%	62.26%
Profit factor:	1.15	1.29	Avg. profit/loss:	0.38%	0.61%
Payoff ratio:	0.77	0.83	Avg. holding time (days):	7.07	6.83
Recovery factor:	1.17	2.02	Avg. profit (winners):	3.5%	3.71%
Exposure:	43.97%	28.71%	Avg. Hold time (winners):	5.41	5.25
Max. DD:	-33.94%	-23.92%	Avg. Loss (losers):	-4.53%	-4.5%
Longest flat period:	461 bars	390 bars	Avg. Hold time (losers):	9.68	9.44
Total commissions:	\$9,343	\$6,385	Max consec. win/loss:	17/12	17/7

PERIODIC RETURNS

	Avg. return %		Sharpe ratio		Best return %		Worst return %		% profitable periods		Max consec. profitable		Max consec. unprofitable	
	Basic	Fltrd	Basic	Fltrd	Basic	Fltrd	Basic	Fltrd	Basic	Fltrd	Basic	Fltrd	Basic	Fltrd
Monthly	0.57%	0.65%	0.13	0.28	10.76%	7.86%	-14.79%	-13.34%	59.17	67.5	6	11	4	3
Quarterly	1.68%	1.94%	0.12	0.25	17.64%	14.78%	-16.95%	-12.32%	58.54	63.41	5	6	4	4
Annually	5.87%	7.07%	0.09	0.29	21.88%	17.62%	-10.96%	-5.9%	72.73	90.91	6	6	2	1

LEGEND

Net profit — Profit at end of test period, less commission. **Profit factor** — Gross profit divided by gross loss. **Payoff ratio** — Average profit of winning trades divided by average loss of losing trades. **Recovery factor** — Net profit divided by maximum drawdown. **Exposure** — The area of the equity curve exposed to long or short positions, as opposed to cash. **Max. drawdown** — Largest percentage decline in equity. **Longest flat period** — Longest period, in days, the system is between two equity highs. **No. trades** — Number of trades generated by the system. **Win/loss** — The percentage of trades that were profitable. **Avg. profit/loss** — The average profit/loss for all trades. **Avg. hold time** — The average holding period for all trades. **Avg. profit (winners)** —

The average profit for winning trades. **Avg. hold time (winners)** — The average holding time for winning trades. **Avg. loss (losers)** — The average loss for losing trades. **Avg. hold time (losers)** — The average holding time for losing trades. **Max. consec. win/loss** — The maximum number of consecutive winning and losing trades. **Avg. return** — The average percentage for the period. **Sharpe ratio** — Average return divided by standard deviation of returns (annualized). **Best return** — Best return for the period. **Worst return** — Worst return for the period. **Percentage profitable periods** — The percentage of periods that were profitable. **Max. consec. profitable** — The largest number of consecutive profitable periods. **Max. consec. unprofitable** — The largest number of consecutive unprofitable periods.

Sell at tomorrow's open after two consecutive days of higher prices.

Strategy rules (filtered):

Enter long at tomorrow's open after three consecutive days of lower prices if the 14-day CI is below 50.

Sell at open next bar after two consecutive days of higher prices.

Figure 1 (p. 46) shows the CI resembles an inverted and smoothed version of the VHF — most of the time. The CI does a good job here detecting lifeless, range-bound conditions, sometimes staying at relatively high or low levels (i.e., above 61.8 or below 31.8 percent, see yellow and red highlights) for extended periods.

Money management: Allocate 10 percent of account equity per position.

Starting equity: \$100,000. Deduct \$2.50 commission and 0.10 percent slippage per trade.

Test data: The system was tested on the *Active Trader* Standard Stock Portfolio, which contains the following 17 stocks: Apple (AAPL), Boeing (BA), Citigroup (C), Caterpillar (CAT), Cisco Systems (CSCO), Disney (DIS), General Motors (GM), Hewlett Packard (HPQ), International Business Machines (IBM), Intel (INTC), International Paper (IP), J.P.Morgan Chase (JPM), Coca Cola (KO), Microsoft (MSFT), Starbucks (SBUX), AT&T (T), and Wal-Mart (WMT). Data source: Yahoo.com.

Period: June 1999 to May 2009.

Test results: Figure 2 (p. 46) shows the basic system was surprisingly productive, despite its simplistic design. Although trigger happy (1,871 trades), the system exited quickly (average trade length of seven days). Its higher-than-average win rate (61 percent) is representative of a countertrend technique, as is the low

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average trade size (0.38 percent).

Although the system outperformed buy-and-hold overall (79 percent vs. 54 percent), it couldn't keep up the strong bull trend that dominated the second half of the test period; the equity curve began to move sideways after its steady increase in the first half. The system's reward-risk ratio (net percentage profit divided by the maximum percentage drawdown) was around 2.3.

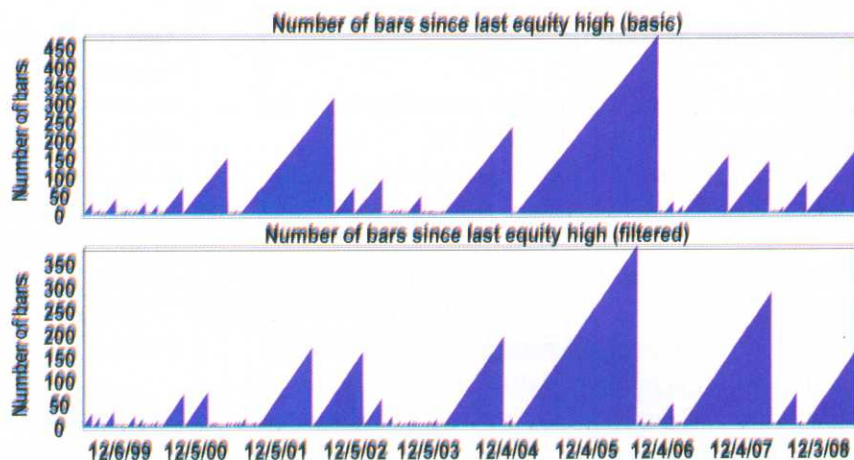
Let's look at the filtered version of the system. In Figure 3 (p. 47), each bar in the lower graph represents the average percentage profit per trade using different CI filter levels. Although there is only a slight negative correlation of trade profitability to the indicator, notice how the average net profit per trade rises as the CI declines. (The left-most bar should be ignored because using this CI value represents the results of rejecting almost all trades.) The best-performing CI value was 35 (it more than doubled the average trade profit), but to avoid using an optimized value, the strategy will instead skip trades when the CI is above 50, which is a representative value from the zone of stable readings.

The "Strategy summary" table (p. 48) shows the CI filter drastically reduced the number of trades (from 1,871 to 1,277) while improving performance noticeably. The basic system's high number of trades and small profits posed a problem in terms of increased slippage and trading costs, so to almost double the average trade (from 0.38 to 0.61 percent) with the filter is a big plus. Also, the reward-risk ratio jumped to almost 4.5, and the net profit (106.72 percent) increased to almost twice that of buy and hold.

Figure 4 (p. 47) shows the filtered equity curve was smoother than the original, and the strategy outperformed buy and hold throughout most of the test period, taking a backseat only when the bull market was raging.

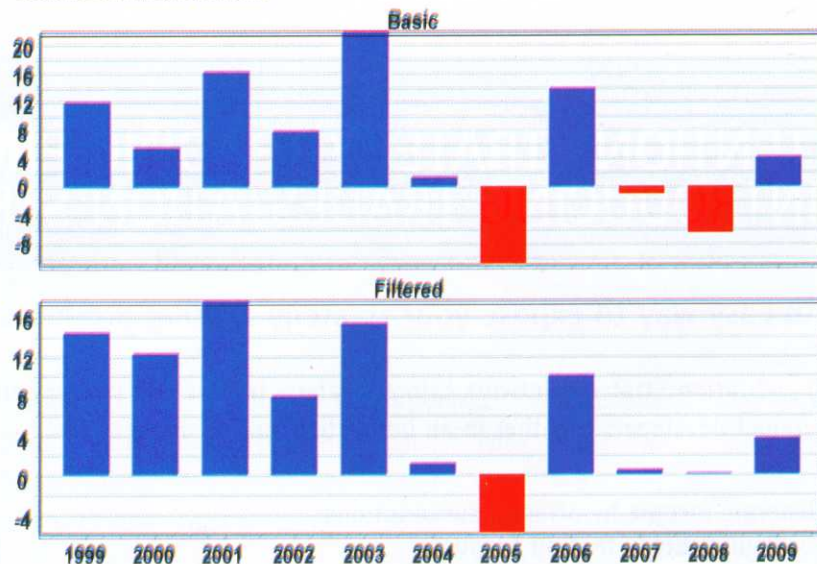
After setting a new equity high, the system entered its largest drawdown, which it is currently still in (-23.9 percent, Figure 5, p. 48), but the test results suggest the system bounces back fairly quickly (Figure 6). However, Figure 7 shows the system's

FIGURE 6: DRAWDOWN DURATION COMPARISON



The system typically recovered from drawdowns relatively quickly.

FIGURE 7: ANNUAL RETURN



The CI saved the system from a couple of losing years.

uneven annual returns in the second half of the test period were responsible for a mediocre Sharpe ratio (0.7).

Finally, the system's profits were relatively well distributed, with no single stock accounting for too much of the total gain (Figure 8, p. 61).


Bottom line: This test suggests the CI could be useful as a filter or screen to block trades when the odds of success are reduced. For example, to enhance a long trend-following system by using a scale-in buying approach on pullbacks, you might

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jump after three-month index lows and its decline after six-month index lows points toward focusing on the consistent decline following three- and six-month highs in the economic surprise index's rolling 20-day total (Figures 3 and 5). In both cases, SPY declined at least 0.61 percent by day 5, followed by additional weakness in the second week.

Ideas for further research

Searching for reliable market patterns around economic news extremes is just one way to analyze the economic surprise index. Another idea is to identify sharp spikes and drops in the index that don't actually reach historic extremes (i.e., the 30-point drop just before the market's plunge on Feb. 27, 2007).

Also, the economic surprise index's methodology of incorporating many elements into an index can be applied to other types of data that influence the market, such as quarterly earnings and even geopolitical events. 

Related reading

"Trading Market Events: Economic Reports and Market Holidays"

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Trading System Lab

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avoid entering immediately if the CI posts persistently low values for extended periods, as this reflects a strong trend and can result in repeated entries at unfavorably high prices.

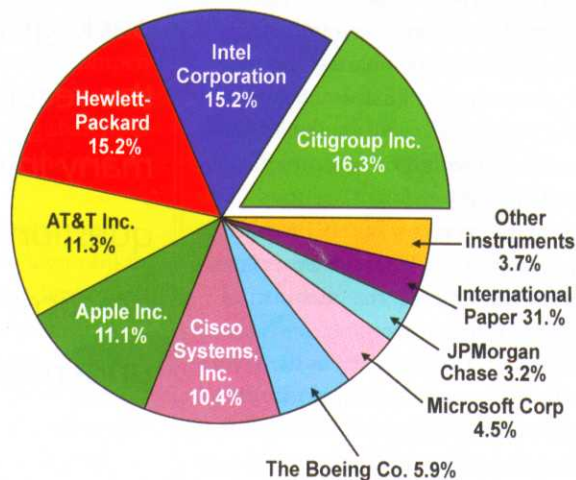
Another possible application: using high CI readings along with other technical tools to identify the proper conditions for accumulating shares in long-lasting basing periods in anticipation of a new trend. Also, it would be possible to make the CI thresholds adaptive by applying Bollinger Bands to them (see "Adaptive RSI 2.0," *Active Trader*, July 2009). 

For information on the author see p. 8.

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FIGURE 8: PROFIT DISTRIBUTION



The modified system's profit distribution was well balanced.