BRUCE WALDMAN

True Relationship Revealed!

The Link Between Bollinger Bands And The Commodity Channel Index

Bollinger Bands and the commodity channel index (CCI) have been employed independently, in conjunction with other indicators, and with each other. Could standard deviation bands around price action be a generalization of an oscillator plotted below the prices?

by Neil Jon Harrington

In my work in technical market analysis (TMA), I never really considered the commodity channel index (CCI) until December 2003, when I attended a conference of Woodie's CCI Club, highlighted by a talk by CCI creator Donald R. Lambert. Seeing so many people willing to come to a conference just to discuss one indicator got me curious. That curiosity led to my own study of the CCI in December 2003 and early January 2004. During that time, I happened upon an interesting relationship between the CCI and John Bollinger's work with standard deviation bands, which he coined "Bollinger Bands."

INITIAL RESEARCH

When I got home from the conference, I started experimenting with the CCI in the e-mini Standard & Poor's 500 market. I noticed it looked a lot like Bollinger's %B indicator, which I sometimes use. I changed a default setting of the %B and it became so close to the CCI that they had to be mathematically equivalent, or very close to it. That intrigued me even more.

But before going any further into my research, let's review the technical foundation of the commodity channel index and Bollinger Bands.

LAMBERT'S COMMODITY CHANNEL INDEX

Donald Lambert's article on the CCI was originally published in *Commodities* magazine (now *Futures*) in October 1980,

and republished with corrections in *Technical Analysis of* STOCKS & COMMODITIES in its inaugural year of 1982.

Lambert's article, corrected, outlines four steps to calculating the CCI:

Compute the typical price:

$$1 \qquad TP_i = \frac{High + Low + Close}{3}$$

Compute the simple moving average of the *n* most recent typical prices:

$$2 \qquad SMA = \frac{1}{n}\sum_{i=1}^{n} TP_i$$

Compute the mean deviation of the *n* most recent typical prices:

$$3 \qquad MD = \frac{1}{n}\sum_{i=1}^{n} |TP_i - SMA|$$

Compute the commodity channel index:

$$4 \qquad CCI = \frac{TP_i - SMA}{0.015 * MD}$$

Lambert commented that the 0.015 constant normalizes the result so that 70–80% of the values fall within a +100% to -100% channel. There was an error in the fourth step in Lambert's original article; this step reflects the corrected equation.

Lambert's use of statistical mathematics is similar to that used by Bollinger Bands. Lambert used the mean deviation, while Bollinger used the standard deviation.

Let's look at Bollinger's calculations. Figure 1 shows the CCI plotted below a chart of the emini S&P 500 futures contract.

Lambert's use of statistical math is similar to that used by Bollinger Bands.

BOLLINGER'S BANDS

John Bollinger's classic article, "Using Bollinger Bands," published in *Technical Analysis of* STOCKS & COMMODITIES in 1992, describes the calculations for Bollinger Bands. Steps 1 and 2 are the same as Lambert's calculations. The next step is:

Calculate the standard deviation of the *n* most recent typical prices:

$$5 \qquad SD = \sqrt{\frac{(TP_i - SMA)^2}{n}}$$

This is the key calculation difference between Lambert's and Bollinger's techniques. As I will comment later, with a 20-period simple moving average, the difference between a mean deviation and standard deviation is relatively insignificant.

Calculate the upper band:

$$6 \qquad TopBand = SMA + 2 * SD$$

Calculate the middle band:

$$7 \qquad MidBand = SMA$$

Calculate the bottom band:

$$8 \qquad BotBand = SMA - 2 * SD$$

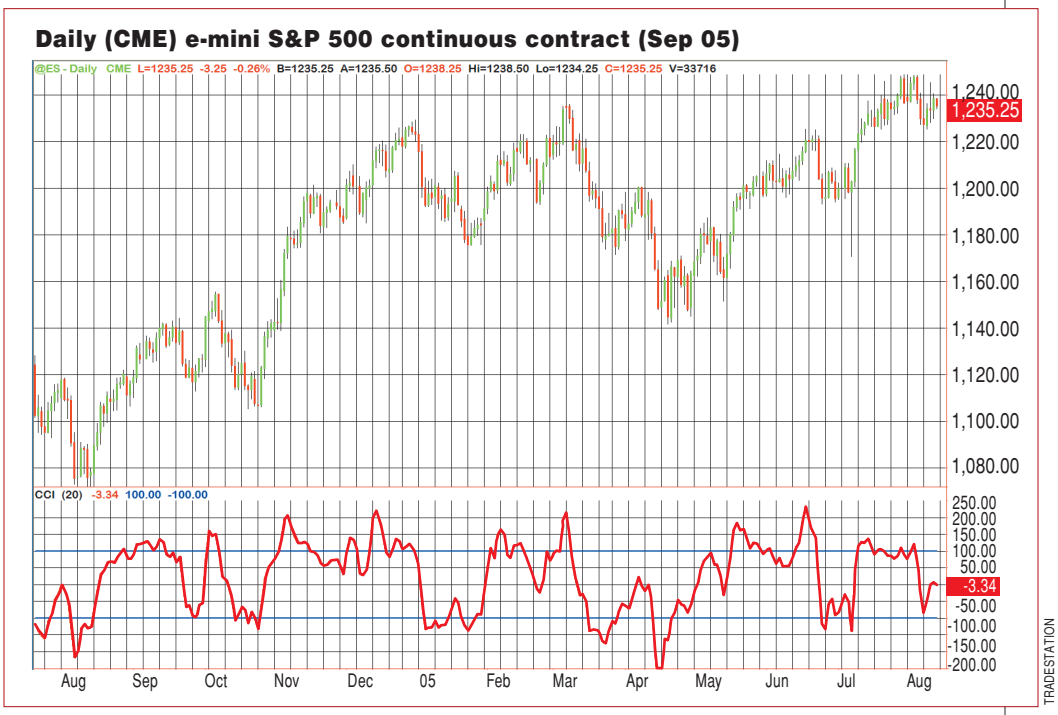

FIGURE 1: THE CCI. Here's the CCI plotted with the e-mini S&P 500 futures contract.

Figure 2 shows the default Bollinger Bands plotted on the same chart as the CCI.

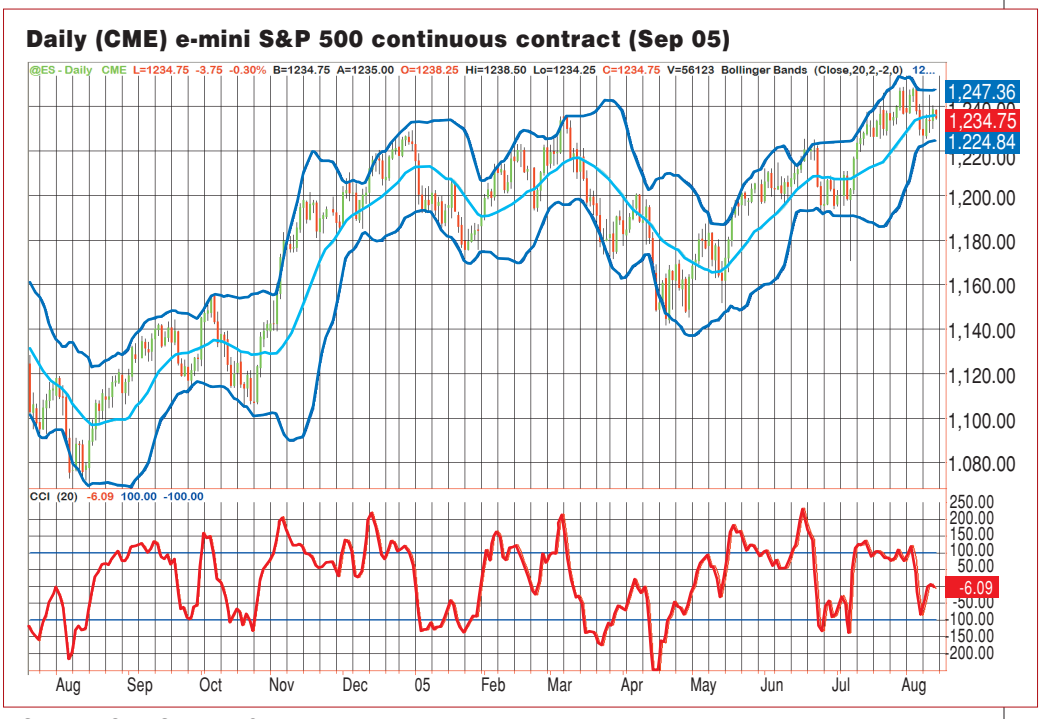

FIGURE 2: BOLLINGER BANDS. Here's the default Bollinger Bands plotted with the CCI.

BOLLINGER'S %B AND BANDWIDTH

In his article, Bollinger went on to describe two other useful derivative indicators of the Bollinger Bands — %B and bandwidth.

Bollinger called this first indicator *%B* because he used the same calculation for it that the late George Lane did in calculating %K in his stochastics calculations. %B tells you where prices are within the bands, but like the CCI and unlike stochastics, %B can be above or below one and zero. Here is the calculation:

$$\%B = \frac{Close - BotBand}{TopBand - BotBand} \quad (9)$$

I normalize this equation to map the Bollinger Bands to ±100 instead of one and zero. This makes its numbers map to the same range as the CCI. Here is the normalized %B:

$$\%NB = 200 * \left(\frac{Close - BotBand}{TopBand - BotBand}\right) - 100 \quad (10)$$

%B presents a normalized view of ±2 standard deviations around the moving average of the price action. The 100% line is the TopBand and the -100% line is the BotBand of the Bollinger Bands. When price goes above the TopBand, it also goes above 100%. Statistically, ±2 standard deviations will encompass 95% of the price action.

Bandwidth measures the width of the band as a percentage of the moving average:

$$BW = \frac{TopBand - BotBand}{MidBand} \quad (11)$$

To quote Bollinger: "When the bands narrow drastically, a sharp expansion in volatility usually occurs in the very near future." We will come back to this later.

LAMBERT'S CCI AND BOLLINGER'S %B

This is where the plot thickens. Figure 3 shows the standard CCI in subgraph 2, my normalized %B in subgraph 3, and the Bollinger Bands on the price graph. There are similarities as well as differences. Lambert used the mean deviation in his calculations and Bollinger used the standard deviation. With the 0.015 constant in his equations, Lambert wanted to encompass 70–80% of the price action within ±100%. Bollinger used ±2 standard deviations to encompass 95% of the price action with ±100%. An interesting sidenote is that Lambert used mean deviation instead of standard deviation because, in 1980, he was dealing with a Texas Instruments calculator and not a personal computer. Mean deviation was an easier calculation than standard deviation.

My first experiment created almost an exact match. I changed the standard deviation parameter of the normalized %B indicator from two to one. Statistically, this meant the bands encompassed 68% of the price action within the bands. I actually like using SD = 1 instead of two, because with this setting, like the CCI, it indicates a bullish move when it penetrates the top band and a bearish move when it penetrates the bottom band. Figure 4 shows this new setting of 1 for both the Bollinger Bands and the normalized %B.

As you can see from Figure 4, the plots for the CCI and the normalized %B with a parameter of 1 are virtually identical.

MASSAGING THE EQUATIONS

Since these graphs of the CCI and %B were so similar, I had to figure out how their calculations came to the same results. In other words, how could:

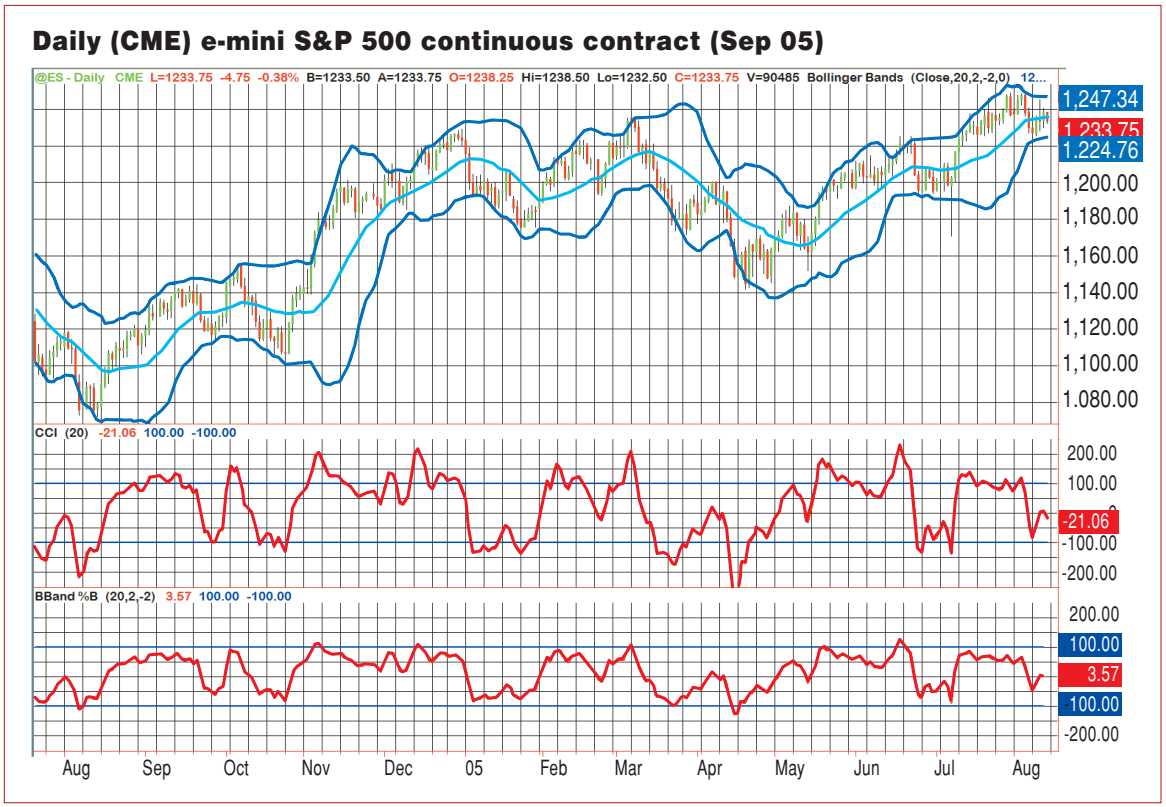

FIGURE 3: CCI AND BOLLINGER BANDS. Here's the standard CCI, the normalized %B in subgraph 3, and Bollinger Bands in the price graph. There are similarities as well as differences.

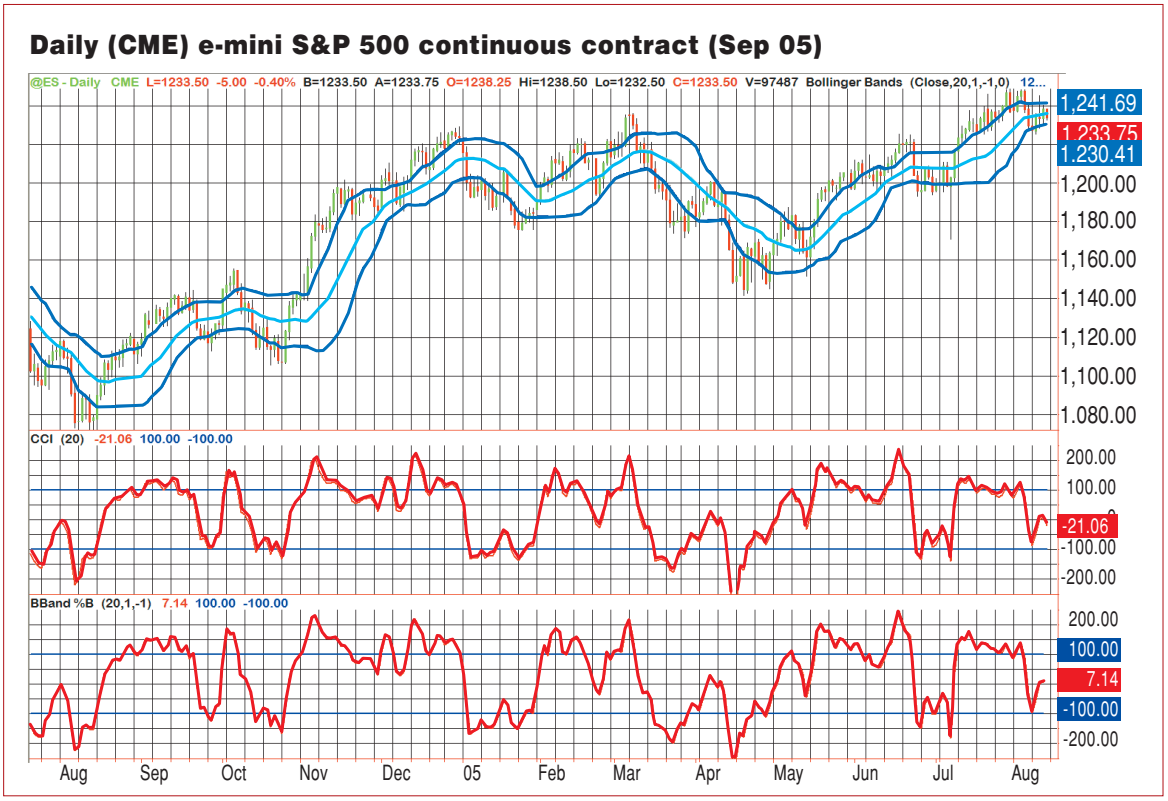

FIGURE 4: THEY DO SEEM SIMILAR. The plots for CCI and the normalized %B with a parameter of 1 appear almost identical.

12
$$CCI = \frac{TP_i - SMA}{.015 * MD} \approx \%NB$$

$$= 200 * \left(\frac{Close - BotBand}{TopBand - BotBand}\right) - 100$$

First, let's look at the normalized %B and see what we can do with it. With equation 10:

$$\%NB = 200 * \left(\frac{Close - BotBand}{TopBand - BotBand}\right) - 100$$

TopBand = SMA + SD
BotBand = SMA – SD
TopBand – BotBand = (MA + SD) – (MA – SD)
= 2*SD

So:

$$\%NB = 200 * \left(\frac{Close - SMA + SD}{2 * SD}\right) - 100$$

$$\%NB = 100 * \left[2 * \left(\frac{Close - SMA}{2 * SD} + \frac{1}{2}\right) - 1\right]$$

13
$$\%NB = 100 * \left(\frac{Close - SMA}{SD}\right)$$

Now, let's manipulate the CCI, starting with equation 4:

$$CCI = \frac{TP_i - SMA}{0.015 * MD}$$

$$= \frac{TP_i - SMA}{MD} * \frac{1{,}000}{15}$$

14
$$= 66.66667 * \frac{TP_i - SMA}{MD}$$

So now, instead of equation 12, we have:

15
$$CCI = 66.66667 * \left(\frac{TP_i - SMA}{MD}\right) \approx \%NB$$

$$= 100 * \left(\frac{Close - SMA}{SD}\right)$$

This approximate equality works because:

- TP_i is approximately equal to close
- When you compare standard deviation and mean deviation, the former is greater than the latter, compensating some for 66.66667 being less than 100.

After figuring this out, I researched the trading literature to see if anyone else had already discovered and discussed this. It was no surprise to me that John F. Ehlers in his book *Rocket Science For Traders* discussed the CCI in a way that showed he got exactly the meaning of the 0.015 constant in Lambert's calculations. But Ehlers didn't go on to discuss the CCI's similarity to John Bollinger's %B oscillator.

We must realize that the commodity channel index and Bollinger Bands are cut from the same mathematical cloth.

WHAT DO WE DO NOW?

We must realize the CCI and Bollinger Bands are cut from the same mathematical cloth, or as John Bollinger said, *don't use redundant indicators*. It is interesting to note that Bollinger said that the CCI was an early choice to use with the bands, but, as it turned out, it didn't work, as it tends to be collinear with the bands themselves in certain time frames. Bollinger found out empirically what this article shows mathematically; namely, that the only difference between Bollinger's %B and Lambert's CCI is the use of the mean deviation versus the standard deviation and the values of the parameters feeding them.

Simplify, simplify, simplify just by using Bollinger's %B where you were using CCI. Use Bollinger Bands (BB) and bandwidth (BW) to provide added visual impact and information to support your trading decisions.

Finally, find a nonredundant indicator to complement your use of Bollinger Bands so that you have "two independent witnesses" confirming your trading decisions.

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SUGGESTED READING

Bollinger, John [1992]. "Using Bollinger Bands," *Technical Analysis of* STOCKS & COMMODITIES, Volume 10: February.
Ehlers, John F. [2001]. *Rocket Science For Traders*, John Wiley & Sons.
Lambert, Donald R. [1982-3]. "Commodity Channel Index: Tool For Trading Cyclic Trends," *Technical Analysis of* STOCKS & COMMODITIES, Volume 1: Chapter 5.

†See Traders' Glossary

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