INDICATORS

Are You In A Trend?

Trend Detection Index

Can you tell when a trend's begun and when it's ended? You can with this.

by M.H. Pee

The *trend detection index* (TDI) is used to detect when a trend has begun and when it has come to an end. The TDI can be used as a stand-alone indicator or combined with others; it will perform well in detecting the beginning of trends. However, this does not mean its signals are totally accurate. Protective stops as well as trailing stops† must be incorporated to produce a complete mechanical system. These stops are required to protect against large losses when the indicator generates a losing trade. The TDI is robust; it can trade a diverse portfolio of markets profitably over many years, using the same parameters throughout.

DEFINITION

To calculate the 20-day trend detection index, first find the value of the momentum indicator. After the market closes, calculate today's 20-day momentum by subtracting the close 20 days ago from that of today. Next, find the 20-day absolute momentum, which is defined as the absolute value of today's 20-day momentum. The TDI is therefore obtained by:

$$\text{20-day TDI} = (\text{AV20}) - \{(\text{SumAM40}) - (\text{SumAM20})\}$$

In which:

AV20 = Absolute value of the sum of 20-day momenta of the last 20 days

SumAM40 = Sum of 20-day absolute momenta of the last 40 days

SumAM20 = Sum of 20-day absolute momenta of the last 20 days

FIGURE 1: YEN. Long at +1 (blue line); short at -1. The trend detection index is in red and the direction indicator is in green. A positive TDI means a trend is starting, whereas a negative TDI indicates a consolidation. The direction indicator determines the direction of the trend.

Confused? Relax. See the sidebar, "The TDI rules in Excel," for an example that illustrates the calculation of the TDI. At this point, simply bear in mind that the absolute value of the sum of momenta is not the same as the sum of absolute momentum.

INTERPRETING THE INDEX

The trend detection index will signal a trend if it shows a positive value and a consolidation† if it shows a negative one (Figure 1). As a trend-follower, I will enter a position in the direction of the trend when the TDI is positive. To determine the current direction of the trend, I use the direction indicator, which is defined as the sum of the 20-day momentum of the last 20 days. An uptrend is signaled by a positive direction indicator value, whereas a downtrend is signaled by a negative value. Basically, it comes down to this: Enter long tomorrow at the open if both the TDI and direction indicator are positive after today's close or enter short at the open if the TDI is positive and the direction indicator is negative.

THE THEORY BEHIND THE INDEX

Volatility can be measured using various methods, such as average true range† or standard deviation†. Momentum is another method. During trends, price tends to move in one direction — either up or down. Hence, there is a tendency for more up changes between two consecutive closes in an uptrend, and vice versa in a downtrend.

During consolidation, such tendency isn't so evident. Since a 20-day momentum is also obtained by summing the changes in the close for the past 19 days, momentum during

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THE TDI RULES IN EXCEL

Here's an example to illustrate the calculation of the TDI. The Excel spreadsheet in sidebar Figure 1 lists all the values required for the calculations of the trading signals of the TDI for yen between September 23, 1998, and December 31, 1998. The spreadsheet is structured in rows, with each row representing one day. The date and close are recorded in columns A and B, respectively. (Since the prices in column B are from a continuous contract, they may not match the actual prices on those dates, but the system signals and results should be extremely close.) The date is entered using six digits. The first two digits represent the year, the center two the month, and the last two the day. As an example, the number 980923 represents September 23, 1998.

The first calculation of the TDI is the 20-day momentum. It is found by subtracting the close 20 days ago from the close of today and indicated in column C. Enter the following formula in cell C21 and copy it down to the bottom of the spreadsheet:

=B21-B2

Column D shows the 20-day absolute momentum. It is obtained by taking the absolute value of the value in column C. Enter the following in cell D21 and copy it down to the bottom of the spreadsheet:

=ABS(C21)

Column E shows the 20-day direction indicator, which is calculated by summing the 20-day momentum values (shown in column C) for the last 20 days. Enter the following formula in cell E60 and copy it down to the bottom of the spreadsheet:

=SUM(C41:C60)

Column F indicates the absolute value of the sum of 20-day momentum of the last 20 days. This is actually the absolute value of the value shown in column E. Enter the following formula in cell F60 and copy it down to the bottom of the spreadsheet:

=ABS(E60)

Column G represents the sum of absolute momentum for the last 40 days. It is obtained by adding the last 40 values in column D. Enter the following formula in cell G60 and copy it down to the bottom of the spreadsheet:

=SUM(D21:D60)

Column H shows the sum of the absolute momentum for the last 20 days. It is calculated by adding the last 20 values in column D. Enter the following formula in cell H60 and copy it down to the bottom of the spreadsheet:

=SUM(D41:D60)

Column I indicates the 20-day TDI. It is obtained by adding the result obtained in column F to that obtained in column H and then subtracting the value in column G from it. Enter the following formula in cell I60 and copy it down to the bottom of the spreadsheet:

=(F60 + H60) –G60

Column J indicates the current position in the market after the close (1 for long, -1 for short, and zero for flat). Enter the following formula in cell J61 and copy it down to the bottom of the spreadsheet:

=IF(I60>0,IF(E60>0,1,-1),J60)

Column K(not shown in sidebar Figure 1) shows the price at which a trade is entered or exited. If it shows a blank, no trade is made or exited on that day. Enter the following formula in cell K61 and copy it down to the bottom of the spreadsheet:

=IF(J61=J60,"",B60)

Column L (not shown in Figure 1) gives the trading signals for the next day. Enter the following formula in cell L61 and copy it down to the bottom of the spreadsheet:

=IF(A61="",IF(A60="","",IF(J61=J60,"REMAIN WITH CURRENT POSITION",IF(J61=1,"GO LONG AT OPEN TOMORROW","GO SHORT AT OPEN TOMORROW"))),"")

Continued on the following page

consolidation will be near zero (there are equal chances for the market to close up or down for the day). Momentum during uptrends will be significantly positive because there are more up closes. The opposite applies in a downtrend. Thus, the magnitude of momentum during trends will be greater than during consolidation. Volatility follows suit.

Therefore, the scenario we are looking for is a breakout of a consolidation whereby the recent 20-day period is in a trend and the previous 20-day period is in consolidation. Hence, the size of the sum of momentum (as indicated by the absolute value of the sum of a 20-day momentum of the last 20 days in the TDI formula) during the recent 20-day period of trend will definitely be greater than the sum of the sizes of momentum during the prior 20-day period of consolidation (seen as the difference between the sum of 20-day absolute momentum of the last 40 days and the sum of 20-day absolute momentum of the last 20 days).

Note we are using the size, which is the absolute momentum value, and not the *actual* momentum value when summing momentum in consolidation. The rationale behind this is that during a consolidation, the momentum values are usually fluctuating between a positive value or a negative value and therefore tend to cancel out each other.

Since we are interested in the volatility, which is essentially the magnitude and not the direction of momentum, taking the absolute momentum will be an ideal solution. However, during a trend, momentum will consistently remain positive (during an uptrend) or negative (during a downtrend) and there

THE TDI RULES IN EXCEL

	A	B	C	D	E	F	G	H	I	J
1	Date	Close								
2	980923	75.66								
3	980924	75.92								
4	980925	75.28								
5	980928	75.47								
6	980929	76.37								
7	980930	74.97								
8	981001	75.54								
9	981002	75.54								
10	981005	76.29								
11	981006	78.28								
12	981007	84.94								
13	981008	85.69								
14	981009	87.67								
15	981013	85.81								
16	981014	86.03								
17	981015	86.74								
18	981016	88.52								
19	981019	89.02								
			20-day momentum	20-day absolute momentum						
20	981020	87.51								
21	981021	87.26	11.6	11.6						
22	981022	86.52	10.6	10.6						
23	981023	86.49	11.21	11.21						
24	981026	85.5	10.03	10.03						
25	981027	86.46	10.09	10.09						
26	981028	86.46	11.49	11.49						
27	981029	87.1	11.56	11.56						
28	981030	87.78	12.24	12.24						
29	981102	88.71	12.42	12.42						
30	981103	88.24	9.96	9.96						
31	981104	87.4	2.46	2.46						
32	981105	86.52	0.83	0.83						
33	981106	85.49	-2.18	2.18						
34	981109	83.7	-2.11	2.11						
35	981110	82.96	-3.07	3.07						
36	981111	83.63	-3.11	3.11						
37	981112	83.41	-5.11	5.11						
38	981113	82.89	-6.13	6.13						
39	981116	84.55	-2.96	2.96						
40	981117	83.97	-3.29	3.29						
41	981118	83.6	-2.92	2.92						
42	981119	84.66	-1.83	1.83						
43	981120	84.41	-1.09	1.09						
44	981123	83.96	-2.5	2.5						
45	981124	83.77	-2.69	2.69						
46	981125	83.39	-3.71	3.71						
47	981127	82.48	-5.3	5.3						
48	981130	82.41	-6.3	6.3						
49	981201	83.13	-5.11	5.11						
50	981202	84.57	-2.83	2.83						
51	981203	85.5	-1.02	1.02						
52	981204	85.14	-0.35	0.35						
53	981207	84.6	0.9	0.9						
54	981208	85	2.04	2.04						
55	981209	85.96	2.33	2.33						
56	981210	86.3	2.89	2.89						
57	981211	87.07	4.18	4.18						
58	981214	87.7	3.15	3.15						
					20-day sum of momentum (Col C) ("direction indicator")	Absolute value of 20-day direction indicator	40-day sum of absolute momentum (Col D)	20-day sum of absolute momentum (Col D)	20-day trend detection index (TDI)	Market position
59	981215	86.97	3	3						
60	981216	86.86	3.26	3.26	-13.9	13.9	199.85	57.4	-128.55	
61	981217	87.13	2.47	2.47	-8.51	8.51	190.72	56.95	-125.26	0
62	981218	87.52	3.11	3.11	-3.57	3.57	183.23	58.23	-121.43	0
63	981221	87	3.04	3.04	0.56	0.56	175.06	60.18	-114.32	0
64	981222	86.66	2.89	2.89	5.95	5.95	167.92	60.57	-101.4	0
65	981223	87.2	3.81	3.81	12.45	12.45	161.64	61.69	-87.5	0
66	981224	86.97	4.49	4.49	20.65	20.65	154.64	62.47	-71.52	0
67	981228	87.36	4.95	4.95	30.9	30.9	148.03	62.12	-55.01	0
68	981229	87.37	4.24	4.24	41.44	41.44	140.03	60.06	-38.53	0
69	981230	87.89	3.32	3.32	49.87	49.87	130.93	58.27	-22.79	0
70	981231	88.84	3.34	3.34	56.04	56.04	124.31	58.78	-9.49	0

SIDEBAR FIGURE 1: CALCULATING TRADING SIGNALS. Computing TDI isn't complicated, but it does take at least 40 days of data if you use the standard length of 20 days. Here's an example to illustrate the calculation of the TDI. This Excel spreadsheet lists all the values required for the calculations of the trading signals of the TDI for yen between September 23, 1998, and December 31, 1998. The spreadsheet is structured in rows, with each row representing one day. The date and close are recorded in columns A and B. (Since the prices in column B are from a continuous contract, they may not match the actual prices on those dates, but the system signals and results should be very close.) The date is entered using six digits. The first two digits represent the year, the center two the month, and the last two the day. As an example, the number 980923 represents September 23, 1998.

The TDI's robustness is demonstrated by its ability to profitably trade a diverse portfolio of markets, across varying parameter lengths.

is no need to take the absolute momentum. But we *do* take the absolute value of the sum of the momentum if the trend is down and the sum is negative, because we are concerned about the magnitude and not the direction of the sum of momentum.

Regarding the direction, the direction indicator will sum the momentum of the last 20 days and indicate an uptrend with a positive sum and a downtrend with a negative one. The direction indicator is based on consistently positive momentum during an uptrend and consistently negative momentum during a downtrend.

Markets	Net profit	Maximum drawdown	Average trade	No. of trades	% winners	P/L ratio
T-bonds	51675.05	32743.75	1013.24	51	45.10	2.02
British pounds	23487.50	24262.50	510.60	46	47.83	1.36
Coffee	63862.50	45806.25	1358.78	47	44.68	1.83
Crude oil	40125.00	8950.00	1028.85	39	51.28	2.06
Copper	23087.50	23587.50	461.75	50	36.00	2.61
Cotton	73290.00	8240.00	1879.23	39	51.28	3.14
Deutschemarks	15300.00	5015.00	332.61	46	34.78	2.97
Eurodollars	23675.00	7650.00	503.72	47	46.81	2.12
Gold	14000.00	9475.00	333.33	42	38.10	2.25
Heating oil	21007.80	13603.20	437.66	48	39.58	2.19
Yen	100025.00	18987.50	2326.16	43	41.86	3.29
Oats	6337.50	6512.50	134.84	47	36.96	2.21
Orange juice	36442.50	8542.50	888.84	41	43.90	2.66
Swiss francs	33675.00	14275.00	732.07	46	36.96	2.35
Silver	14170.00	19315.00	322.05	44	36.36	2.12

FIGURE 2: RESULTS. Testing the TDI against a basket of 15 futures contracts over 16 years generated a profitable result throughout, with P/L ratios in the 2+ range.

HYPOTHETICAL TESTING RESULTS

Historical testing was conducted following the parameters discussed: going long when both the TDI and the direction indicator are positive and going short when the TDI is positive and the direction indicator negative. It was tested as a reversal system: After entering long, one indicator will stay with the long position until the TDI issues a short entry signal and vice versa. The performance of the TDI was tracked taking only one contract per trading signal from January 4, 1982, through December 31, 1998. (A total of $75 was deducted from each trade as commission and slippage.) All open positions were closed on December 31, 1998, and the exit price was taken as the closing price of that day.

The same parameters were used to trade all of the 15 nonrelated markets through the entire 16-year period, using the same parameters to prevent curve-fitting of the TDI to the past data. The testing was done using continuous contracts, which are designed for ease of testing without worrying about rollovers but at the same time without affecting the validity of the testing results. The testing results are presented with the statistics corrected to two decimal figures (see Figure 2).

Trading the 15 markets as a portfolio, the TDI was 41.93% accurate on 676 trades, with an average trade of $799.05, total net profit of $540,160.40, profit/loss ratio of 2.27, and maximum closed trade drawdown of $51,515. Taking the account size required to trade the portfolio as the sum of the maximum closed trade drawdown and the total margin required of $29,433, we arrived at an annual compounded rate of return of about 41.71%.

VARYING THE LENGTH

	10 days	15 days	20 days	25 days	30 days
Net profit	455069.60	673437.90	540160.40	513745.80	389489.40
Maximum drawdown	57213.90	77708.30	51515.00	44905.95	77627.55
% return	32.83	39.28	41.71	43.19	22.74
No. of profitable markets out of 15	11	14	15	14	11
Average trade	327.86	754.98	799.05	969.33	873.29
No. of trades	1388	892	676	530	446
% winners	38.98	43.50	41.93	41.32	39.46
P/L ratio	2.05	2.17	2.27	2.33	2.27

FIGURE 3: P/L ratios remain in the 2s when the parameter length is varied from 10 to 30 days, though some markets that were profitable at 20 days were not profitable at other lengths.

ROBUSTNESS OF THE INDICATOR

The TDI's robustness is demonstrated by its ability to profitably trade a diverse portfolio of markets. As an example, the trend detection index was profitable trading all of the 15 markets tested using identical parameters for each and every market. Since it is profitable trading across different markets, let's see how it will perform if we vary the parameter value of 20 days. Figure 3 shows the performance of the TDI trading the 15 markets as a portfolio when the parameter of 20 days is changed to 10, 15, 25, and 30 days. The rules of the entry and exit stay the same.

The results from Figure 3 indicate the TDI is also profitable trading the portfolio using the parameter values of 10, 15, 25, and 30 days. This demonstrates the robustness of the indicator. Even if you do not use the optimal parameter for trading, you will still be profitable since the indicator itself is profitable over a range of parameter values. Next, look at the number of profitable markets out of the 15 tracked as we vary the parameter value. At its best, the TDI is profitable on all the 15 markets. However, it is still profitable on 11 out of 15 markets

at its worst, which is equivalent to being profitable on about 75% of the markets traded — still not bad at all!

CONCLUSION

The TDI is a new indicator that is robust not only across markets but also across parameters. You can use the TDI as a stand-alone indicator as I have tested it, combine it with other indicators, or even add a stop-loss order to it. Feel free to amend the rules or add in your own ideas; perhaps you can make it a better indicator. I welcome your comments or queries.

M.H. Pee specializes in system development and currently has systems tracked by Futures Truth.

†See Traders' Glossary for definition

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