

Wait For It — Wait For It

Anticipating Moving Average Crossovers

Although simple moving averages may be a technical analyst's best friend, they do tend to lag. Here's how you can overcome this problem.



Moving averages are excellent indicators to confirm existing trends in spite of their lag. To overcome this lag, several alternatives such as the exponential moving average (EMA) and the weighted moving average (WMA) have been applied to price charts. In this article, I will not tweak the simple moving average (SMA). Instead, I will decrease the lag of the SMA crossover by one day by basing it on a simple mathematical observation.

SIMPLE MOVING AVERAGE CROSSOVER

First, I would like to show you an arithmetic example. A five-day simple moving average (MA5) is the average of the last five closing values:

$$\begin{aligned} \text{MA5} &= (C + C_{-1} + C_{-2} + C_{-3} + C_{-4})/5 \\ &= C/5 + (C_{-1} + C_{-2} + C_{-3} + C_{-4})/5 \end{aligned} \quad \text{[A1]}$$

In a similar fashion, a four-day SMA is:

$$\text{MA4} = (C + C_{-1} + C_{-2} + C_{-3})/4$$

Its previous value is:

$$\text{MA4}_{-1} = (C_{-1} + C_{-2} + C_{-3} + C_{-4})/4$$

$$\text{or } 4 * \text{MA4}_{-1} = C_{-1} + C_{-2} + C_{-3} + C_{-4}$$

$$\text{or } 4 * \text{MA4}_{-1}/5 = (C_{-1} + C_{-2} + C_{-3} + C_{-4})/5$$

If you replace $(C_{-1} + C_{-2} + C_{-3} + C_{-4})/5$ in [A1] you get:

$$\text{MA5} = C/5 + 4 * \text{MA4}_{-1}/5$$

or

$$\text{MA5} = (C + 4 * \text{MA4}_{-1})/5 \quad \text{[A2]}$$

The equation in [A2] expresses the five-day SMA as a function of the previous value of the four-day SMA. You can generalize the relation in [A2] for any period K as:

$$\text{MA}(K) = (C + (K-1) * \text{MA}(K-1)_{-1})/K \quad \text{[A3]}$$

Let MA(K) represent the SMA for day k, MA(P) the SMA for day p, and assume $k > p$. Using the information given, you can determine the values of tomorrow's close (TC), k-period moving average, TMA(K), and p-period moving average, TMA(P).

If you apply [A3] you get:

$$\text{TMA}(K) = (TC + (K-1) * \text{MA}(K-1))/K \text{ and}$$

$$\text{TMA}(P) = (TC + (P-1) * \text{MA}(P-1))/P$$

If tomorrow's SMAs are equal, then $\text{TMA}(K) = \text{TMA}(P)$ or $(TC + (K-1) * \text{MA}(K-1))/K = (TC + (P-1) * \text{MA}(P-1))/P$. You can now solve for tomorrow's close (TC) using the following formula:

$$\text{TC} = \frac{P * (K-1) * \text{MA}(K-1) - K * (P-1) * \text{MA}(P-1)}{K - P}$$

[Relation A0]

For a crossover of moving averages to occur, they need to touch. So here's how you can use what we have learned so far. For example, if P = 20 and K = 30, in order for the MA(20) and MA(30) to cross over tomorrow, the TC would have to be:

$$\text{TC} = [20 * 29 * \text{MA}(29) - 30 * 19 * \text{MA}(19)] / (30 - 20) \text{ or}$$

$$\text{TC} = [580 * \text{MA}(29) - 570 * \text{MA}(19)] / 10 \text{ or finally}$$

$$\text{TC} = 58 * \text{MA}(29) - 57 * \text{MA}(19)$$

So when the TC crosses with the actual closing price, it could potentially predict the crossing of the SMAs in the next price bar.

PROPERTIES OF TC

The daily chart of the NASDAQ 100 (NDX) in Figure 1 displays the 20-day SMA (red) and 30-day SMA (yellow). When the 20-day SMA crosses above the

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INDICATORS



FIGURE 1: THE TC GRAPH. On this daily chart of the NASDAQ 100 (NDX) is plotted the 20-day moving average (red) and the 30-day moving average (yellow) on the price chart. The closing prices and the TC line are plotted in the subchart. Note how, in most cases, the crossing of the close and the TC take place one day prior to the SMA crossover.

30-day SMA, you see a bullish green arrow. Conversely, when the 30-day SMA crosses below the 20-day SMA, you see a bearish red arrow. In the subgraph below the price bars, you see the actual closing line in black with the TD (red) line overlaid. Since the TC values are either extremely high (2722) or extremely low (-1949), the actual close (800 to 1100 for the selected period) looks like a flat line. An interesting observation from this analysis is that the crossing of the TC with the actual close usually occurs one day prior to the SMA crossover.

Given the volatility of TC, it is obvious there are some periods that make the crossing impossible. For example, TC cannot be negative and if today's close is 1000, it will be extremely difficult, if not impossible, for tomorrow's close to be 2600. Applying this observation properly will limit the area for a probable SMA cross.

The AmiBroker AFL code for the plotting of the TC can be found in "The TC Graph" sidebar.

THE STATISTICS

Here's a look at the statistical analysis for the crossing of TC with the actual close and

THE TC GRAPH

```
p=20;MAp=MA(C,p);
k=30;MAk=MA(C,k);
TC=(p*(k-1)*MA(C,k-1)-k*(p-1)*MA(C,p-1))/(k-p);
Plot(C,"Close",1,8);
Plot(TC,"TC",4,8);
```

SIDEBAR FIGURE 1: THE TC GRAPH FORMULA

SMA CROSS PREDICTION STATISTICS

// Explore the database for the n=1 last quotations

```
p=20;MAp=MA(C,p);
k=30;MAk=MA(C,k);
TC=(p*(k-1)*MA(C,k-1)-k*(p-1)*MA(C,p-1))/(k-p);
DescCrossPrediction=Cross(TC,C);
AscCrossPrediction=Cross(C,TC);
ConfirmedDesc=Cross(MAk,MAp);
ConfirmedAsc=Cross(MAp,MAk);
DescTotalPredictions=Cum(DescCrossPrediction);
Accurate0DescPredictions=Cum(ConfirmedDesc AND Ref(DescCrossPrediction,-1));
Accurate1DescPredictions=Cum(ConfirmedDesc AND Ref(DescCrossPrediction,-2));
Accurate2DescPredictions=Cum(ConfirmedDesc AND Ref(DescCrossPrediction,-3));
UselessDescPredictions=Cum(ConfirmedDesc AND DescCrossPrediction);
AscTotalPredictions=Cum(AscCrossPrediction);
Accurate0AscPredictions=Cum(ConfirmedAsc AND Ref(AscCrossPrediction,-1));
Accurate1AscPredictions=Cum(ConfirmedAsc AND Ref(AscCrossPrediction,-2));
Accurate2AscPredictions=Cum(ConfirmedAsc AND Ref(AscCrossPrediction,-3));
UselessAscPredictions=Cum(ConfirmedAsc AND AscCrossPrediction);
Filter=1;
AddColumn(DescTotalPredictions,"Total # of Desc Predictions",1,0);
AddColumn(100*Accurate0DescPredictions/DescTotalPredictions,"Acc0 Desc %",1,0);
AddColumn(100*Accurate1DescPredictions/DescTotalPredictions,"Acc1 Desc %",1,0);
AddColumn(100*Accurate2DescPredictions/DescTotalPredictions,"Acc2 Desc %",1,0);
AddColumn(100*UselessDescPredictions/DescTotalPredictions,"Useless Desc %",1,0);
AddColumn(100-Column1-Column2-Column3-Column4,"False Desc %",1,0);
AddColumn(AscTotalPredictions,"Total # of Asc Predictions",1,0);
AddColumn(100*Accurate0AscPredictions/AscTotalPredictions,"Acc0 Asc %",1,0);
AddColumn(100*Accurate1AscPredictions/AscTotalPredictions,"Acc1 Asc %",1,0);
AddColumn(100*Accurate2AscPredictions/AscTotalPredictions,"Acc2 Asc %",1,0);
AddColumn(100*UselessAscPredictions/AscTotalPredictions,"Useless Asc %",1,0);
AddColumn(100-Column7-Column8-Column9-Column10,"False Asc %",1,0);
```

—D.T.

Stocks & Commodities V. 25:2 (20-26): Anticipating Moving Average Crossovers by Dimitris Tsokakis

Ticker	Date	Total # of Desc predictions	Acc0 Desc%	Acc1 Desc%	Acc2 Desc%	Useless Desc%	False Desc%	Total # of Asc predictions	Acc0 Asc%	Acc1 Asc%	Acc2 Asc%	Useless Asc%	False Asc%
^NDX	25/7/2003	12	75	8	0	17	0	12	75	8	0	17	0
AAPL	25/7/2003	19	74	5	0	21	0	19	84	5	0	11	0
ADBE	25/7/2003	18	94	0	0	6	0	18	89	0	0	11	0
ADCT	25/7/2003	15	80	7	7	7	0	14	93	0	0	0	7
ALTR	25/7/2003	20	80	0	10	5	5	20	80	0	15	5	0
AMAT	25/7/2003	20	75	0	0	25	0	20	95	0	0	5	0
AMGN	25/7/2003	17	76	6	0	12	6	17	82	12	0	6	0
AMZN	25/7/2003	17	94	6	0	0	0	17	94	6	0	0	0
APCC	25/7/2003	19	68	11	0	11	11	18	78	0	0	11	11
APOL	25/7/2003	17	82	6	0	12	0	17	100	0	0	0	0
BBBY	25/7/2003	23	83	9	0	9	0	23	91	4	0	4	0
BEAS	25/7/2003	17	88	12	0	0	0	17	100	0	0	0	0
BGEN	25/7/2003	22	77	14	0	5	5	21	90	0	0	5	5
BMET	25/7/2003	18	78	0	0	22	0	18	89	0	0	6	6
BRCB	25/7/2003	18	94	0	0	6	0	17	94	6	0	0	0
BRCM	25/7/2003	17	94	0	0	0	6	17	71	12	0	12	6
CDWC	25/7/2003	21	95	0	0	0	5	21	86	5	0	5	5
CEPH	25/7/2003	16	100	0	0	0	0	16	100	0	0	0	0
CHIR	25/7/2003	20	85	10	5	0	0	19	84	0	0	11	5
CHKP	25/7/2003	19	68	11	0	16	5	18	89	0	6	0	6
CHRW	25/7/2003	17	94	0	0	6	0	17	100	0	0	0	0
CIEN	25/7/2003	18	94	0	0	6	0	18	78	11	0	11	0
CMCSA	25/7/2003	22	95	0	0	5	0	21	90	0	0	10	0
CMVT	25/7/2003	17	82	18	0	0	0	16	94	0	0	6	0
COST	25/7/2003	21	95	0	0	5	0	21	86	10	0	5	0
CPWR	25/7/2003	17	94	0	0	6	0	17	100	0	0	0	0
CSCO	25/7/2003	18	94	0	6	6	-6	18	83	6	0	11	0
CTAS	25/7/2003	15	87	7	0	7	0	15	93	0	7	7	-7
CTXS	25/7/2003	16	81	6	0	6	6	16	88	0	0	6	6
DELL	25/7/2003	18	67	11	0	11	11	19	89	0	0	0	11
DISH	25/7/2003	18	89	6	0	0	6	18	89	0	0	6	6
DLTR	25/7/2003	14	86	0	0	14	0	15	93	7	0	0	0
EBAY	25/7/2003	14	93	0	0	7	0	14	100	0	0	0	0
ERICY	25/7/2003	16	69	19	0	6	6	16	94	0	0	0	6
ERTS	25/7/2003	20	75	5	5	15	0	21	81	10	5	5	0
ESRX	25/7/2003	17	88	0	0	6	6	18	83	6	0	6	6
EXPD	25/7/2003	18	89	6	0	6	0	19	100	0	0	0	0
FAST	25/7/2003	18	72	11	0	6	11	17	88	0	0	0	12
FHCC	25/7/2003	21	81	14	0	5	0	21	95	0	0	5	0
FISV	25/7/2003	15	87	0	0	13	0	16	88	6	0	6	0
FLEX	25/7/2003	18	83	6	0	6	6	18	83	6	0	6	6
GENZ	25/7/2003	15	87	0	7	7	0	15	87	0	0	7	7
GILD	25/7/2003	17	88	0	0	12	0	18	78	11	6	11	-6
GNTX	25/7/2003	16	94	0	0	6	0	16	81	6	0	13	0
HGSI	25/7/2003	15	93	0	0	0	7	14	71	14	0	7	7
HSIC	25/7/2003	17	88	12	0	6	-6	18	94	0	0	6	0
IACI	25/7/2003	18	78	0	6	17	0	18	78	6	0	11	6
ICOS	25/7/2003	15	93	0	0	0	7	15	73	13	0	0	13
IDPH	25/7/2003	16	88	0	0	13	0	15	93	0	0	7	0
INTC	25/7/2003	19	89	0	0	11	0	19	79	11	0	11	0
INTU	25/7/2003	18	89	0	0	11	0	18	89	11	0	0	0
IVGN	25/7/2003	16	88	6	0	6	0	16	81	6	0	13	0
JDSU	25/7/2003	15	87	0	7	7	0	14	86	7	0	7	0
JNPR	25/7/2003	17	82	0	0	18	0	17	94	6	0	0	0
KLAC	25/7/2003	16	94	0	6	0	0	16	100	0	0	0	0
LAMR	25/7/2003	19	89	5	0	0	5	18	89	0	0	6	6
LLTC	25/7/2003	21	90	5	0	5	0	21	86	10	0	5	0
LNCR	25/7/2003	19	95	0	0	5	0	20	75	10	0	15	0
MCHP	25/7/2003	19	79	5	5	5	5	19	74	11	5	11	0
MEDI	25/7/2003	17	82	12	0	6	0	17	94	6	0	0	0
MERQ	25/7/2003	21	86	0	0	10	5	21	95	0	0	0	5
MLNM	25/7/2003	14	86	0	0	7	7	13	77	0	0	15	8
MNST	25/7/2003	20	70	5	0	20	5	20	90	0	0	5	5
MOLX	25/7/2003	21	86	5	0	5	5	20	90	0	0	5	5

Ticker	Date	Total # of Desc predictions	Acc0 Desc%	Acc1 Desc%	Acc2 Desc%	Useless Desc%	False Desc%	Total # of Asc predictions	Acc0 Asc%	Acc1 Asc%	Acc2 Asc%	Useless Asc%	False Asc%
MSFT	25/7/2003	16	88	0	0	13	0	17	94	6	0	0	0
MXIM	25/7/2003	19	95	0	0	5	0	19	84	11	0	5	0
NTAP	25/7/2003	14	93	7	0	0	0	14	93	0	0	7	0
NVDA	25/7/2003	17	88	0	0	6	6	16	94	0	0	0	6
NVLS	25/7/2003	21	81	10	5	10	-5	21	81	10	0	10	0
NXTL	25/7/2003	16	88	6	0	0	6	16	88	0	0	6	6
ORCL	25/7/2003	18	83	11	0	0	6	17	94	0	0	0	6
PAYX	25/7/2003	17	88	6	0	6	0	16	94	6	0	0	0
PCAR	25/7/2003	11	91	9	9	0	-9	12	83	17	0	0	0
PDCO	25/7/2003	19	84	5	5	5	0	20	90	0	0	10	0
PETM	25/7/2003	12	92	0	0	0	8	13	85	0	0	8	8
PIXR	25/7/2003	23	83	0	4	0	13	23	78	0	9	4	9
PSFT	25/7/2003	17	82	12	0	0	6	16	94	6	0	0	0
PTEN	25/7/2003	17	82	6	0	12	0	16	100	0	0	0	0
QCOM	25/7/2003	19	79	5	0	11	5	20	75	10	0	15	0
QLGC	25/7/2003	17	94	6	0	0	0	17	94	6	0	0	0
RFMD	25/7/2003	15	87	7	0	0	7	15	87	7	0	0	7
ROST	25/7/2003	17	76	0	0	18	6	18	72	6	0	17	6
RYAAY	25/7/2003	18	78	0	0	11	11	17	76	0	0	18	6
SANM	25/7/2003	16	94	0	0	6	0	16	94	0	0	6	0
SBUX	25/7/2003	16	81	0	0	13	6	16	94	6	0	0	0
SEBL	25/7/2003	18	89	6	0	6	0	17	94	6	0	0	0
SIAL	25/7/2003	16	88	6	0	6	0	16	100	0	0	0	0
SNPS	25/7/2003	13	85	8	0	8	0	14	86	0	0	14	0
SPLS	25/7/2003	21	86	0	0	10	5	22	86	5	0	5	5
SPOT	25/7/2003	17	94	6	0	0	0	17	100	0	0	0	0
SSCC	25/7/2003	21	90	5	0	5	0	22	91	0	0	5	5
SUNW	25/7/2003	21	81	0	0	14	5	20	80	10	0	5	5
SYMC	25/7/2003	18	89	0	0	11	0	17	82	12	0	6	0
TEVA	25/7/2003	19	89	5	0	5	0	19	84	5	0	11	0
TLAB	25/7/2003	15	73	20	0	7	0	15	93	0	0	7	0
VRSN	25/7/2003	18	83	6	0	11	0	17	82	6	0	12	0
VRTS	25/7/2003	14	93	0	0	0	7	14	79	0	0	14	7
WFMI	25/7/2003	16	88	0	0	13	0	16	100	0	0	0	0
XLNX	25/7/2003	18	100	0	0	0	0	18	100	0	0	0	0
XRAY	25/7/2003	23	87	0	0	4	9	23	83	4	4	4	4
YHOO	25/7/2003	15	87	13	0	0	0	16	100	0	0	0	0
RESULTS		1772	85.79%	4.30%	0.86%	7.02%	2.19%	1766	88.09%	3.83%	0.56%	5.38%	2.31%

FIGURE 2: STATISTICAL RESULTS. Here you see the statistical results on the NASDAQ 100 stocks.

how well it predicts the SMA cross for the next bar. The condition “DescCrossPrediction=Cross(TC,C)” predicts that a descending moving average cross will occur tomorrow, while the condition “AscCrossPrediction=Cross(C,TC)” predicts that an ascending MA cross will occur tomorrow.

We will assign the following:

- Accurate0DescPredictions, if the DescCrossPrediction is confirmed tomorrow
- Accurate1DescPredictions, if it is confirmed one day later
- Accurate2DescPredictions, if it is confirmed two

days later

- UselessDescPredictions, if it is simultaneous with the prediction
- False if it does not belong in any of these categories.

Similar terminology was used for the ascending cross prediction. It should be noted that all last-bar predictions are considered false although the majority will be confirmed the next trading day.

For the statistical calculations I applied the 20-day and 30-day SMA on the 100 stocks in the NASDAQ 100 index from

January 2000 till July 2003. The statistical results of this study for the selected period can be seen in Figure 2. The false predictions for this 42-month period were 2.19% and 2.31% for 1772 descending cross and 1766 ascending cross predictions, respectively. The AFL code for the cross prediction statistics can be found in the “SMA cross prediction statistics” sidebar.

There are other ways of analyzing and applying the cross-over behavior to financial securities, which I will cover in my next article. Until then...keep reading, and keep trading.

Dimitris Tsokakis has studied various innovative technical subjects such as the relative slope, breadth indicators, the relative strength index, and stochastic moving overbought and oversold levels, and pattern recognition studies. He resides in Greece.

See our Traders' Tips section for program code implementing Dimitris Tsokakis' technique.

†See Traders' Glossary for definition

