



# The TRUE STRENGTH Index



BY THOM HARTLE

**T**he True Strength Index (TSI) is a momentum-based indicator, developed by William Blau, designed to determine both the trend and overbought-oversold conditions. The TSI is applicable to intraday time frames as well as longer-term horizons.

Like most momentum indicators, the TSI uses a “differencing function” to measure price change. Differencing function is a fancy way to say “subtraction.” The term is used here for comparison to an averaging function, which is used to smooth prices. By measuring the difference in prices (i.e., the current close minus the close 10 bars ago, which is the basic “momentum” calculation), an indicator can lead changes in the price trend.

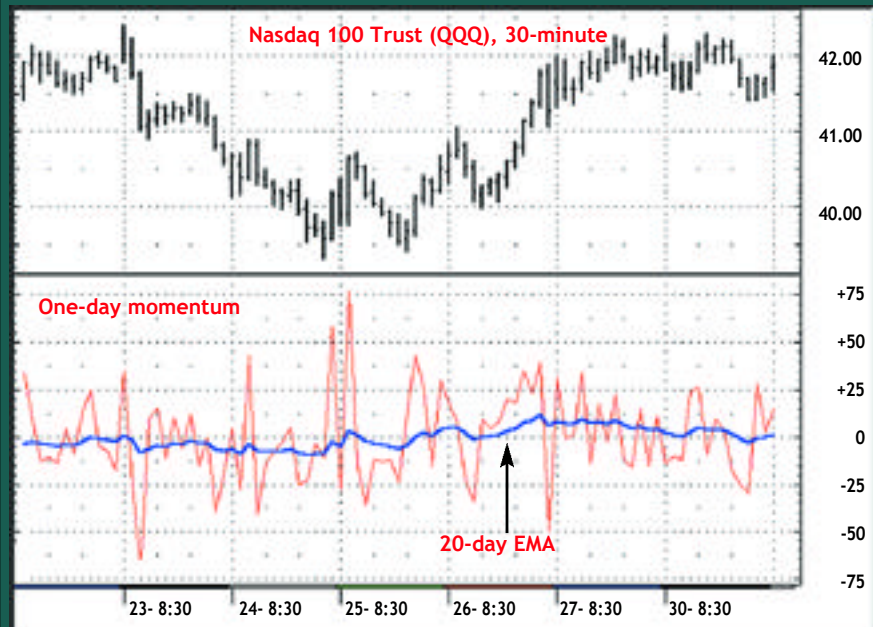
As price moves mature, they often lose momentum. For example, as an uptrend continues, its gains from bar to bar may become smaller and smaller. As a result, the price difference calculated over a certain number of bars will become stagnant or decrease — even

Momentum-based indicators lead the market and moving average-based indicators lag it. Both types of tools have advantages and disadvantages.

Here’s a process that combines the two, and an indicator approach that can help you catch shorter-term swings while staying in sync with the trend.

**FIGURE 1** SMOOTH MOMENTUM

*A raw, one-day momentum calculation is very choppy and does not highlight the trend. Applying a 20-period EMA to the momentum line produces a smoother line that better reflects the market trend and still tracks shorter-term swing points.*



Source: CQGNet

though price is still rising — which would result in the basic momentum calculation flattening or turning downward before price reverses. By contrast, indicators using an averaging function, the most obvious being moving averages, will lag trend changes because the calculation incorporates all the prices over a certain period, and are thus less affected by the change of any single period or bar.

The TSI uses a differencing function to measure momentum and an averaging function to correlate the momentum to the price trend. In other words, the indicator combines the leading characteristic of a differencing momentum calculation with the lagging characteristic of an averaging function to create an indicator that reflects price direction and is in sync with market turns. For more information on the effect of the two types of calculations, see “Lead or lag”.

### Double smoothing

The averaging function used to create the TSI is called “double smoothing,” a process by which a first exponential moving average (EMA) is applied to the data (in this case, momentum), and then a second shorter-term EMA is applied to the result of the first EMA calculation. The result is a smoother line that introduces less lag than a single EMA with a longer period length. The formula for the TSI is:

$$\text{TSI}(\text{close}, r, s) = 100 * \text{EMA}(\text{EMA}(\text{mtm}, r), s) / \text{EMA}(\text{EMA}(|\text{mtm}|, r), s)$$

where

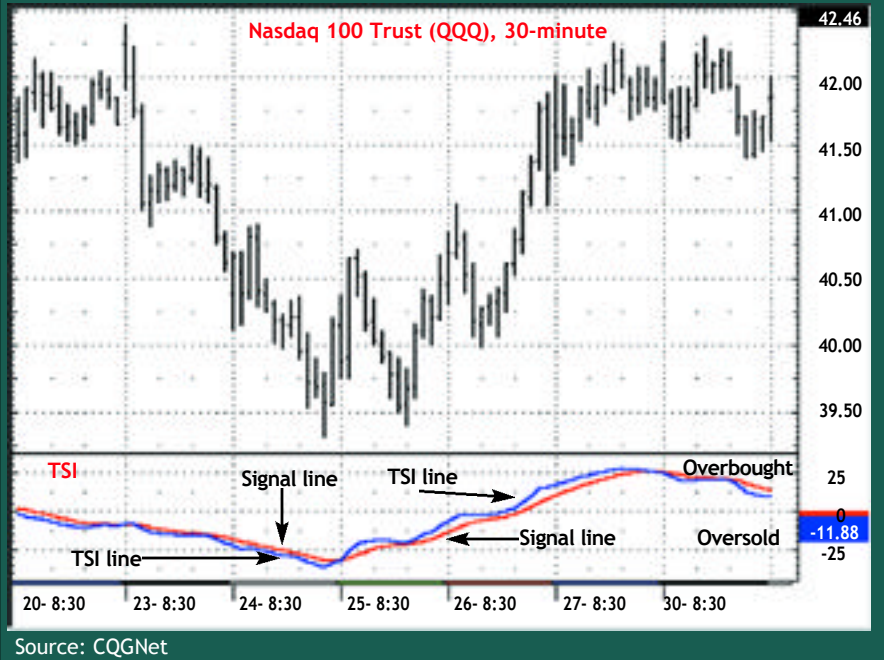
- $\text{mtm} = \text{close}_{\text{today}} - \text{close}_{\text{yesterday}}$
- $\text{EMA}(\text{mtm}, r) = \text{exponential moving average of mtm with period length} = r$
- $\text{EMA}(\text{EMA}(\text{mtm}, r), s) = \text{exponential moving average of EMA}(\text{mtm}, r) \text{ with period length} = s$
- $|\text{mtm}| = \text{absolute value of mtm}$
- $r = 25,$
- $s = 13$

For custom formulas for CQGNet and MetaStock, visit [www.activetradermag.com/code.htm](http://www.activetradermag.com/code.htm).

Let’s delve into the formula to better understand what the indicator tells us. First, the TSI measures one-day momentum (today’s close minus yesterday’s close). Calculating the one-day price difference may seem unimportant because, as Figure 1 shows, the one-day momentum (red line) appears to be a

**FIGURE 2 THE TRUE STRENGTH INDEX**

The True Strength Index (TSI) is a one-day momentum calculation that is “double-smoothed” with two moving averages to reveal the trend and highlight overbought and oversold points. It also has a seven-period moving average of the basic indicator line that functions as a signal line (similar to the MACD). The indicator ranges between +100 and -100 and has default overbought and oversold levels of +25 and -25, respectively.



nearly random, jumping back and forth across zero. However, applying a 20-period exponential moving average to the one-day momentum (blue line) results in a much less noisy line that reflects the price trend.

For example, on the left side of the chart, the market is in a downtrend and the smoothed one-day momentum is consistently below zero. The market bottoms on July 25, an uptrend ensues and the smoothed version of the one-day momentum is consistently above zero. This calculation is the basis for the TSI, but is too raw to be used as a trading tool. The next steps create a more practical indicator.

The TSI compares a double-smoothed version of momentum (an EMA of an EMA of momentum) to a double-smoothed version of the absolute value of the momentum. The double smoothing removes the noise, leaving smoothed representations of momentum. Dividing the smoothed momentum by the smoothed absolute value of momentum creates a ratio that is bound by +1 to -1, which is then multiplied by 100 to produce an indicator that ranges from +100 to -100. Most TSI values fall between +25 and -25, and Blau suggested using these values as overbought and oversold levels, respectively.

Blau also advised adding a signal line — in this case, a seven-period EMA of the TSI line — to better indicate trend changes (similar to the role of the signal line in the MACD). Figure 2 shows the TSI (blue line) with the addition of the signal line (red line). Trend changes are indicated when the TSI crosses above or below its signal line. In this example, the TSI accurately tracks the longer-term price trend, while penetrations of the -25 and +25 overbought and oversold levels (com-

plemented by TSI/signal line crossovers) coincided with reversals.

### Putting on trades

Short-term traders can take the TSI one step further to generate trading signals. Figure 3 shows the QQQs (top), the TSI and signal line (middle) and the difference between the TSI and the signal line (bottom). A move above the zero line by the TSI difference indicates the trend has turned up. Notice how the indicator is rising when the short-term trend is up and falling when the short-term trend is down.

To trade, we will use these TSI difference zero-line crossings as well as a concept invented by Bill Williams called the "saucer buy or sell." A saucer buy signal occurs when the TSI

difference is above zero, falls and then begins to climb again (while remaining above zero). Entry occurs on the first higher histogram bar after it declines. A saucer sell signal occurs when the TSI difference is below zero, rises and then begins to fall again. Peaks in the histogram above zero, are exit signals for long trades. The reverse is true for short trades.

Figure 3 provides some examples. Long signals (executed at the close of a bar) are indicated by the letter L; the letter E identifies exits. Two of the four signals produced gains of a dollar or more, while two others resulted in small losses. Losing trades generally occur if the price trend rolls over in a gentle fashion rather than reversing relatively quickly. The upward momentum in this case was gradually decreasing, resulting in a slowly declining indicator that was still generating buy sig-

## LEAD OR LAG

The simplest momentum indicators calculate the difference or ratio between closing prices. Moving average-based indicators smooth prices. Momentum indicators lead price tops and bottoms, while moving average-based indicators lag price peaks or bottoms.

Figure A illustrates these characteristics, showing the relationship between price, a 10-period momentum calculation (current bar's price minus price 10 bars ago) and a 10-period moving average of price. The left y-axis is for price and the moving average, and the right y-axis is for momentum.

The price series begins at 50, rises to above 85, turns down and falls back to 50. At point A, prices are rising at an increasing rate and momentum is leading prices, reflecting the rate increase in 10-period price differences. The 10-period moving average lags price, as it is calculating the average of the current price as well as the lower prices over the previous nine periods.

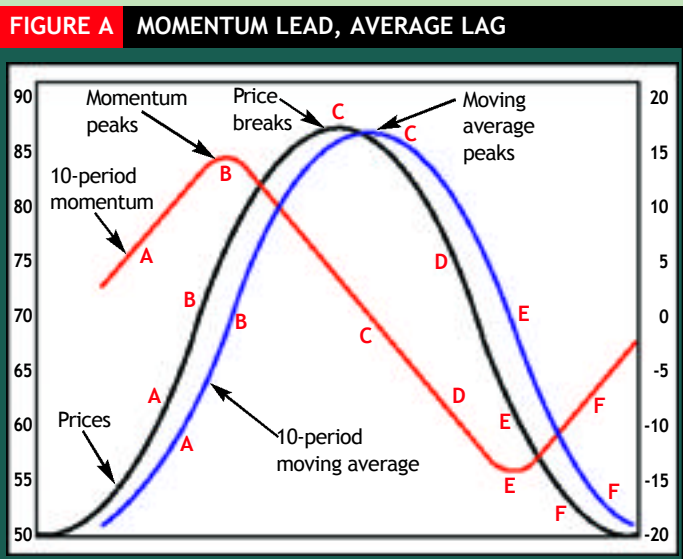
At B, price has reached its fastest rate of increase, and begins to slow as it nears the price peak at C. The momentum indicator peaks at point B and begins to decline. The 10-bar momentum is still positive, but the differences are decreasing. The key point is the momentum indicator peaks at B, leading well ahead of the price peak at point C. The moving average at B is rising, but it still lags price, ascending at a slower rate than price.

Just after the price peak at C, the momentum indicator crosses below zero, indicating that the 10-bar price difference is now negative. The moving average peaks later, lagging the price peak. As price declines, the momentum indicator continues to fall to lower levels (D) as the price drop picks up speed. The moving average is above the falling prices, lagging the decline. At point E, price reaches its steepest rate of decline and the momentum indicator reaches its lowest levels. Price is still trending down, but at a slower rate, and the momentum indicator bottoms and turns up (F), once again leading price.

Momentum indicators remove the trend from the price series. When you plot a detrended price series, the behavior of prices around this trend is apparent and the line appears as an oscillation. In effect, the zero line of the indicator serves as a proxy for the price trend. The price fluctuations above and below this trend are reflected in the indicator oscillations.

A momentum indicator will lead changes in the price trend. However, if there is a trend present greater in length than the lookback period of the indicator, the oscillator will be shifted up (in the case of an uptrend) or down (in the case of a downtrend). That is why most oscillators are consistently at high levels during strong upward markets, and low levels when the market is in a persistent downtrend.

Moving averages filter out price activity with cycles shorter than the lookback period. Consequently, the plot of the moving average is a smooth line correlated with the trend greater than the lookback period. But this indicator lags trend changes.



nals while the stock was essentially moving sideways. On the other hand, a longer-term view based on the fact that the TSI difference crossed and stayed above the zero line successfully captured an extended intraday uptrend. Place stops just below the low of the entry bar for long positions and above the high for short sales.

Figure 4 shows more examples, including short signals (identified by S) by either the TSI difference dropping

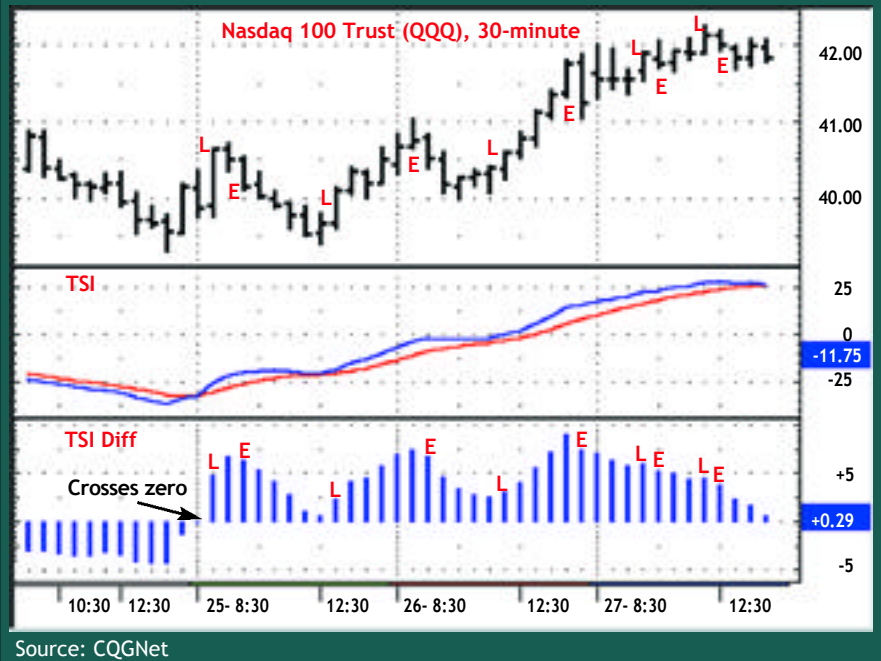
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below zero or the indicator tracing out a saucer sell. In this case, the slight upward bias created low-profit short trades. Still, the price peaks and troughs coincided with the TSI difference peaks and troughs.

Those who like to trade short-term price moves during trading ranges with established support and resistance levels could look to buy when the TSI dif-

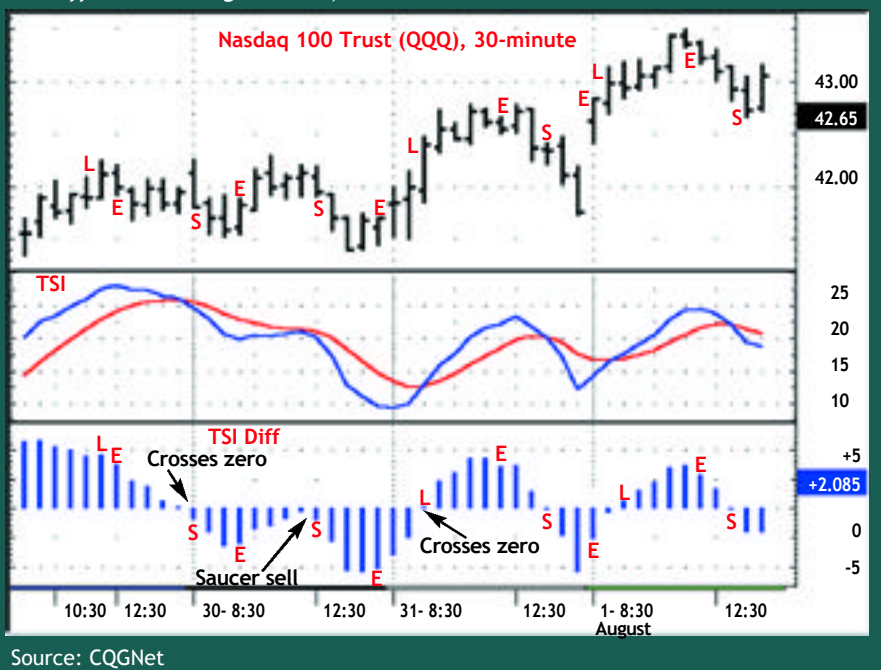
**FIGURE 3 TSI DIFFERENCE**

*TSI-signal line crossovers are often more easily viewed by displaying the difference of the two lines as a histogram (bottom). Moves above and below the zero line by the TSI difference indicate short-term momentum is up or down, respectively. Notice the regular TSI (middle) highlights the longer-term uptrend.*



**FIGURE 4 SHORT TRADES**

*Short trades are signaled when the TSI difference moves below the zero line or the histogram traces out a "saucer sell," such as the one that occurred just prior to 12:30 p.m. Trades are exited when momentum (as represented by the TSI difference histogram bars) reverses.*



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ference is below zero and turning back up or sell when the TSI difference is above zero and turning back down. Also, false breaks of support or resistance, such as those that occurred on

July 30 and 31, are indicated by the TSI difference tracing out a bottom and then a top, with the market dropping back within the confines of the trading range. Moving back in time, Figure 5 shows two nice trends the TSI difference captured, as well as one small loss and a small profit. These charts indicate the TSI is able to identify trend changes, and the outcome of the trade signals depends on the current volatility of the market.

Figure 6 illustrates the same concept applied to daily bars. Again, market peaks and bottoms coincide with the peaks and bottoms in the TSI-difference indicator. The first trade, a short sale at the close of June 8, resulted in a nearly \$5 profit. As the market trend began to move from a downtrend to more of a sideways trading-range condition, the zero-line crossings resulted in less follow-through price movement. However, a number of the signals exceed \$1 in profit before price reversed.

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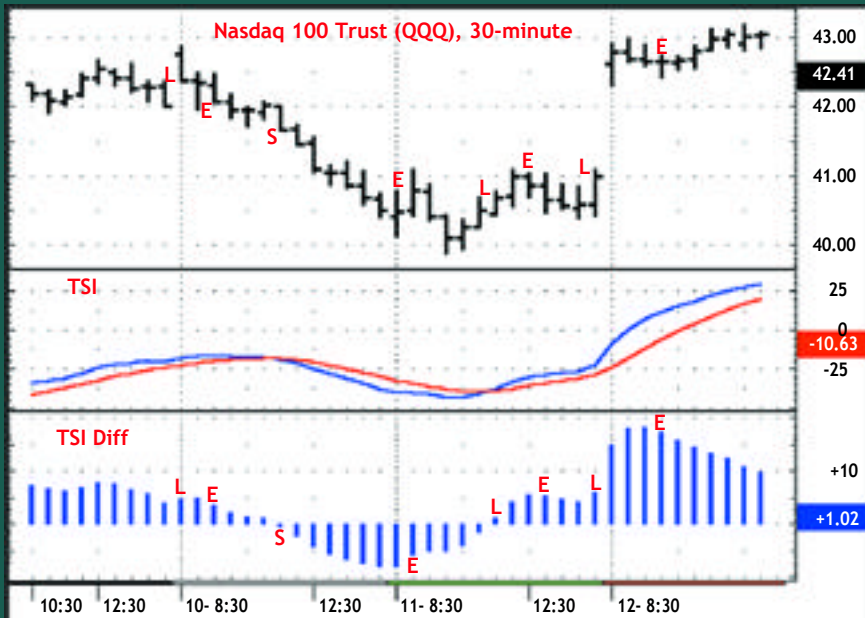
### A flexible tool

There are a number of ways to modify the TSI and the TSI difference indicators. You can vary the period lengths (look-back periods) of the EMAs,  $r$  and  $s$ , to better reflect the current volatility of the market you trade. Also, you could use different exit strategies than the one suggested here, because the TSI-difference peaks or troughs tend to be just past the price peaks or troughs.

The caveat, though, is stop-loss points. The TSI and signal line, as well as the TSI difference, are vulnerable to sudden changes in market direction. Consequently, a risk-management plan that prevents having to wait for the indicators to produce new signals must be in place. 📍

**FIGURE 5 TRENDS AND SWINGS**

This chart highlights the TSI's ability to capture trend moves (middle) and the TSI difference indicator's capacity to time short-term trades.



Source: CQGNet

**FIGURE 6 CATCHING THE DAILIES**

The previous examples consisted of intraday charts. This daily chart shows the TSI's message remains constant regardless of time frame.



Source: CQGNet

### Resources

- William Blau details the basis for the TSI in his book *Momentum, Direction, and Divergence* (Wiley & Sons, 1995).
- Bill Williams discusses buy and sell saucers in his book *New Trading Dimensions: How to Profit from Chaos in Stocks, Bonds, and Commodities* (Wiley & Sons, 1998).