MOVING BEYOND the CLOSING PRICE

Most indicators have two limitations: They're usually based on specific price levels rather than price changes, and they only use the closing price of a bar. This technique allows you to build a price-change-based indicator that incorporates all the price points in a bar.

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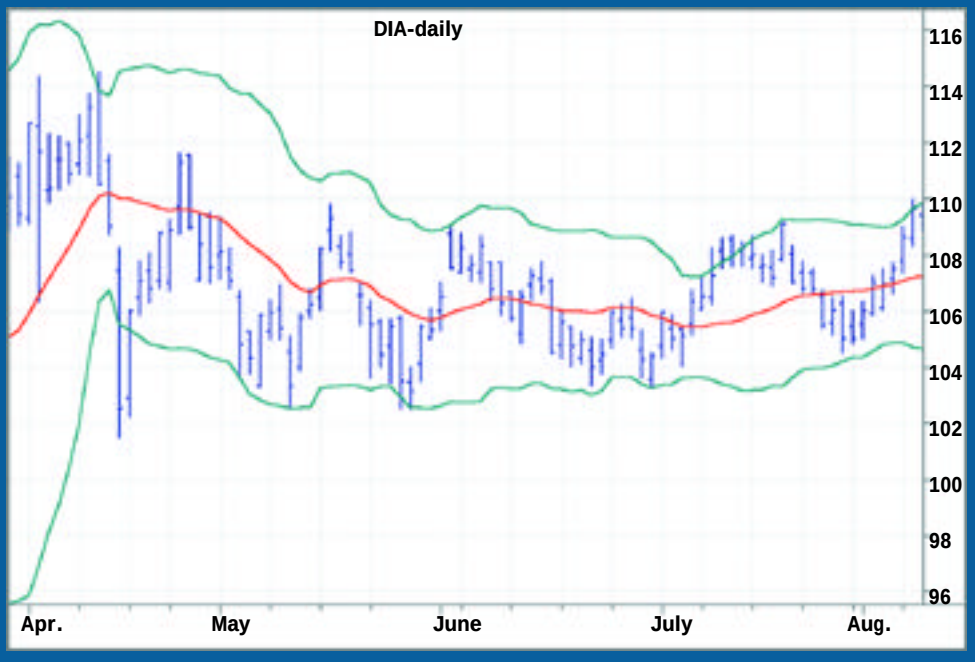
FIGURE 1 BOLLINGER BANDS

Bollinger bands usually do a good job of containing price action. But because they're based on one price observation per bar (the closing price), they don't provide informa - tion about the "hidden" volatility within each bar.



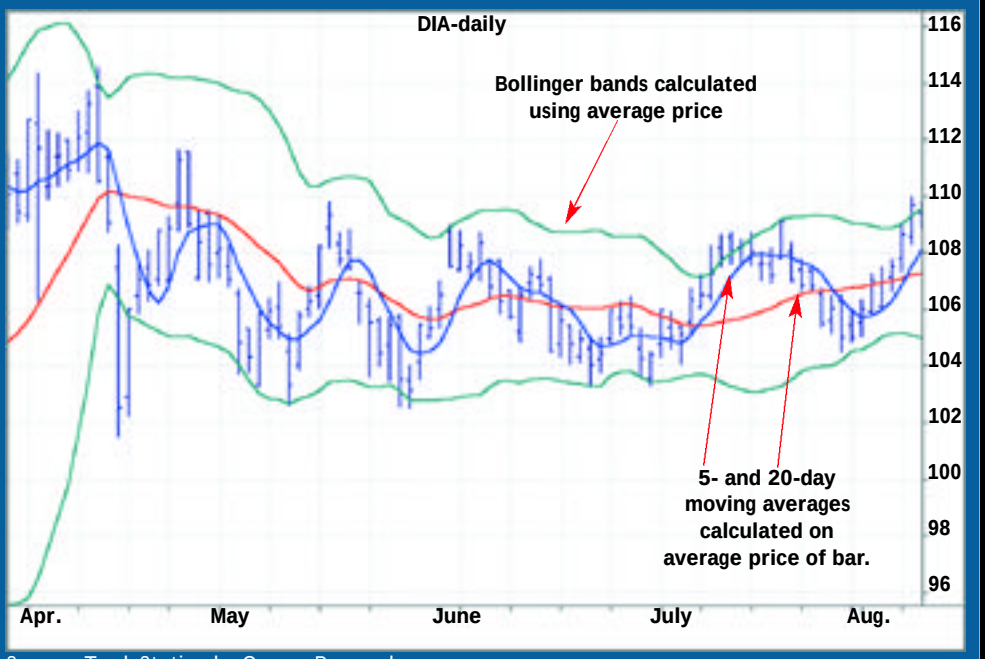
Source: TradeStation by Omega Research

A major disadvantage of many technical indicators is that they only use one piece of price information — the closing price. For instance, a moving average or an indicator such as Bollinger bands (which plots price bands a certain distance above and below a moving average) is usually calculated using the closing price — excluding the open, high and low prices. Figure 1 shows a 20-day moving average (red line) and 20-day Bollinger bands (green lines) on the Dow Jones tracking stock (DIA), distanced two standard deviations away from the moving average.

One way to work around this is to use the average price of a price bar — calculated as the sum of all four price points (open, high, low, close), divid-

FIGURE 2 **USING THE AVERAGE PRICE**

Basing calculations on the average price (as was done here) might provide a better feel for what happened at each particular bar, but it still won't let you make direct use of all price points, rendering this approach no more useful than using closing prices only.



Source: TradeStation by Omega Research

ed by four. Figure 2 shows what this looks like for 5- and 20-day moving averages, respectively. Because the average price consists of the different price point observations within each bar, the 5-day average actually uses 20 different price levels, while the 20-day average uses 80 different price levels.

However, it's still not possible to make distinct use of the different price points within bars when calculating Bollinger bands. As Figure 2 (compared to Figure 1) shows, there is little difference (if any) between Bollinger bands based on the 20-day moving average calculated using the average price and the standard 20-day moving average calculated using the closing price. Also, although there are 20 implicit price points making up the 5-day average of the daily average price (blue line in Figure 2), there is only one price observation per bar (the average price) going into the Bollinger band calculation. To make the standard deviation calculations for the Bollinger bands statistically reliable using traditional statistical guidelines, however, we should use at least 20 (or 30 or more, depending on the source) explicit price observations in our calculations.

A second disadvantage of most indicators is that they usually are calculated using the actual price levels instead of the price changes from bar to bar (or some other period). This makes little sense because price levels are likely to change over time as a market trends up and down, while the percentage changes from one period to the next are more likely to stay the same. Basing indicator calculations on price changes rather than actual prices makes it easier to compare indicator readings, both between different markets and different time periods.

Using price changes rather than price levels

One way to calculate a moving average on price changes rather than actual prices is to measure the average price change over a certain time period and then add that change to the closing price (or the average price) of the most recent bar. For example, you could calculate the average day-to-day price change for the last five days, and add that to the most recent close.

Figure 3A shows what this looks like. It's a 20-day moving average of close-to-close percentage changes added to the closing price of the second-to-last bar. This line shows where the market would have closed on the following bar (the most recent bar in the chart, which is not a part of the calculation) had it followed the average rate of change of the last 20 days.

Moving this calculation forward one day provides an indication of where the market should close tomorrow. This adjusted indicator, which is a 20-day moving average of the percentage price changes, is shown in Figure 3B. Notice how it differs from the regular 20-day moving average (blue line), which really doesn't tell you anything about where the market is going in the short term.

For TradeStation users out there, the EasyLanguage code is:

```
Inputs: LookBack(20);
Variable: PercChange(0),
                                NewLevel(0),
                                AvgPercChange(0);
PercChange = (Close -
                                Close[1])/Close[1];
AvgPercChange =
                                Average(PercChange,20);
NewLevel = Close *
                                (1 + AvgPercChange);
                                Plot1[1](NewLevel,"");
```

To calculate and plot the standard deviation bands around this new moving average (creating a Bollinger band based on the changes in the closing price), add the following code:

FIGURE 3A **USING PRICE CHANGES**

Basing calculations on price changes rather than price itself creates an indicator that hugs the most recent price action more closely, making it more meaningful for short-term traders. Figure 3B compares a 20-day moving average of price changes (red line) to a moving average of the actual price (blue line). The blue line only tells you what the average price of the last 20 days is; the red line tells you where the market is likely to close the next bar given the average change in prices over the same period.

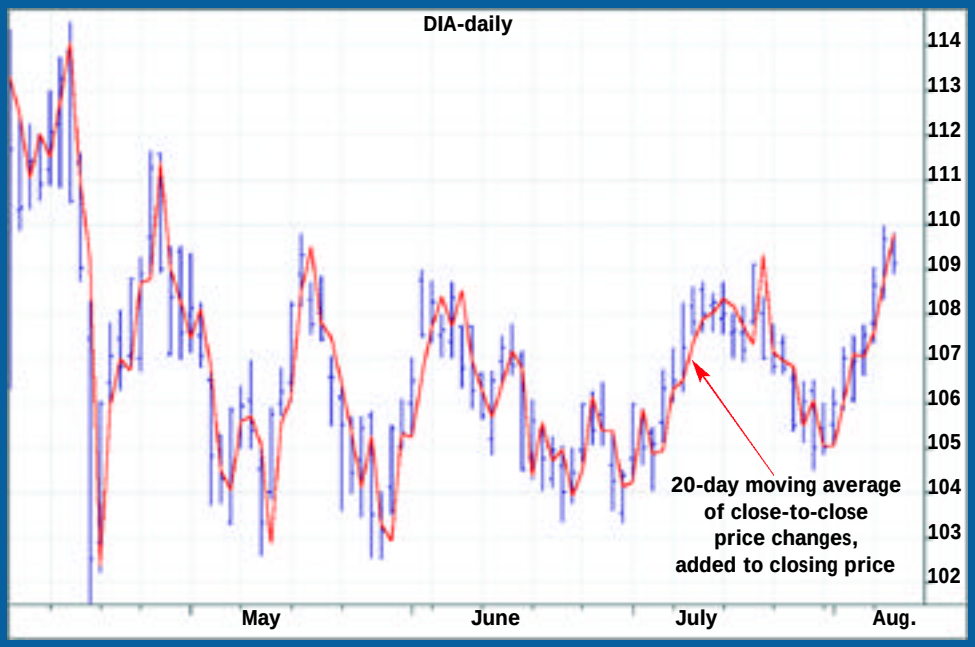
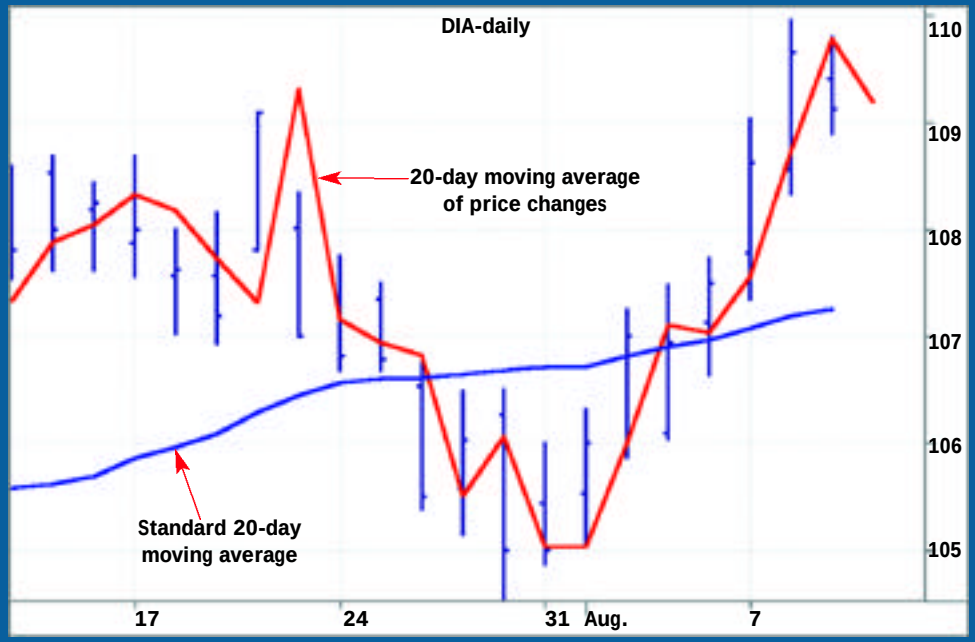


FIGURE 3B



Source for both: TradeStation by Omega Research

```
Inputs: StDevs(1);
Variable:StdDevChange(0),
  UpLevel(0),DownLevel(0);
StdDevChange =
  StdDev(PercChange, 20);
UpLevel = Close *
      (1 + AvgPercChange +
 StDevs * StdDevChange);
DownLevel = Close *
      (1 + AvgPercChange -
      StDevs * StdDevChange);
      Plot2[-1](UpLevel,"");
      Plot3[-
1](DownLevel,"");
```

Figure 4 shows the result. The upper and lower bands now are the Bollinger bands of the change in the closing price rather than the closing price itself. If you compare these three lines with the ones in Figure 1 it's obvious which ones more closely follow price and, therefore, are most useful to a short-term trader.

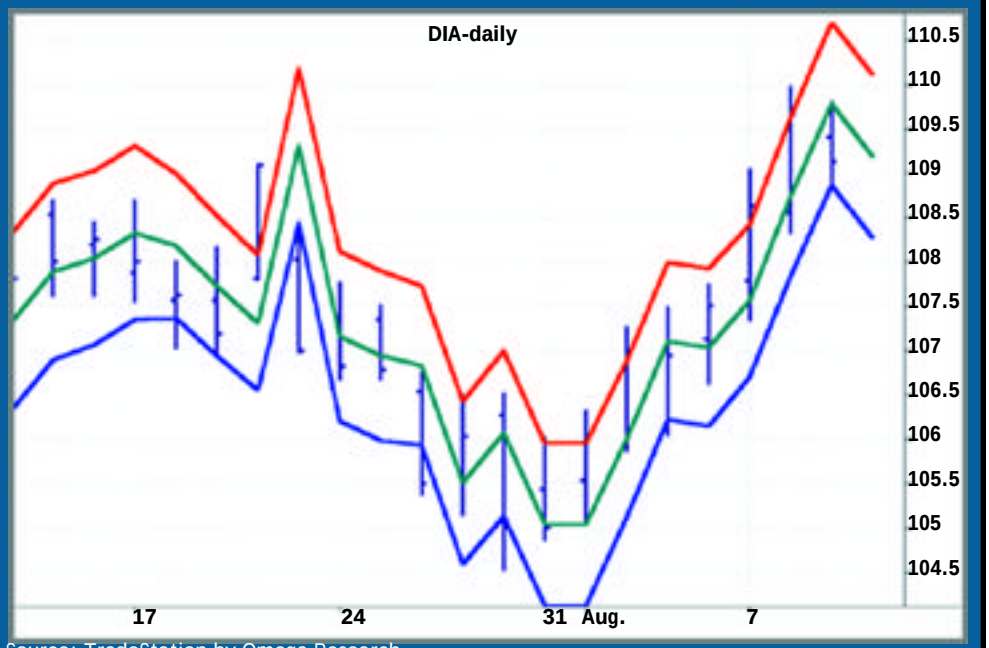
Making a statistical indicator

However, this indicator still doesn't address the main problem of not incorporating the high, low and opening prices. To do this, the calculations get a bit more complicated. What we need to do is create an **array** (a set of sequential values) holding the necessary price data. For each new bar, the four oldest price points (open, high, low and close) will be thrown out of the array and substituted with the corresponding price points for the most recent bar. For example, to calculate a moving average consisting of 20 price points, you will need an array containing the price data (open, high, low, close) of five price bars.

To just use the actual price levels, however, won't make this indicator any different than the 5-day moving average calculated on the average price of the bar (the blue line in Figure 2). To make the indicator more

FIGURE 4 **MEANDER INDICATOR**

Calculating the Bollinger bands of price changes creates the upper and lower standard deviation boundaries for where the market is likely to close the next bar. If the bands are plotted one standard deviation boundary away from the average, they can be expected to contain 67 percent of the price action. If they're two standard deviations away from the average, they should contain 95 percent of the price action.



Source: TradeStation by Omega Research

useful for short-term trading, look instead at the price changes from the previous bar's close, just as we did for the indicators in Figures 3B and 4. In other words, calculate the difference between yesterday's close and today's open, high, low, and close, respectively. For instance, to calculate the percentage change between yesterday's closing price and today's high, the EasyLanguage formula is:

```
HighPercChange = (High -
Close[1])/Close[1];
```

In a more generic form the EasyLanguage code for the entire indicator, including the 20-price-point moving average and its upper and lower standard deviation boundaries, would look something like this:

```
Input: VSStd(1);
Vars: SumVS(0), AvgVS(0),
DiffVS(0), StdVS(0), SetArr(0),
    SumArr(0), DiffArr(0), VSLow(0), VSMid(0), VSHigh(0);
    {First we define the array}
Array: VS[20](0);

{Then we're using a loop function to fill it with the different
price changes}
For SetArr = 0 To 4 Begin
   VS[SetArr * 4 + 0] = (O[SetArr] - C[SetArr + 1]) / C[SetArr + 1];
   VS[SetArr * 4 + 1] = (H[SetArr] - C[SetArr + 1]) / C[SetArr + 1];
   VS[SetArr * 4 + 2] = (L[SetArr] - C[SetArr + 1]) / C[SetArr + 1];
   VS[SetArr * 4 + 3] = (C[SetArr] - C[SetArr + 1]) / C[SetArr + 1];

End;
For SumArr = 0 To 19 Begin
   If SumArr = 0 Then
      SumVS = 0;
   SumVS = SumVS + VS[SumArr];
   If SumArr = 19 Then

{Here we calculate the average price change over the period}

      AvgVS = SumVS / 20;
   For DiffArr = 0 To 19 Begin
      If DiffArr = 0 Then
         DiffVS = 0;
      {Then we calculate the standard deviation}
      DiffVS = DiffVS + Square(VS[DiffArr] - AvgVS);
      If DiffArr = 19 Then
         StdVS = SquareRoot(DiffVS / 20);
   End;
End;
{Finally, we add the moving average (and the standard devia -
tions) to the latest close for an indication of tomorrow's trad -
ing range}

   VSLow = C * (1 + (AvgVS - StdVS * VSStd));
   VSMid = C * (1 + AvgVS);
   VSHigh = C * (1 + (AvgVS + StdVS * VSStd));
   Plot1[-1](VSLow, "VS Low");
   Plot2[-1](VSMid, "VS Mid");
   Plot3[-1](VSHigh, "VS High");
```

Figure 5 shows what this indicator looks like. Because every indicator needs a name, we hereby dub this the Meander Indicator, and the standard deviation boundaries the Upper and Lower Meander Boundaries.

To get a feel for how this indicator works compare it to measuring the weight of four different persons you meet throughout the day. The first and the last ones you meet could be your opening and closing weights, respectively. The other two you pick at random sometime during the day. After five days, when you have met 20 people, you can calculate their average weight and the standard deviation boundaries around their average weight.

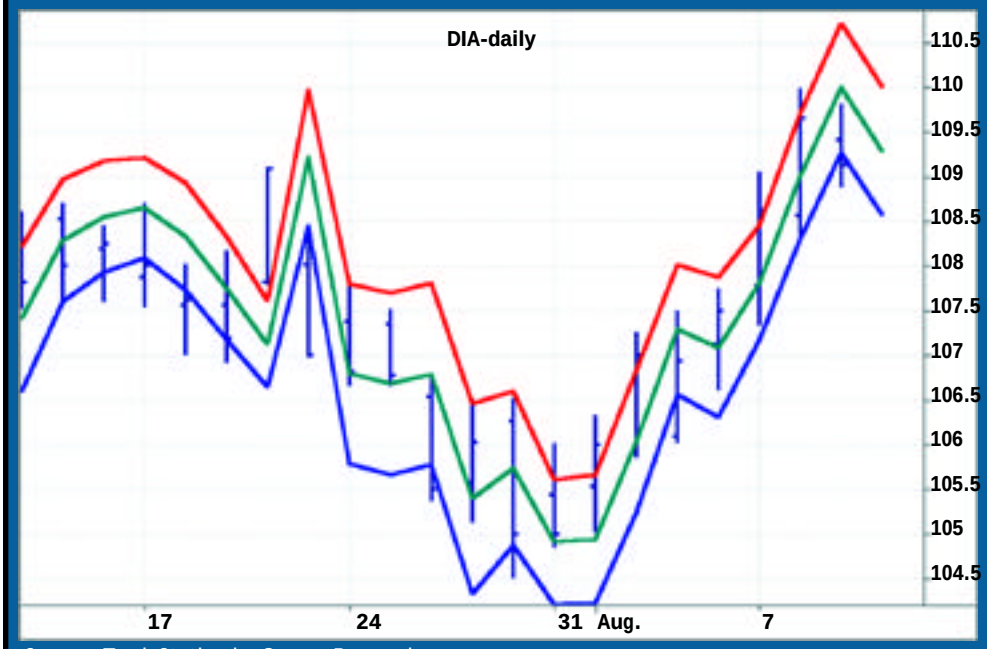
Say on the next day (the sixth day) you go out and weigh the first person you meet, and it so happens that he or she is skin and bones, and well below the lower standard deviation boundary. As a result, your statistical calculations tell you the other three persons you'll meet that day will likely weigh more.

When the sixth day is over, you add that data to the array

and throw away the data from five days ago. This is akin to making sure that you always use the most accurate, up-to-date data, which you'd need if you were collecting weight data around in the world. For example, if you live somewhere in the Midwest, the average weight of the people you meet probably would be higher than that of the people you meet on vacation in Asia (where people generally have a smaller build). Carrying out this line of thought, it also is a well-known fact that people everywhere are getting heavier, so to keep your calculations as accurate and up-to-date as possible, you need to get rid of the older, obsolete data.

FIGURE 5 SHORT-TERM PERSPECTIVE

Basing calculations on the percentage changes between one bar and the close of the previous bar allows you to shorten the lookback period to only five bars, providing an even better indication of what might happen the next bar. Depending on where the market opens and the subsequent price action, you can use the upper and lower "Meander" bands as triggers for limit-order trades.



Source: TradeStation by Omega Research

How to use the indicator: Estimating price movement

Similarly, when trading the market using this indicator, if the opening price is below the lower standard deviation boundary, you know that the low price of the day also will be lower than the standard deviation boundary. Consequently, there is a good chance that: 1) at least the opening price will not equal the high price of the day; and 2) the closing price also has a good chance to be higher than the open.

On the other hand, if the opening price happens to fall somewhere between the upper and lower standard deviation boundaries, but the market subsequently tests any of these levels, chances are pretty good that the closing price also will fall somewhere between the boundaries.

If you set the boundaries one standard deviation away from the average, the laws of statistics say that approximately 67 percent of the daily price action will take place within the boundaries. If you set the boundaries two standard deviations away from the average, you can expect them to contain approximately 95 percent of all the price action. Remember, though, this won't always be the case and the price action within each bar won't necessarily be equally distributed around these levels.

Basing indicator calculations on price changes rather than actual prices make it easier to compare indicator readings, both between different markets and different time periods.

As you can see from Figure 6, every now and then there will be a bar that is completely outside of the boundaries, but with a little experimentation you should be able to come up with a moving-average length and standard-deviation distance that suit your particular trading style, and that help you get a feel for when the market is most likely to reverse and trade higher or lower.

To copy the programming code used in this article, see the online version at Active Trader's Web site www.activetradermag.com.