

Week 10

Artificial Intelligence (AI) for Investments



Lesson 2: Moving Average Indicators

Introduction

- Introduction to Moving Averages (MAs)
- Characteristics of Mas
- Signal Generation with Mas
- Application of Multiple Simple Mas
- Mas in trading ranges
- Weighted Moving Averages (WMAs)
- Exponential Moving Averages (EMAs)

Introduction to Moving Averages

Introduction to Moving Averages

- Moving averages: prices can be volatile; moving averages attempt to reduce this volatility in prices and provide a smoothed trend and reduce the distortions to a minimum
- Three kinds of moving averages are employed: simple MA, weighted MA, and exponential MA
- MAs, like trend-lines, provide dynamic levels of support and resistance
- MA is like a simple mean, just in a rolling over format

Computation of Simple MA

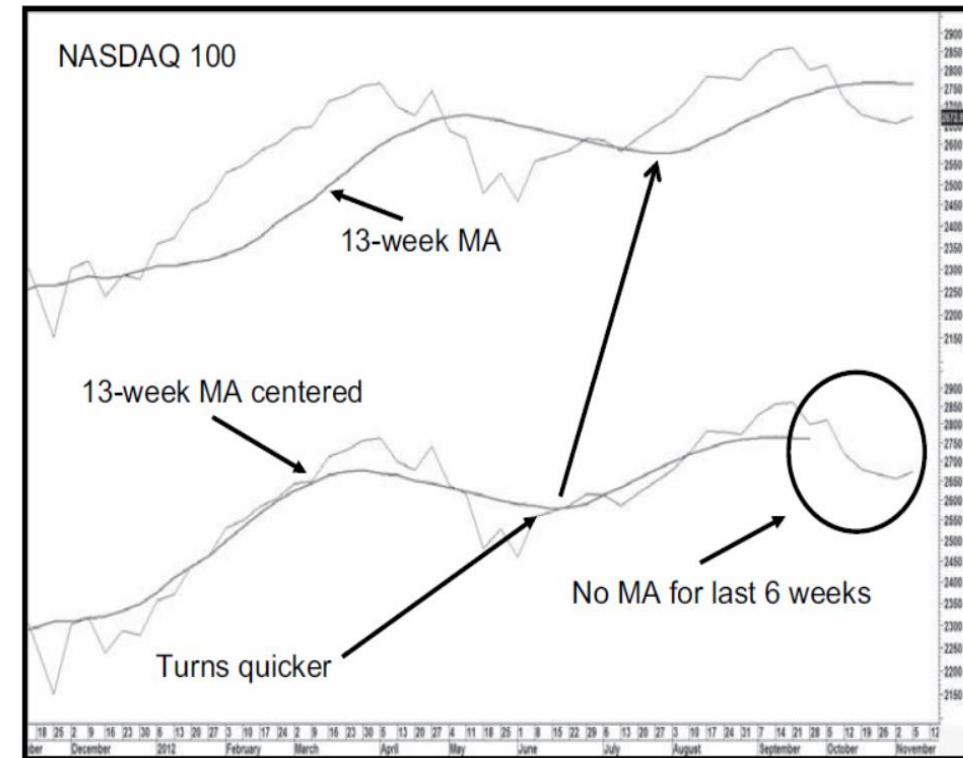
Simple SMA				
Date		Index	10-Week Total	MA
Jan.	8	101		
	15	100		
	22	103		
	29	99		
Feb.	5	96		
	12	99		
	19	95		
	26	91		
Mar.	5	93		
	12	89	966	96.6
	19	90	955	95.5
	26	95	950	95
Apr.	2	103	950	95

Introduction to Moving Averages

- As the window rolls over, a new week is added, and old week is subtracted
- Thus, the average moves (therefore, the term moving average)
- Changes in the price trends are identified by the price crossing MA
- A change from a rising to a declining market is signaled when the price moves below its MA
- A bullish signal is triggered when the price rallies above the average

Introduction to Moving Averages

- An MA is a smoothed version of a trend, and the average itself is an area of dynamic support and resistance
- The more times an MA has been touched, i.e., acts as a support or resistance area, the greater the significance when it is violated



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

Characteristics of MA

Characteristics of MA

- In a rising/falling market, price reactions are often reversed as they find support/resistance in the area of the MA
- If the rest of the evidence agrees, it is not a bad idea to wait for the price to reach its MA prior to making a purchase/sale
- A rally in a declining market often meets resistance at an MA and turns down
- The more times an MA has been touched, i.e., acts as a support or resistance area, the greater the significance when it is violated

Characteristics of MA

- A carefully chosen MA should reflect the underlying trend; its violation, therefore, warns that a change in trend may already have taken place
- If the MA is flat or has already changed direction, its violation is conclusive proof that the previous trend has reversed
- If the violation occurs while the MA is still proceeding in the direction of the prevailing trend, this development should be treated as a preliminary warning that a trend reversal has taken place
- Confirmation should await a flattening or a change in direction in the MA itself or should be sought from alternative technical sources

Characteristics of MA

- The longer the period covered by an MA, the greater is the significance of a crossover signal
- For instance, the violation of an 18-month MA is substantially more important than a crossover of a 30-day MA
- Reversals in the direction of an MA are usually more reliable than a crossover
- The instances in which a change in direction occurs close to a market turning point, a very powerful and reliable signal is given
- However, in most instances, an average reverses well after a new trend has begun and so is only useful as a confirmation

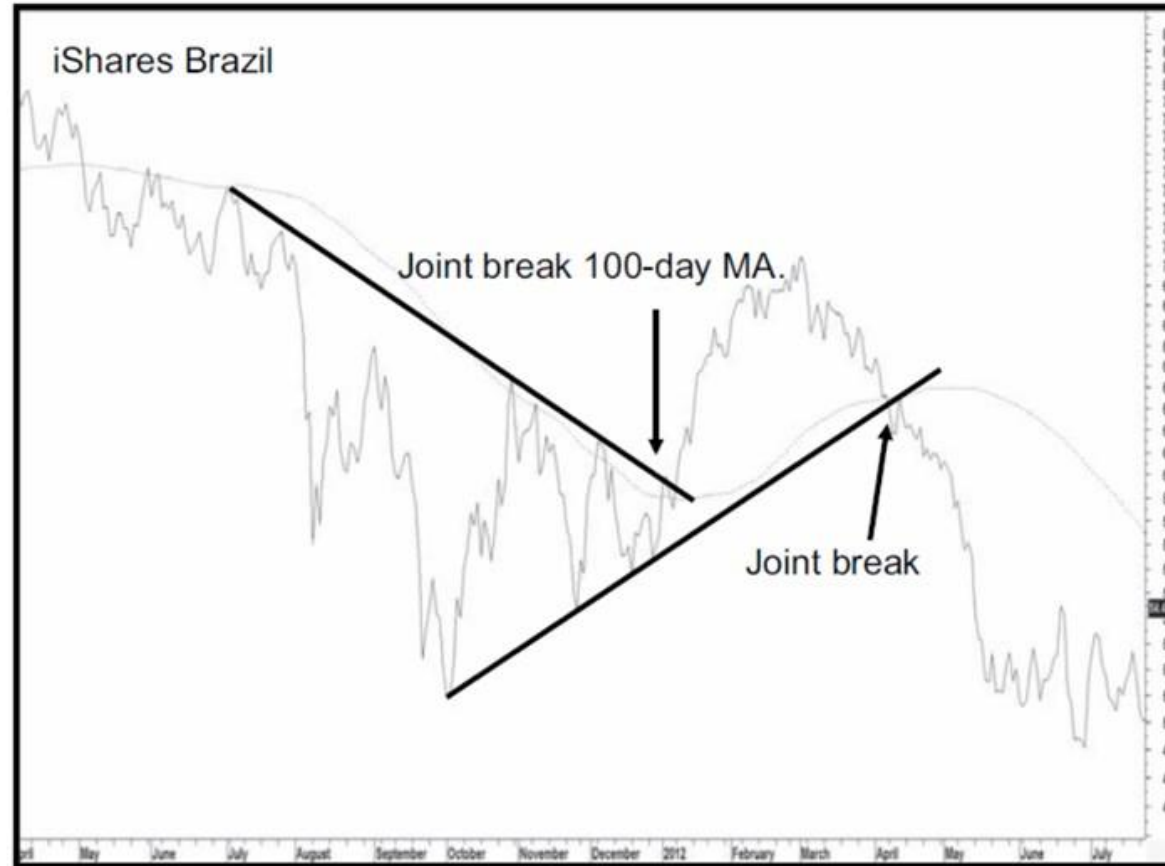
Problems with MA Crossover

- A crossover is any penetration of an MA. However, close observation of any chart featuring an MA will usually reveal several whipsaws or false signals
- However, it is possible to avoid some of these close calls by using filtering techniques
- The type of filter to be used depends on the period in question and is very much a matter of individual experimentation
- For example, we may decide to take action on MA crossovers for which a 3% penetration takes place and to ignore all others

Problems with MA Crossover

- Violations of a 40-week MA might result in an average price move of 15% to 20%
- In this instance, a 3% penetration would be a reasonable filter
- On the other hand, since 3% would probably encompass the whole move signaled by a 10-hour MA crossover, this filter would be of no use whatsoever
- A useful tip is to wait for an MA crossover to take place while a trend line is violated or a price pattern is completed. Such signals strongly reinforce the trend line or price pattern signal and, therefore, needless in the form of a filter requirement

Joint Trend Line/MA Violations



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

Signal Generation with MAs

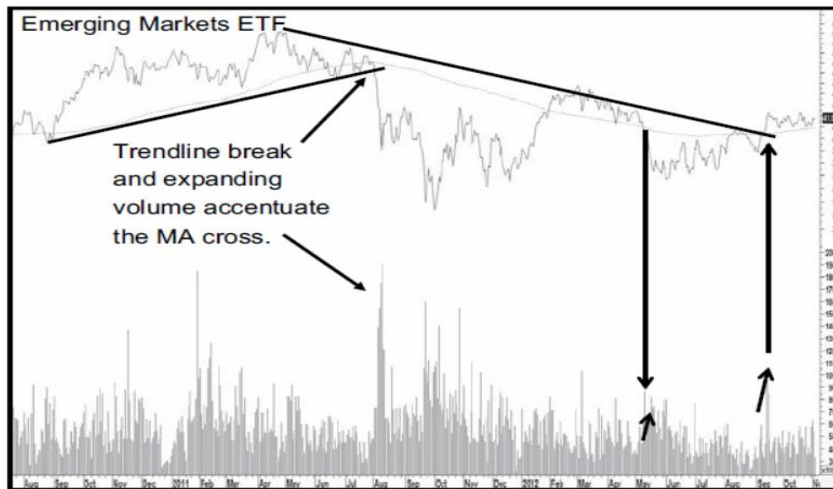
Signal Strength of a Crossover

- If an MA crossover takes place at the same time a trend line is violated or a price pattern is completed, these signals strongly reinforce each other and, therefore, needless in the form of a filter requirement
- Sometimes, it is possible to see an MA crossover accompanied by exceptionally heavy volume
- In such circumstances, you could lower your standards of what represented a decisive breakout since the expanding volume would emphasize enthusiasm by the buyers or fear by the sellers, depending on the direction of the break

Signal Strength of a Crossover

- The cross was accompanied by expanding volume and a trend line break
- Two other breaks also developed on expanding activity, one of which was an upside violation, which was also associated with a trend line break

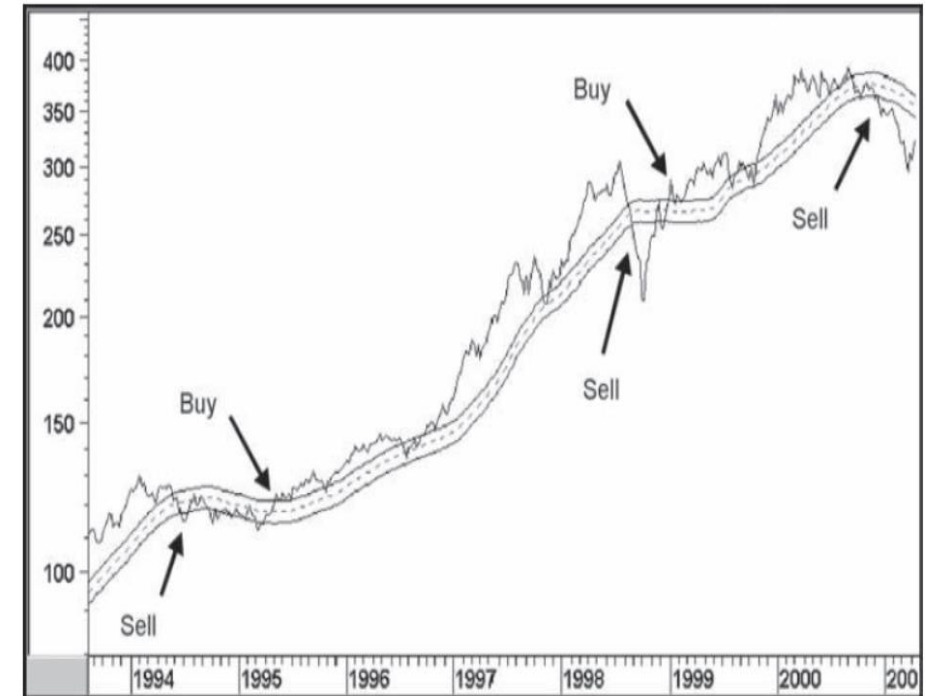
MA Crossovers and Volume Characteristics



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

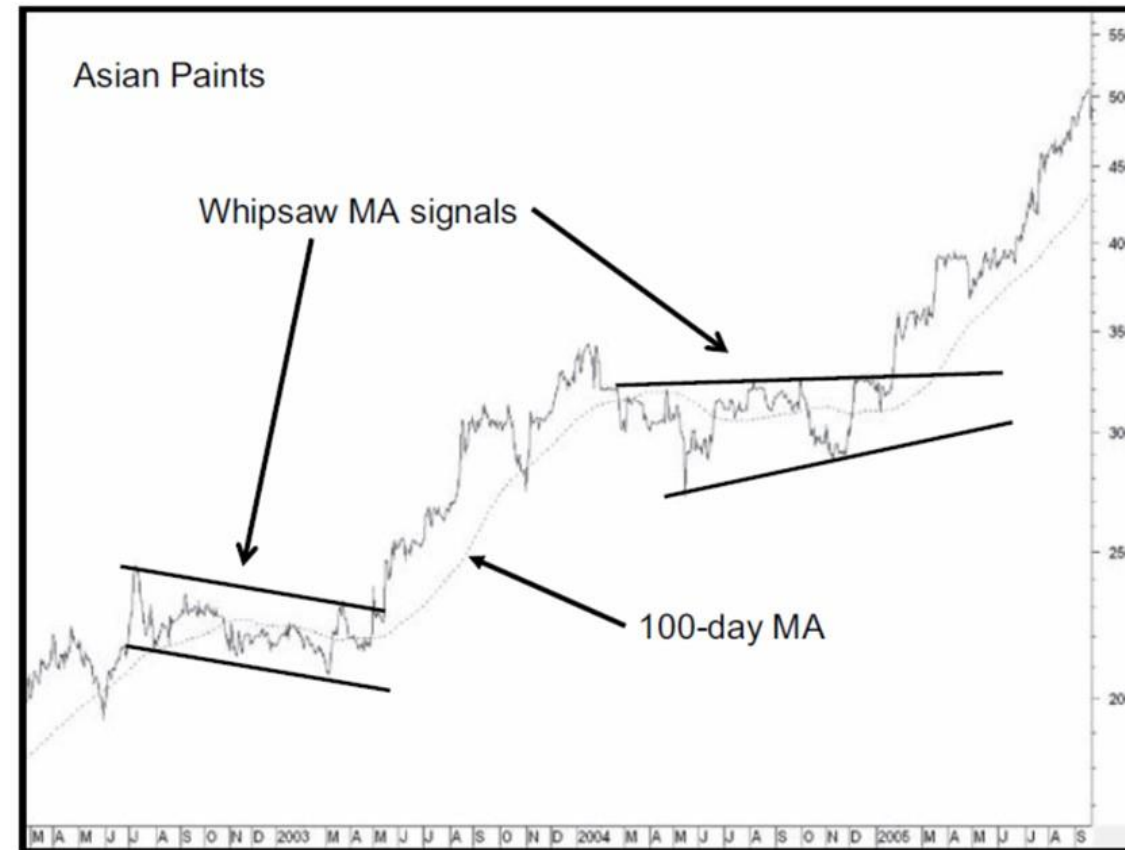
Problems with MA Crossover

- The figure features the Eurotop Index together with a 40-week MA and two bands that have been plotted 3% above and below the average itself
- Buy signals are generated when the price crosses above the upper line and sell signals when it crosses below the lower one
- This has the effect of filtering out some of the whipsaws



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

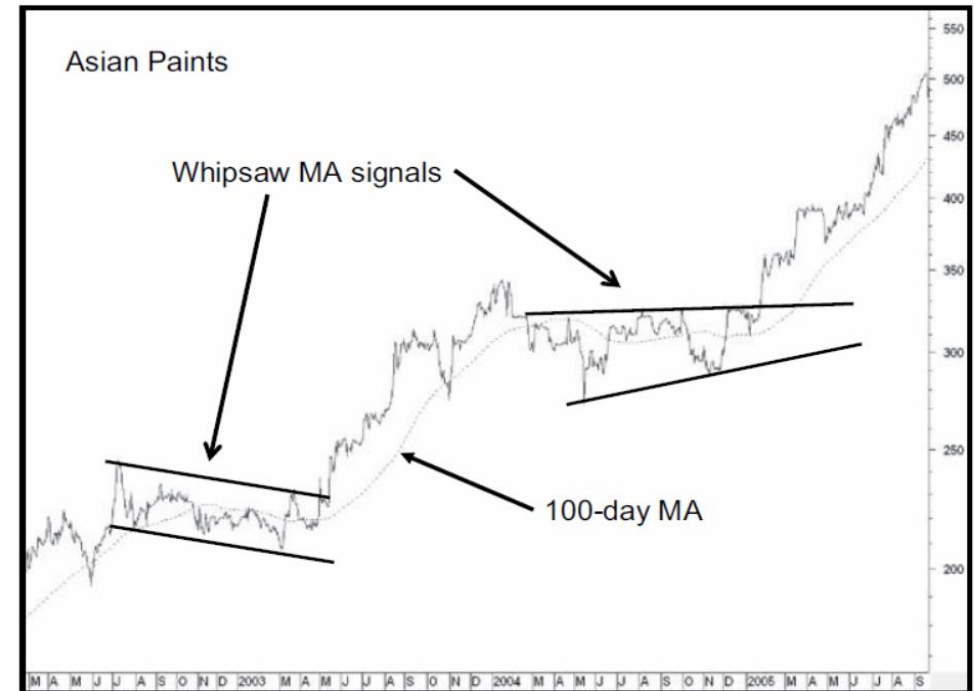
Crossovers and Trading Ranges



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

Problems with Crossovers

- During a trading range, MA crossovers have a strong tendency to be counterproductive
- In these situations, it is usually best to use the outer ends of the trading range for the signal rather than the MA
- That is the time when a well-constructed trend line should be substituted for an MA crossover



Choosing a Time Span

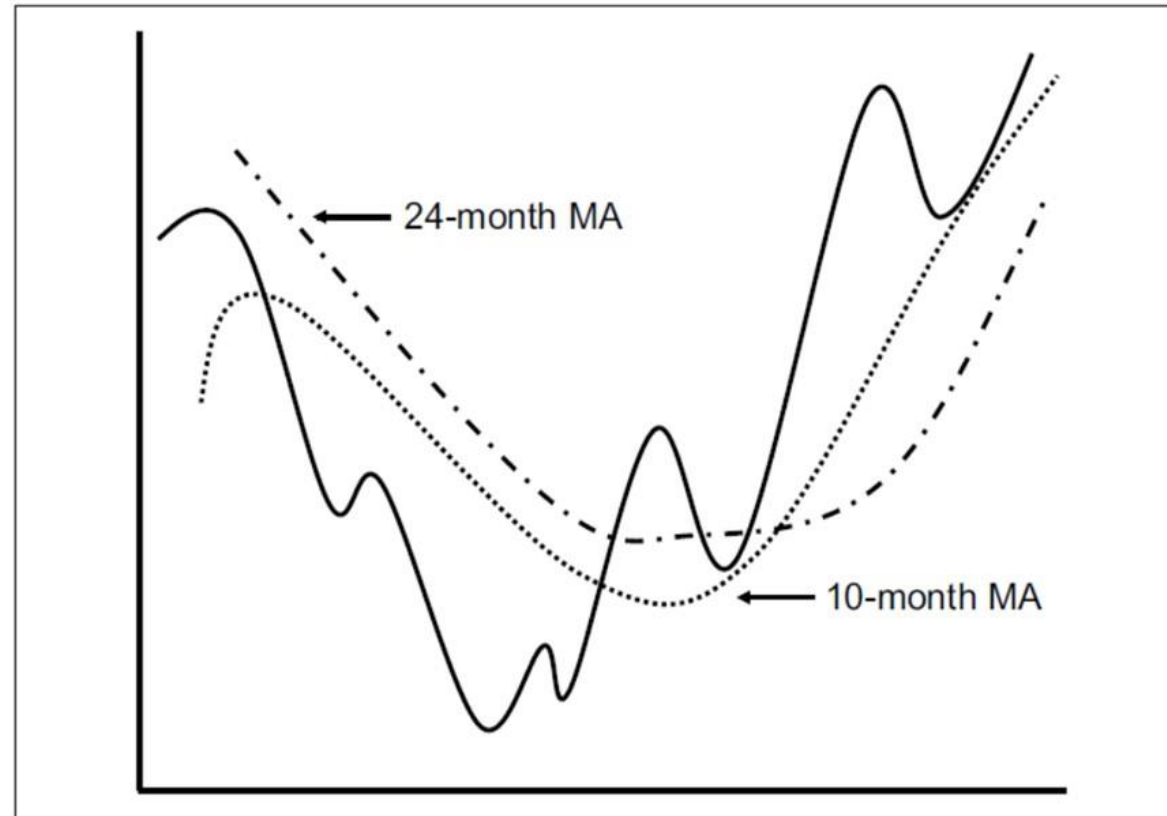
- MAs can be constructed for any time, whether a few days, several weeks, many months, or even years
- Optimal selection of length is very important
- For example, if it is assumed that a complete bull and bear cycle lasts for 1 year, an MA constructed over a time span longer than 6-12 months will not reflect the cycle at all
- This is because it smoothens out all the fluctuations that take place during the period and will appear more or less as a straight-line crossing through the middle of the data unless there is a particularly sharp linear trend

Choosing a Time Span

- On the other hand, a 5-day MA will catch every minor move in the stock cycle and will be useless for identifying the actual top and bottom of the overall cycle
- Even if the 48-month average were shortened to 24 months, using the crossover signals would still cause the 24-month average to give an agonizingly slow confirmation of a change in trend
- The 4-week average would be so sensitive that it would continually give misleading or whipsaw signals
- Only an MA that can catch the movement of the actual cycle will provide the optimum trade-off between lateness and oversensitivity

Application of Multiple Simple MAs

A Short-Term Versus a Long-Term MA



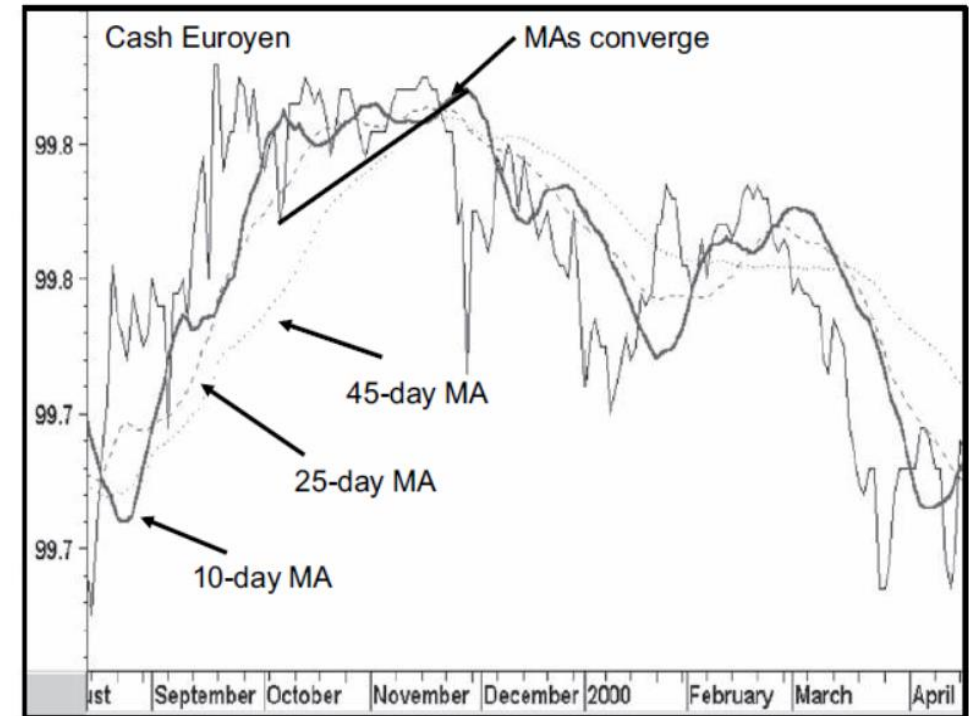
Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

Convergence of Averages

- A sharp price move is often preceded by a gradually narrowing trading range
- In effect, decreasing price fluctuations reflect a very fine balance between buyers and sellers
- When the balance is tipped one way or the other, the price is then free to embark upon a major move
- This kind of situation can often be identified by plotting several MAs and observing when they are all at approximately the same point

Convergence of Averages

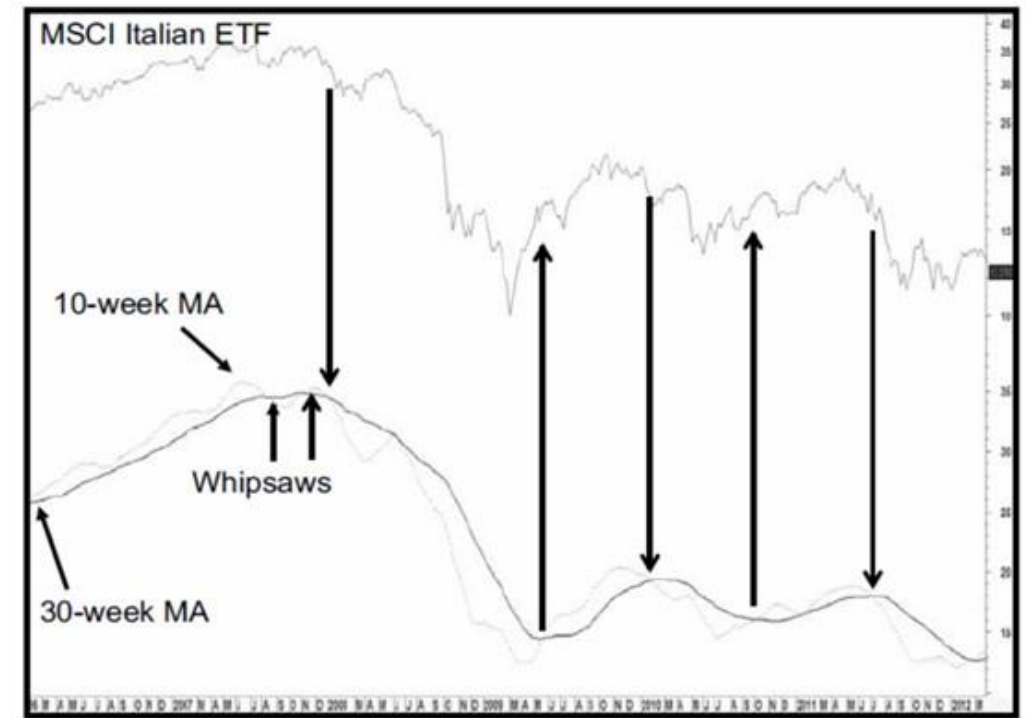
- The figure, for example, shows the daily price for cash Euroyen
- Note how the three MAs almost converge entirely just before the price embarks on a sharp decline
- The convergence of the averages warns that a major move is likely, but the actual signal comes from the violation of the trend line.



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

Application of Multiple Simple MAs

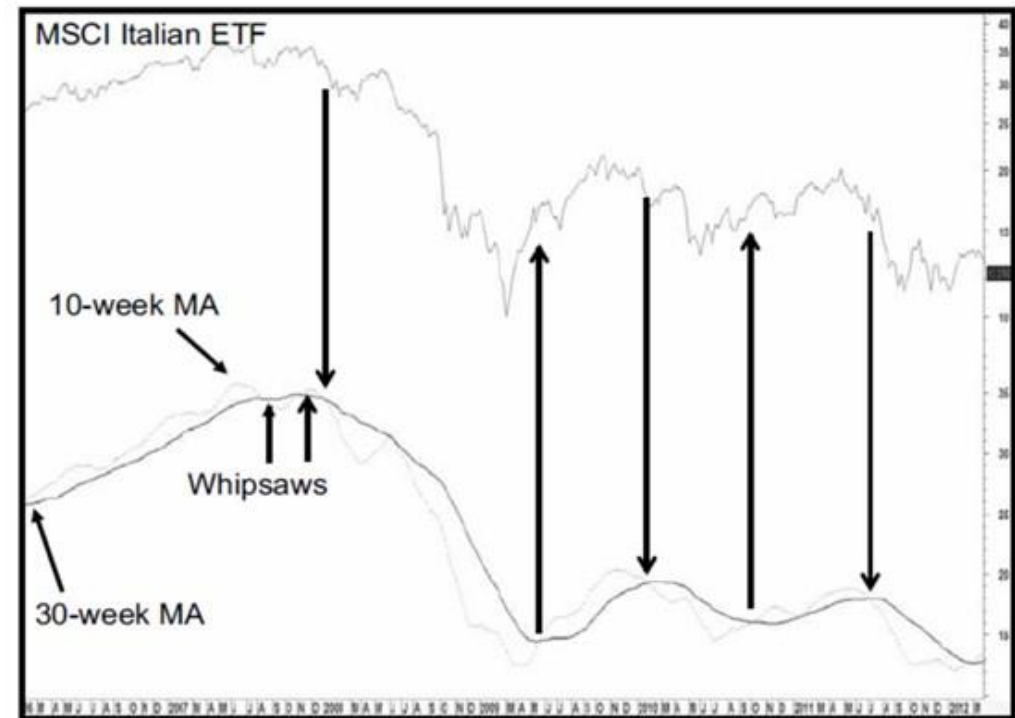
- Some techniques of trend determination involve more than one MA
- Signals are given by a short-term MA crossing above or below a longer one
- This procedure has the advantage of smoothing the data twice, which reduces the possibility of a whipsaw, yet it warns of trend changes fairly quickly after they have taken place



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

Application of Multiple Simple MAs

- In the figure here, for iShares MSCI Italian ETF, the two averages that have traditionally been used for identifying primary trend moves are the 10- and 30-week spans
- Signals are given when the (dashed) 10-week average moves below the 30-week average



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

Application of Multiple Simple MAs

- Some technicians prefer to wait until the 30-week series is moving in the direction of the cross so that a negative cross would require a declining 30-week MA
- Negative signals of either variety warn that the major trend is down
- Subsequently, it is not assumed to have reversed until either the 10-week MA moves higher than the 30-week MA, or it does so when both are rising simultaneously
- By definition, either methodology results in signals being triggered after the ultimate price peak or trough

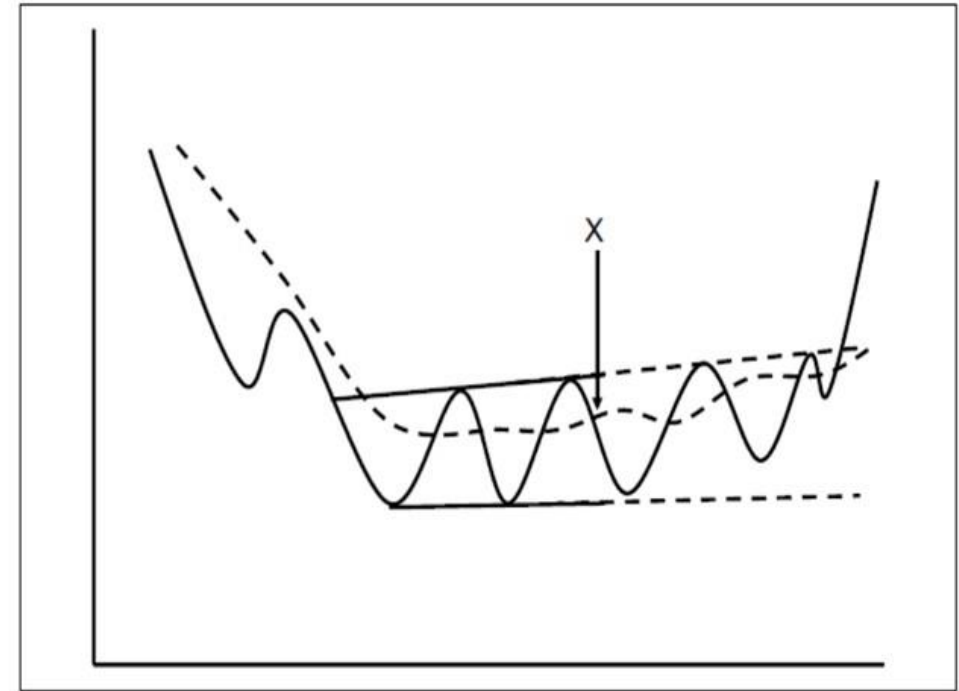
Application of Multiple Simple MAs

- Therefore, they serve as a confirmation of a change in trend rather than as actual juncture points in themselves
- If the signal develops close to the final turning point, it can be acted upon in a timely and practical way
- On the other hand, if it is triggered some distance from the previous peak or trough, it can merely be used as confirmation.

MAs in Trading Range

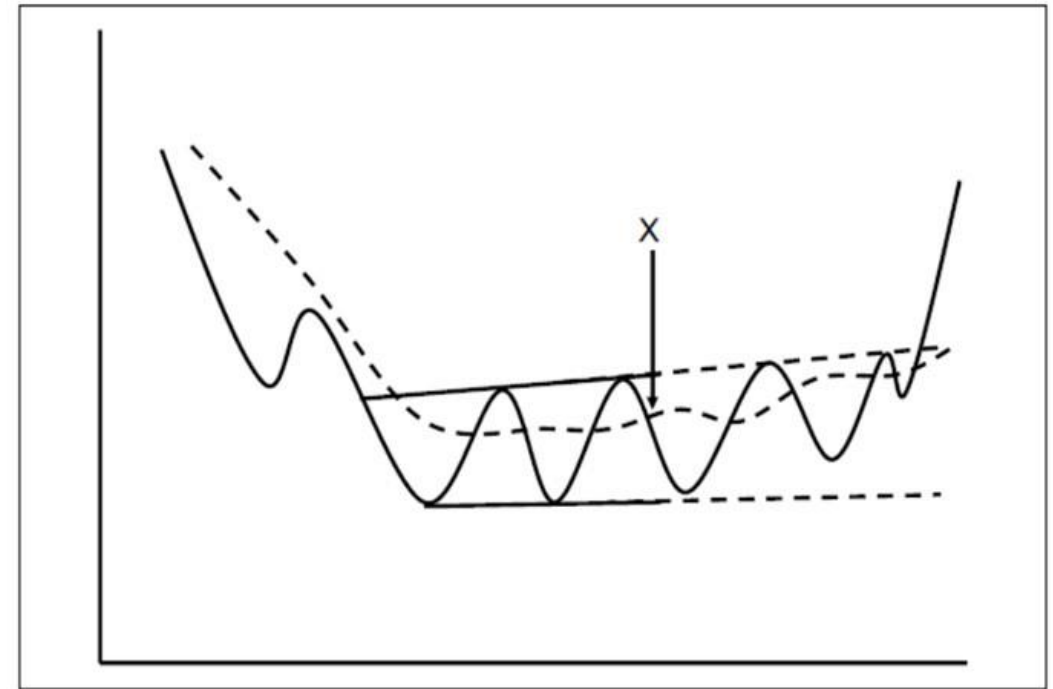
MAs in Trading Range

- MAs should always be used in conjunction with other indicators
- This is because prices occasionally fluctuate in a broad sideways pattern for an extended period, resulting in a series of misleading signals
- The good news is that such frustrating trading-range action is often followed by an extremely strong trend in which the losses incurred from the trendless period of whipsaw signals are more than made up for



MAs in Trading Range

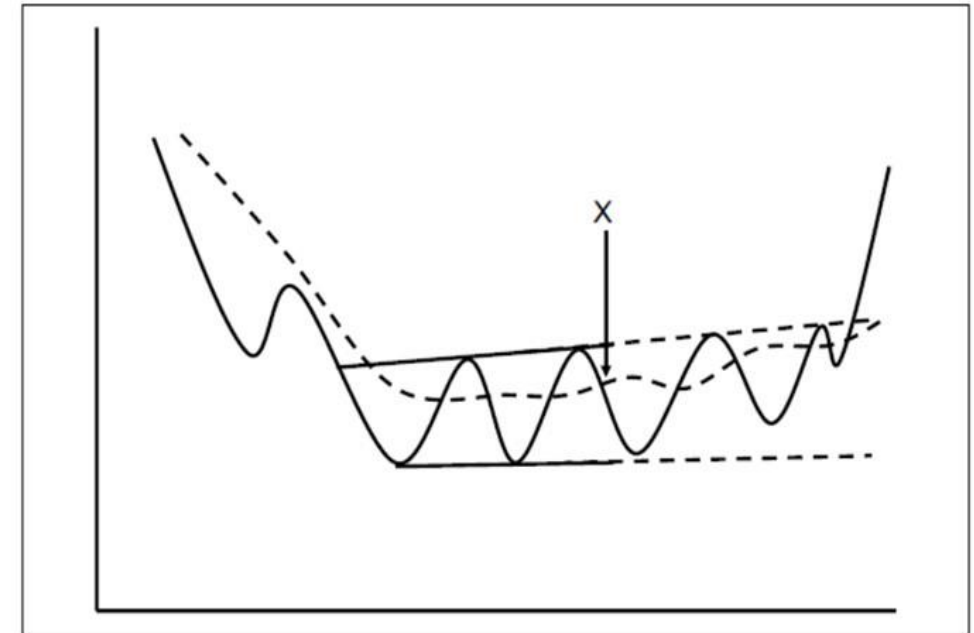
- This is because the whipsaws indicate confusion between buyers and sellers, and this implies a big battle
- When one or the other wins out, the victorious side is then able to push prices in a much stronger way
- The figure shows an example of an MA offering numerous whipsaw signals as it moves through a trading range



Source: From Martin Pring, *Trading Systems Explained*, Marketplace Books, Columbia, Maryland, 2008.

MAs in Trading Range

- At first, it is not obvious that the price action is a trading range
- However, at point X, when the price crosses below the MA again, it is possible to construct two trend lines that reflect this ranging action
- At such a time, it makes much better sense to await the verdict by acting on a trend line break rather than an MA crossover since there is no reason to suspect that the next crossover after X will not turn out to be a whipsaw



Weighted Moving Averages (WMAs)

Weighted Moving Averages (WMA)

- A simple moving average (SMA) can only correctly represent a trend from a statistical point of view if it is centered but centering an average delays the signal
- One technique that attempts to overcome this problem is to weigh the data in favor of the most recent observations. An MA constructed in this manner (WMA) can “turn” or reverse direction much more quickly than a simple MA

Weighted Moving Averages: WMA

- There are countless ways in which data can be weighted, but the most widely used method is a technique whereby the first period of data is multiplied by 1, the second by 2, the third by 3, and so on until the most recent one. The calculations for each period are then totaled. The divisor for a simple MA is the number of periods, but for this form of weighted average, the divisor is the sum of the weights, i.e., $1 + 2 + 3 + 4 + 5 + 6 = 21$
- For a 10-week weighted MA, the sum of the weights would be $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = 55$

Weighted Moving Averages: WMA

Weighted Moving Average Calculation										
			6 × col. 1	5 × col. 1	4 × col. 1	3 × col. 1	2 × col. 1	1 × col. 1	Total	Total /21
			Present	1 week ago	2 weeks ago	3 weeks ago	4 weeks ago	5 weeks ago		
Date		Index								
Jan.	8	101								
	15	100								
	22	103								
	29	99								
Feb.	5	96								
	12	99	594	480	396	309	200	101	2080	99.1
	19	95	570	495	384	297	206	100	2052	97.7
	26	91	546	475	396	288	198	103	2006	95.5
Mar.	5	93	558	455	380	297	192	99	1981	94.3
	12	89	534	465	364	285	198	96	1924	92.5

Exponential Moving Averages (EMAs)

Exponential Moving Averages (EMAs)

- An exponential moving average (EMA) is a shortcut to obtaining a form of weighted MA
- $EWMA_t = \alpha * (P_t - EWMA_{t-1}) + EWMA_{t-1}$; α = exponent
- To construct a 20-week EMA, it is necessary to calculate a simple 20-week MA first, i.e., the total of 20 weeks of observations divided by 20
- In the table, this has been done for the 20 weeks ending January 1, and the result appears as 99.00 in column 6
- The 20-week average becomes the starting point for the EMA
- It is transferred to column 2 for the following week

Exponential Moving Averages (EMAs)

Exponential Moving Average Calculation							
			EMA for previous week	Difference (1)-(2)	Exponent	(4)*(3)	(2)+(5)
		(1)	(2)	(3)	(4)	(5)	(6)
Date		Index					
Jan.	1	99.00
	8	100.00	99.00	1.00	0.10	0.10	99.10
	15	103.00	99.10	3.90	0.10	0.39	99.49
	22	102.00	99.49	2.51	0.10	0.25	99.74
Mar.	29	99.00	99.74	-0.74	0.10	-0.07	99.67

Exponential Moving Averages (EMAs)

- Next, the entry for the 21st week (January 8 in the earlier example) is compared with the EMA, and the difference is added or subtracted and posted in column 3, i.e., $100 - 99 = 1.00$
- This difference is then multiplied by the exponent, which for a 20-week EMA is 0.1
- This exponentially treated difference, 1.00×0.1 , is then added to the previous week's EMA, and the calculation is repeated each succeeding week
- In the example, the exponentially treated difference for January 8 is 0.1, which is added to the previous week's average, 99.00, to obtain an EMA for January 8 of 99.10. This figure in column 6 is then plotted. The exponent used varies with the time span of the MA

Exponential Factors for Various Time Frames

Number of Weeks	Exponent
5	0.4
10	0.2
15	0.13
20	0.1
40	0.05

$\frac{2}{\text{Time Span}}$

Exponential Moving Averages

- The correct exponents for various periods are shown, where the periods have been described as weekly
- In effect, however, the exponent 0.1 can be used for any measure of 20 days, weeks, months, years, or an even longer period
- Exponents for time periods other than those shown in the table can easily be calculated by dividing 2 by the time span
- Trade-off between timeliness and sensitivity

Exponential Moving Averages

- A 5-week average will need to be twice as sensitive as a 10-week average; thus, 2 divided by 5 gives an exponent of 0.4
- On the other hand, since a 20-week average should be half as sensitive as for a 10-week period (0.2), its exponent is halved to 0.1
- If an EMA proves to be too sensitive for the trend being monitored, one solution is to extend its time period. **All forms of MAs represent a compromise between timeliness and sensitivity**

Summary

Summary

- One of the basic assumptions of technical analysis is that stocks move in trends
- Since major trends comprise many minor fluctuations in prices, an MA is constructed to help smooth out the data so that the underlying trend will be more clearly visible
- Often, MA crossovers are employed to provide warnings of a reversal in trend and using WMAs or EMAs, which are more sensitive to changes in the prevailing trend since they weigh data in favor of the most recent periods

Summary

- There is no such thing as a perfect average. The choice of time span always represents a trade-off between timeliness—catching the trend at an early stage—and sensitivity—catching the trend turn too early and causing an undue amount of whipsaws

Thanks!

