

# Battle of the bands

Putting various Bollinger Band strategies to the test in stock indices since 1999.

BY CAMILLO LENTO

**B**ollinger Bands are price boundaries that are typically placed two standard deviations (SD) above and below a simple moving average (SMA). The indicator shows whether volatility is high or low as the width between the bands widens or narrows; it also shows where the market is relative to past prices and within the bands themselves.

Most price action occurs within the upper and lower bands, so when price hits either line, the market is reaching an extreme. As with most technical indicators, Bollinger Bands are interpreted in different ways. Traditionally, traders have viewed Bollinger Bands as relative overbought or oversold levels and potential reversal points. Others interpret price touching or penetrating one of the bands as a sign of strong momentum and an indication a new trend has been confirmed and should be followed. Which scenario is more likely?

To answer this question, this study summarizes and updates results from a recent academic paper that tested Bollinger Band strategies (see “Related reading,” p. 43). It analyzes two interpretations of Bollinger Bands on daily prices on the S&P 500 index (SPX), Dow Jones Industrial Average (DJIA), and Nasdaq Composite (COMP) over the

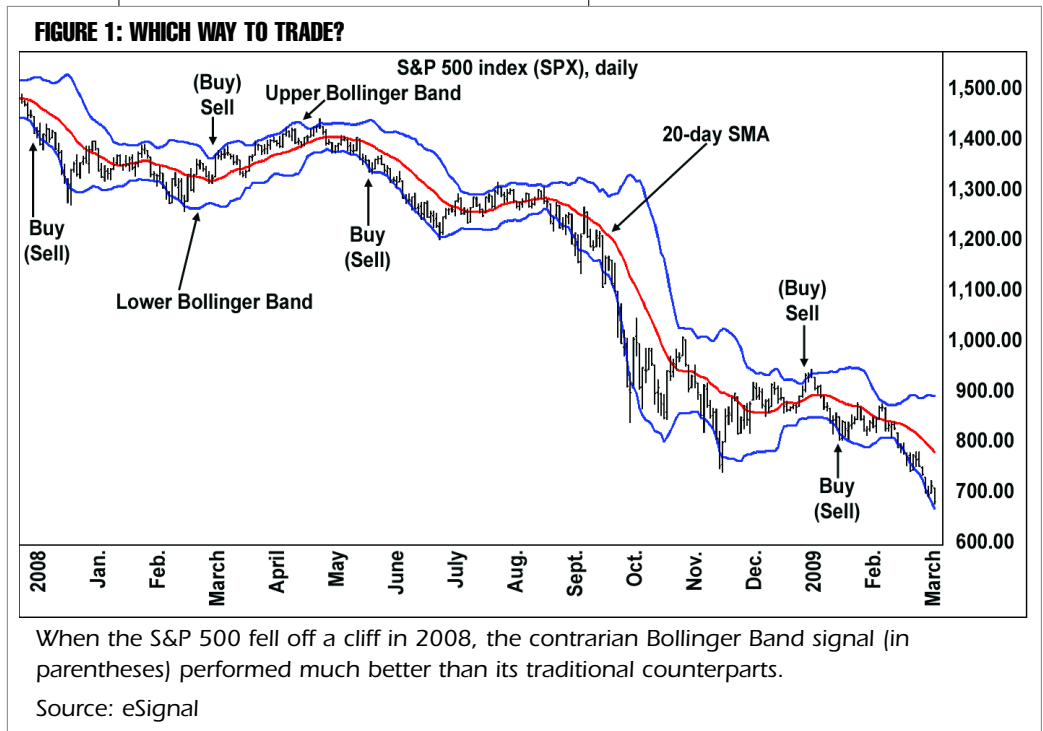
past 10 years. It then focuses on two distinct periods — the technology bubble’s arc from 1999 to 2002 and the recent financial meltdown from late 2007 to early 2009. In such crisis periods, one Bollinger Band approach worked better than the other.

### Take the traditional (countertrend) view ...

The debate over how to interpret situations in which price hits or exceeds the upper or lower Bollinger Bands boils down to one question: Fade or trade? In other words, is the market poised to reverse direction or continue moving higher or lower?

According to standard interpretations, when price touches or exceeds one of the trading bands, the market is overextended. The essence of the traditional approach is to sell into strength and buy into weakness on the premise that strength or weakness is overdone. A buy signal triggers if price drops below the lower band. In this case, the market could be oversold. A sell signal triggers if price breaks above the upper band. In this case, the market could be overbought.

However, this method doesn’t work during strong trends. When the market is trending higher, Band penetrations give sell signals all the way up, and when the



**TABLE 1: TESTING BOLLINGER BANDS, 1999-2009**

	<b>Bollinger Bands</b>			<b>Contrarian Bollinger Bands</b>			<b>Difference</b>		
	<b>MA (days) / +/- SD</b>			<b>MA (days) / +/- SD</b>			<b>MA (days) / +/- SD</b>		
<i>Market index</i>	<i>20/2</i>	<i>20/1</i>	<i>30/2</i>	<i>20/2</i>	<i>20/1</i>	<i>30/2</i>	<i>20/2</i>	<i>20/1</i>	<i>30/2</i>
<b>S&amp;P 500</b>									
Annual return	-2.6%	-3.4%	-2.4%	-4.4%	-5.4%	-4.1%			
Buy & hold return	-5.3%	-5.3%	-6.0%	-5.3%	-5.3%	-6.0%			
<b>Over / (under) performance</b>	<b>2.7%</b>	<b>1.9%</b>	<b>3.6%</b>	<b>0.9%</b>	<b>-0.1%</b>	<b>1.9%</b>	<b>-1.8%</b>	<b>-2.0%</b>	<b>-1.7%</b>
No. of trades	257	281	192	257	281	192			
<b>Dow Jones Industrial Average</b>									
Annual return	0.5%	0.5%	-0.1%	-3.9%	-5.7%	-3.2%			
Buy & hold return	-1.9%	-1.9%	-2.7%	-1.9%	-1.9%	-2.7%			
<b>Over / (under) performance</b>	<b>2.4%</b>	<b>2.4%</b>	<b>2.6%</b>	<b>-2.0%</b>	<b>-3.8%</b>	<b>-0.5%</b>	<b>-4.4%</b>	<b>-6.2%</b>	<b>-3.1%</b>
No. of trades	257	291	197	257	291	197			
<b>Nasdaq Composite</b>									
Annual return	-13.8%	-11.9%	-12.0%	7.6%	3.0%	6.5%			
Buy & hold return	-5.8%	-5.8%	-7.0%	-5.8%	-5.8%	-7.0%			
<b>Over / (under) performance</b>	<b>-8.0%</b>	<b>-6.1%</b>	<b>-5.0%</b>	<b>13.4%</b>	<b>8.8%</b>	<b>13.5%</b>	<b>21.4%</b>	<b>14.9%</b>	<b>18.5%</b>
No. of trades	235	282	177	235	282	177			

Traditional Bollinger Band rules (left column) outperformed the S&P 500 and the Dow Jones Industrial Average since 1999, but not the Nasdaq Composite. However, the contrarian rules succeeded where the traditional ones fell flat.

market is trending lower, they signal buys all the way down.

Clearly, it is risky to follow these signals without other types of analysis. Bollinger himself warns that they aren't automatic trade signals and suggests confirming them with other indicators.

### ... or follow the momentum crowd?

The opposite approach buys into strength and sells into weakness, seeking to follow developing trends. Instead of selling when price tags the upper band, trend followers buy on the logic that a break above the upper band is bullish. Similarly, momentum traders sell when price sinks below the lower band as they expect price to continue falling lower.

Figure 1 shows a daily chart of the S&P 500 index (SPX) along with Bollinger Bands (20-day SMA, two standard deviations) from January 2008 to March 2009. Traditional (countertrend) trade signals are shown along with contrarian (momentum) signals in parentheses. As the market collapsed, the contrarian Bollinger Band signals performed much better than their traditional counterparts.

For example, a signal was triggered when price closed below the lower band on June 11, 2008, and the S&P 500 fell 30 percent over the following six months before the system triggered an exit on Jan. 2. Obviously, you would want to be out of the market (or short) during this period, not long. But that doesn't mean selling weakness and buying strength is always the best strategy.

### The test

By default, Bollinger Bands lie two standard deviations above and below a 20-day SMA. However, there is no theoretical or practical explanation for using the traditional parameters. Why not use one standard deviation or a 30-day SMA?

The test used rules based on Bollinger Bands' traditional settings, as well as two others: two standard deviations from a 30-day SMA, and one standard deviation from a 20-day SMA. The traditional and contrarian Bollinger Band approaches were tested using these settings on the S&P 500, the Dow, and the Nasdaq Composite indices in the 10-year period from Jan. 1, 1999 to Jan. 30, 2009. Two questions we hope to answer are: Does a

longer-term MA generate more effective signals, and does a narrower band generate correct signals quicker?

The system takes only long signals; when a sell signal triggers, the system exits and earns a notional interest rate of 3 percent annually. If the system is long and a buy signal appears, no action is taken. Similarly, if the system is out of the market and a sell signal appears, no action is taken. The trade rules are:

*Default settings (20-day SMA, 2 SDs):*

1. **Go long** at the next day's open if price closes below two standard deviations from the 20-day moving average.
2. **Exit the market** at the next day's open if price closes above two standard deviations from the 20-day moving average and earn 3-percent interest.

*Narrow band settings (20-day SMA, 1 SD):*

1. **Go long** at the next day's open if price closes one standard deviation below the 20-day

*continued on p. 40*

**TABLE 2: BOLLINGER BANDS IN TECH BUBBLE, 1999-2002**

Market index	Bollinger Bands MA (days) / +/- SD			Contrarian Bollinger Bands MA (days) / +/- SD			Difference MA (days) / +/- SD		
	20/2	20/1	30/2	20/2	20/1	30/2	20/2	20/1	30/2
<b>S&amp;P 500</b>									
Annual return	-2.7%	-3.8%	-0.1%	-11.6%	-12.2%	-14.7%			
Buy & hold return	-11.8%	-11.9%	-13.7%	-11.9%	-11.9%	-13.7%			
<b>Over / (under) performance</b>	<b>9.1%</b>	<b>8.1%</b>	<b>13.6%</b>	<b>0.3%</b>	<b>-0.3%</b>	<b>-1.0%</b>	<b>-8.8%</b>	<b>-8.4%</b>	<b>-14.6%</b>
No. of trades	92	110	72	92	110	72			
<b>Dow Jones Industrial Average</b>									
Annual return	1.5%	-0.6%	4.4%	-7.2%	-7.5%	-11.8%			
Buy & hold return	-3.9%	-3.9%	-6.0%	-3.9%	-3.9%	-6.0%			
<b>Over / (under) performance</b>	<b>5.4%</b>	<b>3.3%</b>	<b>10.4%</b>	<b>-3.3%</b>	<b>-3.6%</b>	<b>-5.8%</b>	<b>-8.7%</b>	<b>-6.9%</b>	<b>-16.2%</b>
No. of trades	102	120	85	102	120	85			
<b>Nasdaq Composite</b>									
Annual return	-27.1%	-27.0%	-23.2%	9.7%	7.2%	3.6%			
Buy & hold return	-18.1%	-18.1%	-21.1%	-18.1%	-18.1%	-21.1%			
<b>Over / (under) performance</b>	<b>-9.0%</b>	<b>-8.9%</b>	<b>-2.1%</b>	<b>27.8%</b>	<b>25.3%</b>	<b>24.7%</b>	<b>36.8%</b>	<b>34.2%</b>	<b>26.8%</b>
No. of trades	84	99	67	84	99	67			

The contrarian rules beat traditional techniques by a wide margin on the Nasdaq Composite as the technology bubble grew and then popped. By contrast, the traditional rules were more successful on the S&P 500 and the Dow during this period.

moving average.

2. **Exit the market** at the next day's open if price closes one standard deviation above the 20-day moving average and earn 3-percent interest.

Longer MA settings  
(30-day SMA, 2 SDs):

1. **Go long** at the next day's open if price closes two standard deviations below the 30-day moving average.
2. **Exit the market** at the next day's open if price closes two standard deviations above the 30-day moving average and earn 3-percent interest.

All three versions of the traditional Bollinger Band strategy were tested separately. We then reversed the rules and tested the contrarian, or momentum, approach. For example, this method goes long at the next day's open if price closes above the upper band and exits the mar-

ket after it closes below the lower band. Again, all three Bollinger Band settings were tested — a total of six tests. Commissions were \$19.99 per trade; slippage was calculated as a percentage of the bid-ask spread on a related stock index ETF.

**Test results**

Table 1 (p. 39) compares the annual returns of all six strategies to the buy-and-hold returns in each index. The three versions of the traditional Bollinger Band rules outperformed in the S&P 500 and the Dow Jones Industrial Average; however, none of the traditional rules were profitable on the Nasdaq Composite.

Furthermore, two of the three traditional versions (20-day SMA/two-SD, and 20-day SMA/one-SD) earned slight profits in the Dow over the 10-year period, while a buy-and-hold approach had a 1.9 percent annualized loss.

Conversely, all three variations of the contrarian, or momentum, Bollinger Band strategy performed well in the Nasdaq

Composite. These sets of rules earned annualized gains of 3.0 to 7.6 percent vs. an annualized loss of roughly 5.8 percent for buy-and-hold since 1999. In other words, the contrarian rules beat buy-and-hold from 8.8 to 13.5 percent annually in this market. Two of the three variations were also profitable in the S&P 500, but none of them made money in the Dow.

Table 1 also compares the profitability of both types of Bollinger Band trade rules (right column). The momentum strategies earned 14.9 percent to 21.4 percent more than the countertrend ones on the Nasdaq Composite. But that dynamic was reversed on the S&P 500 and Dow Jones Industrial Average.

**Bands on the run**

The wide gap in performance between the two types of strategies on the Nasdaq merits further investigation. One explanation is the Nasdaq climbed and fell surrounding the technology bubble more dramatically than the S&P 500 or the Dow. In this case, trend-following tech-

**TABLE 3: BOLLINGER BANDS IN FINANCIAL CRISIS, 2007-2009**

Market index	Bollinger Bands MA (days) / +/- SD			Contrarian Bollinger Bands MA (days) / +/- SD			Difference MA (days) / +/- SD		
	20/2	20/1	30/2	20/2	20/1	30/2	20/2	20/1	30/2
<b>S&amp;P 500</b>									
Annual return	-41.3%	-32.9%	-35.3%	-17.1%	-14.8%	-15.9%			
Buy & hold return	-52.1%	-52.5%	-49.4%	-52.1%	-52.5%	-49.4%			
<b>Over / (under) performance</b>	<b>10.8%</b>	<b>19.6%</b>	<b>14.1%</b>	<b>35.0%</b>	<b>37.7%</b>	<b>33.5%</b>	<b>24.2%</b>	<b>18.1%</b>	<b>19.4%</b>
No. of trades	92	110	72	92	110	72			
<b>Dow Jones Industrial Average</b>									
Annual return	-32.4%	-6.3%	-34.8%	-22.5%	-43.0%	-10.6%			
Buy & hold return	-47.7%	-47.9%	-45.7%	-47.7%	-47.9%	-45.7%			
<b>Over / (under) performance</b>	<b>15.3%</b>	<b>41.6%</b>	<b>10.9%</b>	<b>25.2%</b>	<b>4.9%</b>	<b>35.1%</b>	<b>9.9%</b>	<b>-36.7%</b>	<b>24.2%</b>
No. of trades	33	35	15	33	35	15			
<b>Nasdaq Composite</b>									
Annual return	-48.6%	-48.6%	-27.3%	-6.2%	-6.9%	-18.2%			
Buy & hold return	-53.0%	-53.0%	-47.2%	-53.0%	-53.0%	-47.2%			
<b>Over / (under) performance</b>	<b>4.4%</b>	<b>4.4%</b>	<b>19.9%</b>	<b>46.8%</b>	<b>46.1%</b>	<b>29.0%</b>	<b>42.4%</b>	<b>41.7%</b>	<b>9.1%</b>
No. of trades	29	30	18	29	30	18			

As the stock market tumbled recently, the contrarian strategies (middle columns) beat their counterparts.

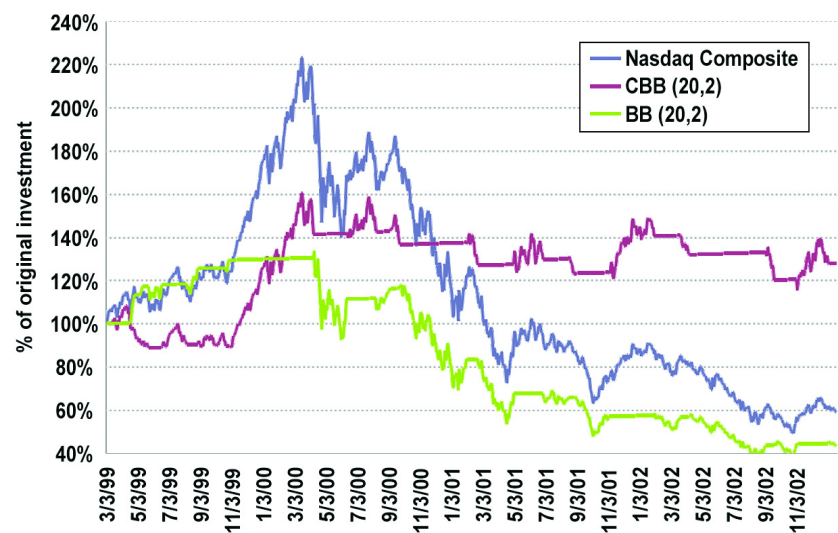
niques would outperform countertrend ones.

For example, the traditional countertrend Bollinger Band rules would trigger sell signals on the incredible upward momentum during the technology bubble, and they would trigger buy signals as the market crashed. Furthermore, those same rules may have generated various buy signals as the market declined during the credit crisis in late 2008.

To find out how the strategies performed during bubbles and high volatility periods, we tested them in two sub-periods: 1999 to 2002 and 2007 to 2009. The first sub-period represents the technology bubble's sharp rise and fall, and the second spans the market's meltdown during the recent financial crisis.

Table 2 (p. 40) lists each strategy's performance from Jan. 4, 1999 to Dec. 31, 2002. Results are similar to those of the overall 10-year period, except the gaps in performance are more extreme. Again, the contrarian rules beat traditional techniques by a wide margin in the Nasdaq, but not in the other indices. Also, the traditional rules posted gains in the Dow while the index itself lost ground on an annualized basis.

**FIGURE 2: BOLLINGER BANDS IN BUBBLE**



Unlike the standard Bollinger Band strategy, the technique of buying strength and selling weakness helped to preserve capital from 1999 to 2002 (green and purple lines, respectively).

Indeed, all three standard approaches outperformed buy-and-hold in the S&P 500 and Dow Jones Industrial Average.

Table 3 (p. 41) shows performance statistics from Nov. 1, 2007 to Jan. 30, 2009. Interestingly, the contrarian (momentum) strategies trounced their counterparts during this period. Although

the standard rules outperformed a buy-and-hold approach, that wasn't a high hurdle given that buy-and-hold lost 30 percent (or more) annually.

Unlike the standard Bollinger Band strategy, the technique of buying strength  
*continued on p. 42*

and selling weakness helped preserve capital. In the Nasdaq, for example, the contrarian approach lost just 6.2 percent on an annualized basis, while the overall index retreated 53 percent. In the S&P 500, the same methods lost from 14.8 percent to 17.1 percent, while the S&P shed 52.5 percent. On the Dow, two of these three rules also managed to preserve capital.

Figures 2 and 3 compare the cumulative percentage moves of the standard and contrarian Bollinger Band strategies (20-day SMA, 2 SD) to a buy-and-hold investment in the Nasdaq Composite during these two sub-periods.

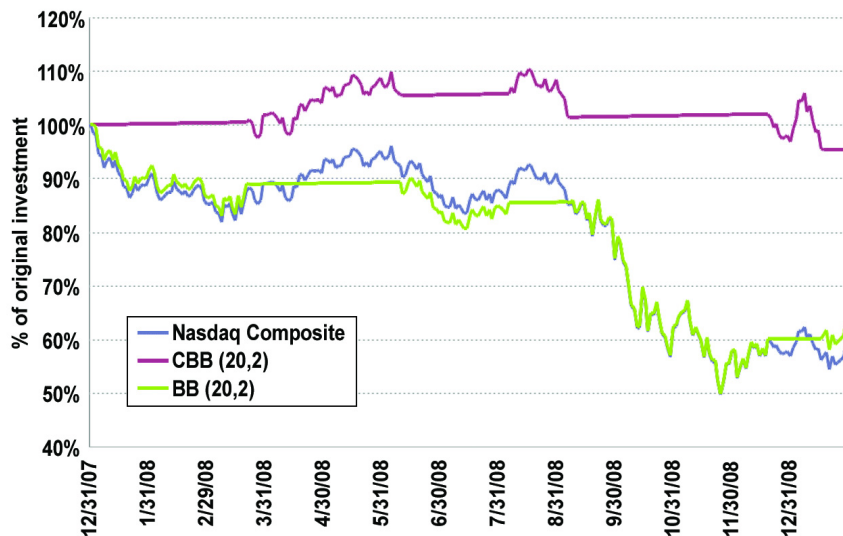
Figure 3 clearly shows that during the recent credit crisis, the contrarian strategy generated a sell signal before the market sank and stayed out of the market during these declines. However, the traditional Bollinger Band rules bought the market as it crashed (based on the premise that it was oversold), and it was out of the market during the recoveries. This evidence suggests you should use traditional Bollinger Band strategies with caution during periods of high volatility and market declines.

There are two caveats to these back-tested results. First, Bollinger Bands tend to be used in combination with other trading rules. The results may change if an additional indicator is relied upon to confirm the signals. For example, previous studies suggest that combining individual trading rules into a consensus tends to generate a more powerful signal than individual signals alone.

Secondly, these strategies are long only and assume you stay out of the market after a sell signal. But you can also sell short on sell signals. Performance will likely become far more volatile because you will always be in the market (either long or short). 📌

For information on the author see p. 8.

FIGURE 3: RECENT NASDAQ PERFORMANCE



The contrarian Bollinger Band strategy (purple line) generated a sell signal before the market sank last year and stayed out of the market during these declines.

### Related reading

**“Investment information content in Bollinger Bands?”**

by Camillo Lento, Nikola Gradojevic, and C.S. Wright.  
*Applied Financial Economic Letters*, 3:4, 263-267.  
 Download paper at <http://ssrn.com/author=970955>

**“Indicator insight: Bollinger Bands”**

*Active Trader*, July 2003.  
 By providing a framework designed to contain nearly 90 percent of price fluctuations, Bollinger Bands are a tool for identifying whether a price is relatively low or high at a given time.

**“John Bollinger Three-Article Collection”**

This discounted collection of three articles from 2001, 2002, and 2003 goes to the source — Bollinger himself — through two interviews plus one article he wrote. In the interviews, Bollinger discusses (among other topics) his career, technical analysis, systematic vs. discretionary trading, the transition of stocks out of the major bull market, and how to use Bollinger Bands. In the third article, he writes expansively on a wide range of volume indicators, including on-balance volume, accumulation-distribution, money flow, and intraday intensity.

Article 1 (interview):

**“John Bollinger: Focus on the markets,”** January-February 2001 issue.

Article 2 (interview):

**“Relatively speaking: John Bollinger,”** April 2003 issue.

Article 3:

**“Volume indicators revisited,”** by John Bollinger (March 2002 issue).

**“Filtering Bollinger Band breakouts”**

*Active Trader*, December 2007.  
 Does volatility make or break your strategy? Avoiding choppy market conditions strengthens this system.

**“Futures Trading System Lab: Long-term volatility breakout system”**

*Active Trader*, January 2003.  
 This system uses 60-day Bollinger Bands to attempt to ride the long-term trend in any market that tends to trend.

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