Week 10
Artificial Intelligence (AI) for Investments

Lesson 3: Momentum Indicators

Introduction to Momentum Oscillators

Introduction

- Ball thrown in the air, Car rolling down the hill
- Various momentum indicators are Rate of change (ROC), the relative strength indicator (RSI), moving-average convergence divergence (MACD), and Stochastics
- The principles or characteristics of momentum interpretation are the same for all indicators, but some are specially constructed to bring out a particular characteristic

Momentum signals

- The momentum signal performs the act of supplementary “witness” in our weight-of-the-evidence approach
- Momentum and sentiment are closely aligned
- Momentum indicators have two major applications
- Momentum indicators are often useful in identifying overbought and oversold conditions, and divergences
- Also, momentum indicators can be used for identifying trend reversals: assumption here is that if momentum is reversed, prices will follow in sometime

Rate of Change (RoC) Oscillator

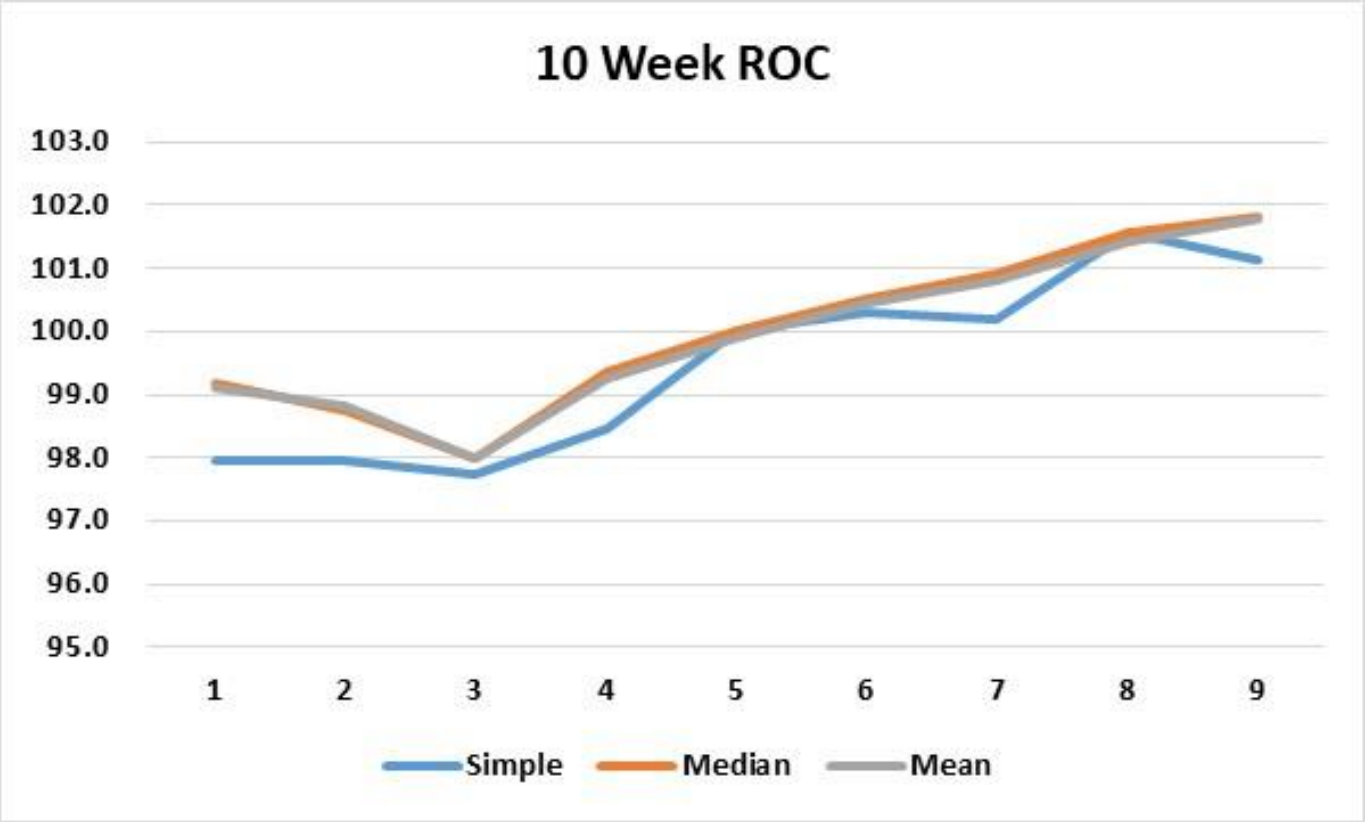
Rate of Change (RoC)

- Divide current price by the price 10-week/Day ago (or any period that is more suitable) to obtain RoC
- For example, if the current price is 100 and the price 10-week ago was 105, then RoC= 100/105=95.2
- The subsequent price will be divided by the price 10-week ago
- The resulting series will oscillate around some central point
- Instead of using exact value, we can use mean and median of the period

10 Week ROC calculation

Date	Index Price	Seq	10 Weeks Ago (2)	10 Week ROC (1) divided by (2)	10 Weak ROC (Median)	10 Weak ROC (Mean)
Jan-01	985	1				
8	980	2				
15	972	3				
22	975	4				
29	965	5				
Feb-05	967	6				
12	972	7				
19	965	8				
26	974	9				
Mar-05	980	10		Simple	Median	Mean
12	965	11	985	98.0	99.2	99.1
19	960	12	980	98.0	98.8	98.8
26	950	13	972	97.7	98.0	98.0
Apr-02	960	14	975	98.5	99.4	99.2
9	965	15	965	100.0	100.0	99.9
16	970	16	967	100.3	100.5	100.4
23	974	17	972	100.2	100.9	100.8
30	980	18	965	101.6	101.6	101.4
May-07	985	19	974	101.1	101.8	101.8

10 Week ROC calculation

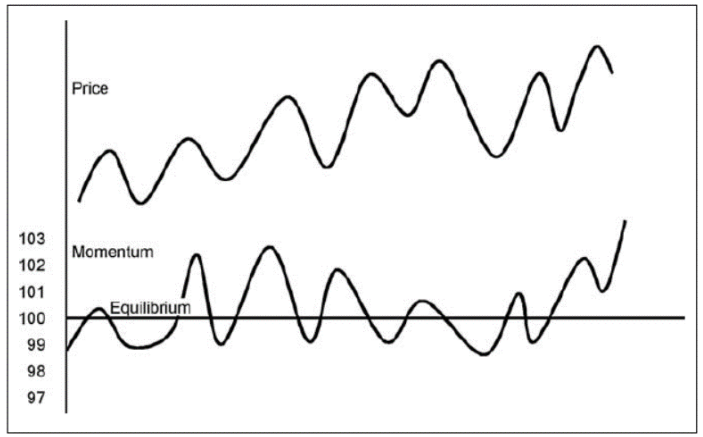


RoC Characteristics

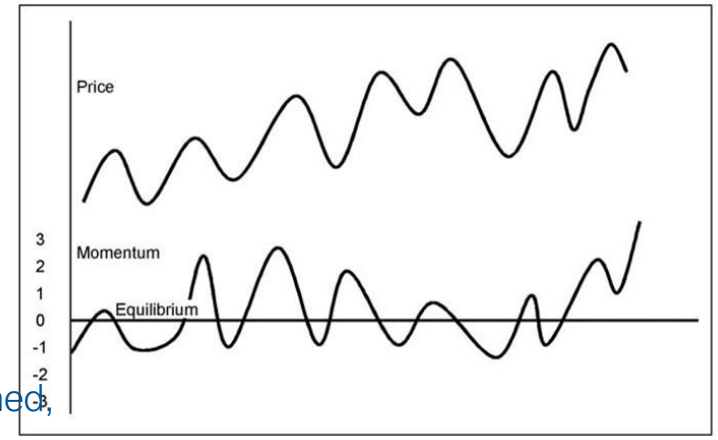
Rate of Change (RoC) Oscillator

- This horizontal equilibrium line represents the level at which the price is unchanged from its reading 10 weeks ago
- When an ROC indicator is above the reference line, the market price that it is measuring is higher than its level 10 weeks ago
- If the ROC indicator is also rising, the difference between the current reading of the price and its level 10 weeks ago is growing

RoC with % scaling



RoC in return form

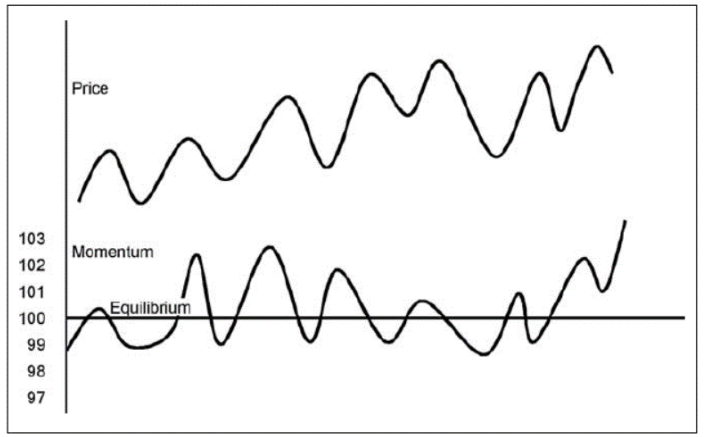


Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland, 2008.

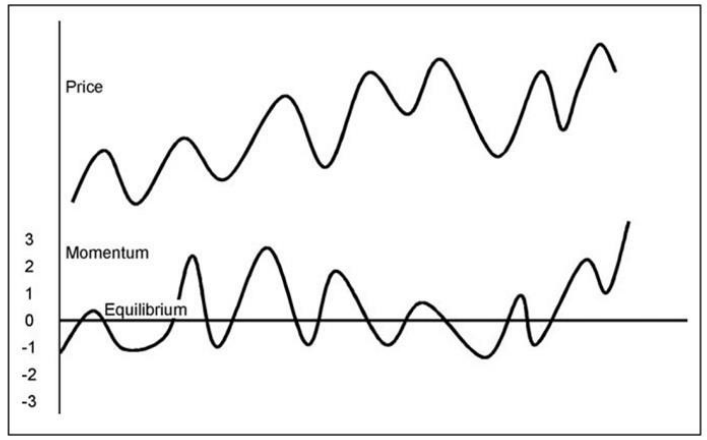
Rate of Change (RoC) Oscillator

- If an ROC indicator is above the central line but is declining, the price is still above its level 10 weeks ago, but the difference between the two readings is shrinking
- When the ROC indicator is below its central line and falling, the price is below its level 10 weeks ago, and the difference between the two is growing

RoC with % scaling



RoC in return form



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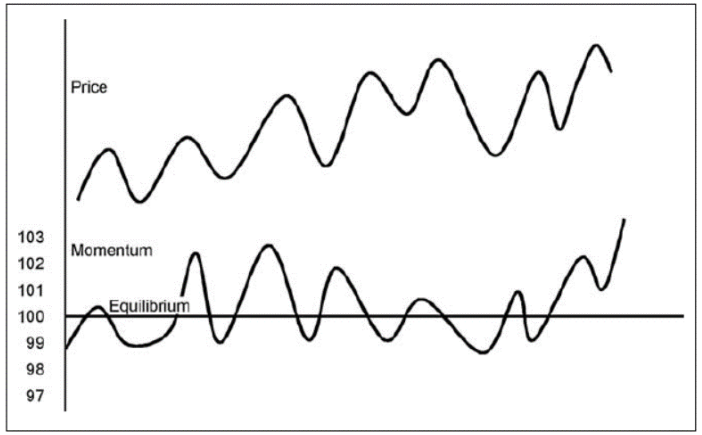
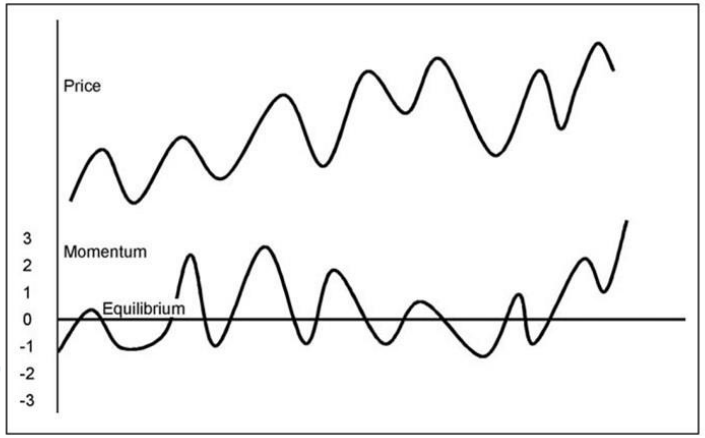
Rate of Change (RoC) Oscillator

- If the indicator is below its central line but rising, the price is still lower than its level 10 weeks ago, but its rate of decline is slowing
- In short, a rising ROC indicator implies expanding velocity, and a falling one implies a loss of momentum
- Rising momentum should be interpreted as a bullish factor, and declining momentum as a bearish one

RoC with % scaling



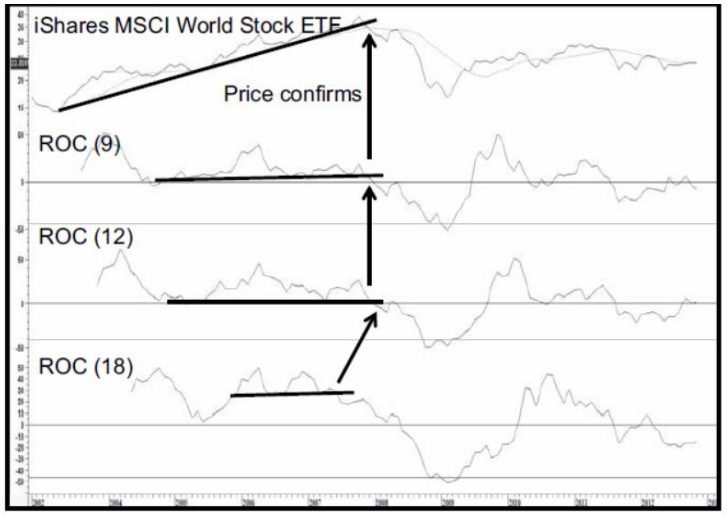
RoC in return form



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

RoC: Use of different time-spans

- Calculation of momentum indicators (e.g., ROC) for different time span helps
- E.g., trendlines, price patterns, or divergences, which may not be apparent in one period, are more apparent in another
- 12 month MA along with 9, 12, and 18 month ROC are provided here
- Notice the 12 month MA trend line violation



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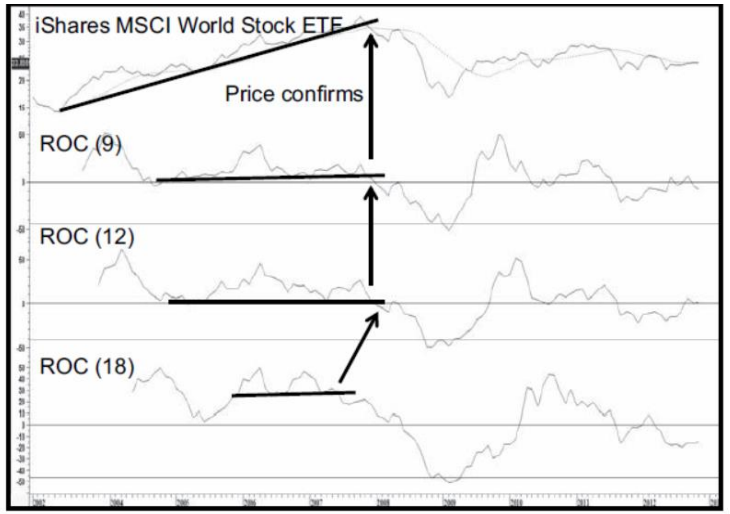
RoC: Use of different time-spans

- The trendline was violated with 12 month MA along with loss of momentum in all the three ROCs (9, 12, 18)
- Momentum typically reverses along with price, often with a small lead, but just because oscillators change direction, doesn't always mean that prices will too
- Normally, a reversal in the momentum trend acts as confirming evidence of a price trend reversal signal

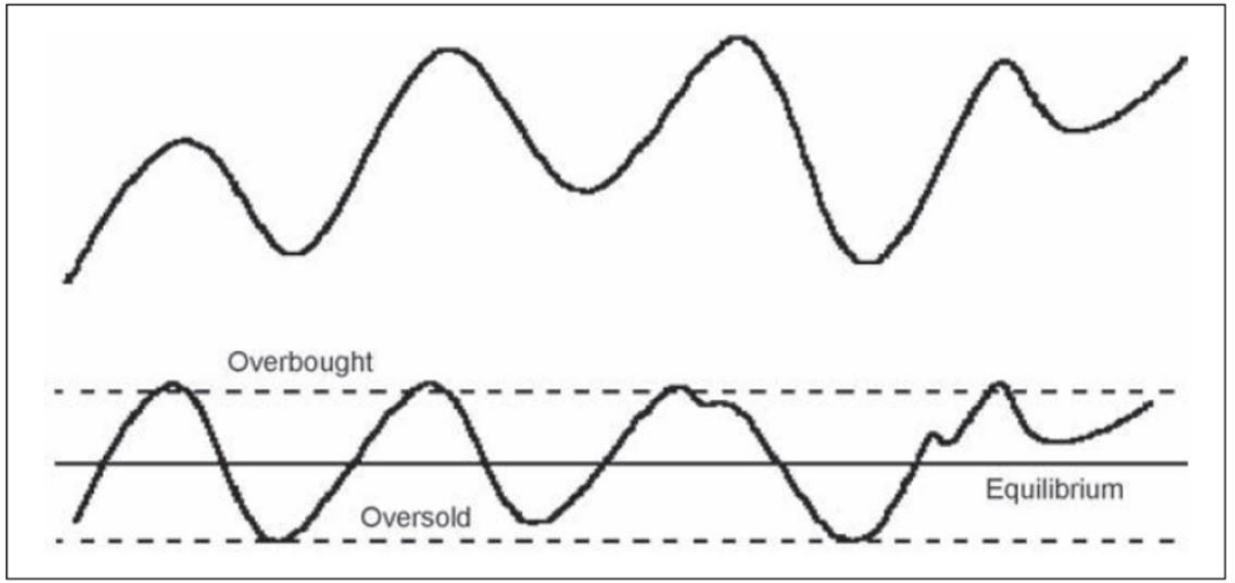


Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland, 2008.

Overbought and Oversold levels

Overbought and oversold levels

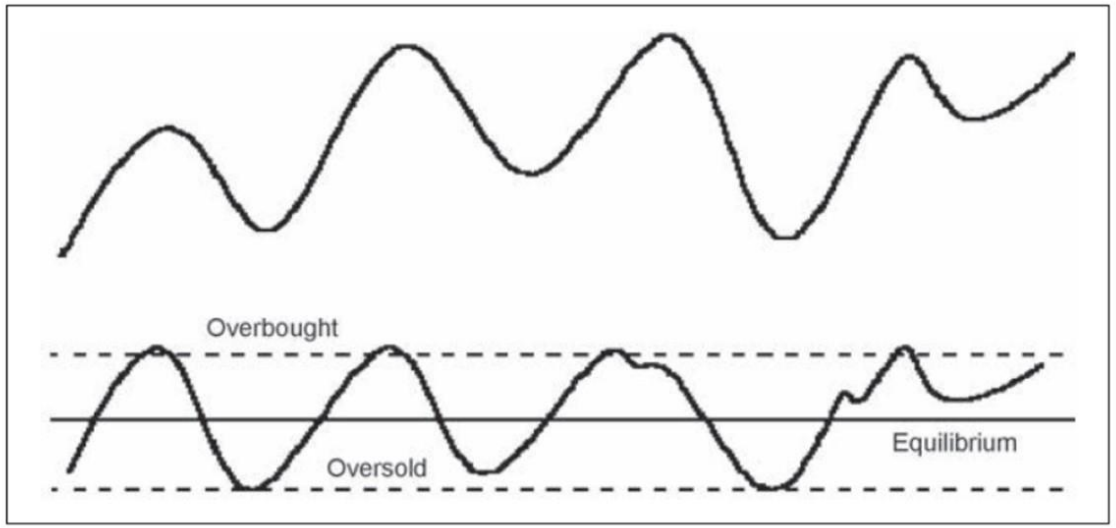
- Perhaps the most widely used method of momentum interpretation is the evaluation of overbought and oversold levels
- Consider the price as a stone tied to an elastic band, oscillating up and down



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

Overbought and oversold levels

- A particularly strong or weak price tends to extend beyond the normal limits, known as overbought and oversold levels
- These areas are drawn on a chart at some distance above and below the equilibrium level
- The actual boundaries will depend on the volatility of the price being monitored and the time period over which the momentum indicator has been constructed

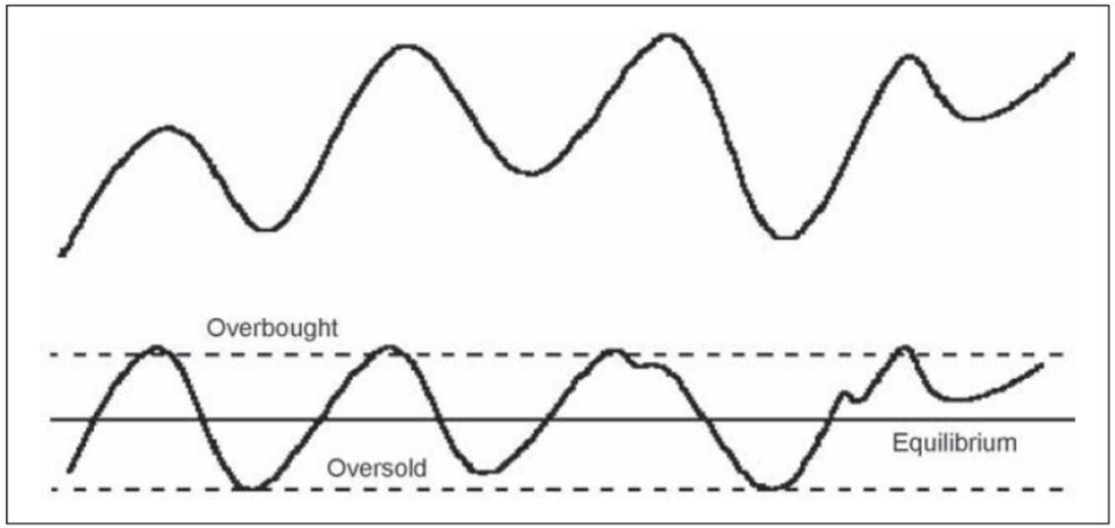


Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland, 2008.

Overbought and oversold levels

- When a price reaches an overbought or oversold extreme, the probabilities favor but, by no means guarantee, a reversal

- An overbought reading is a time to be thinking about selling, and an oversold one warns that the current technical position may warrant a purchase



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

Overbought and oversold levels

- In many cases, when a price reaches an overbought extreme, the news is good, participants are optimistic, and human nature tells us to buy

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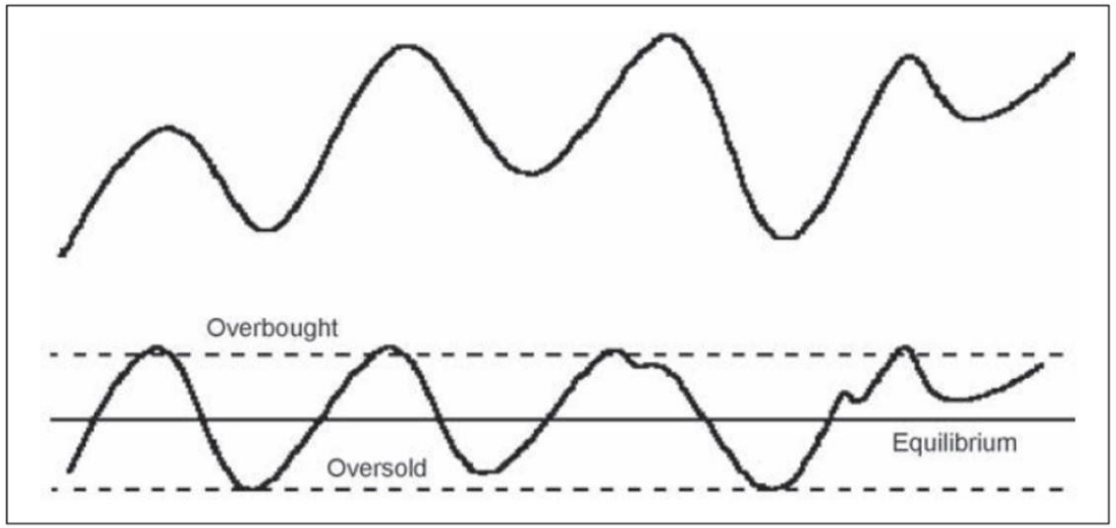

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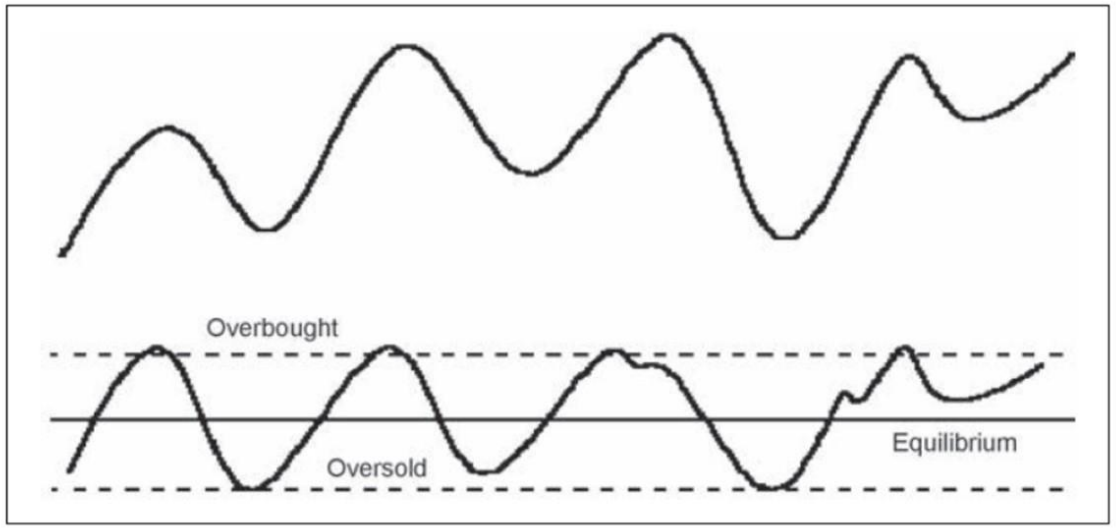
Overbought and oversold levels

- On the other hand, an oversold reading is usually associated with a negative news background

- Most of the people are fearful (at oversold level) and it takes a lot of courage to buy but mostly likely that is the right thing to do



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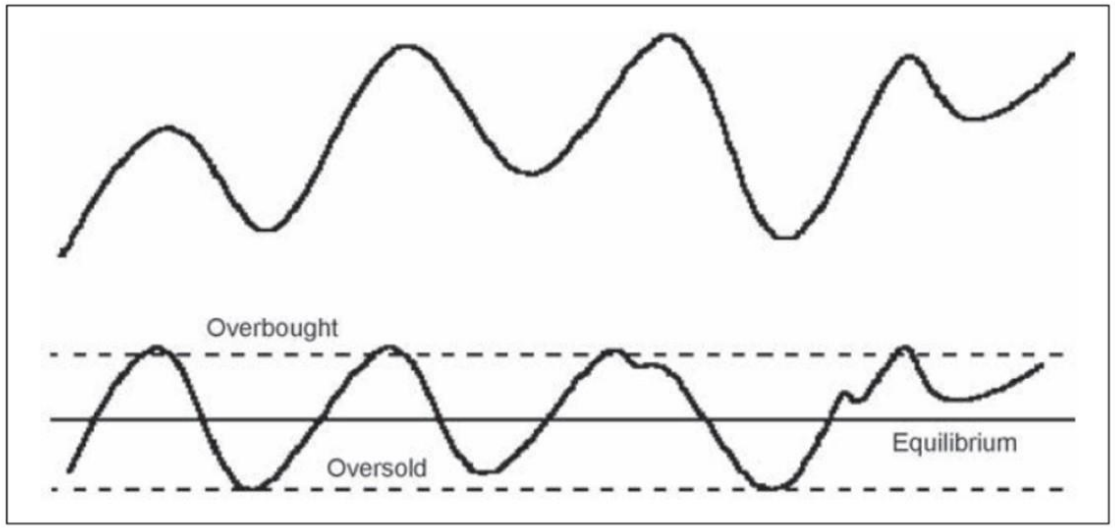
Overbought and oversold levels

- However, where to draw these lines of overbought and oversold can only be determined by studying the history and characteristics of the security being monitored

- They should be drawn such that they will act as pivotal points, which, when touched or slightly exceeded, are followed by a reversal in the oscillator

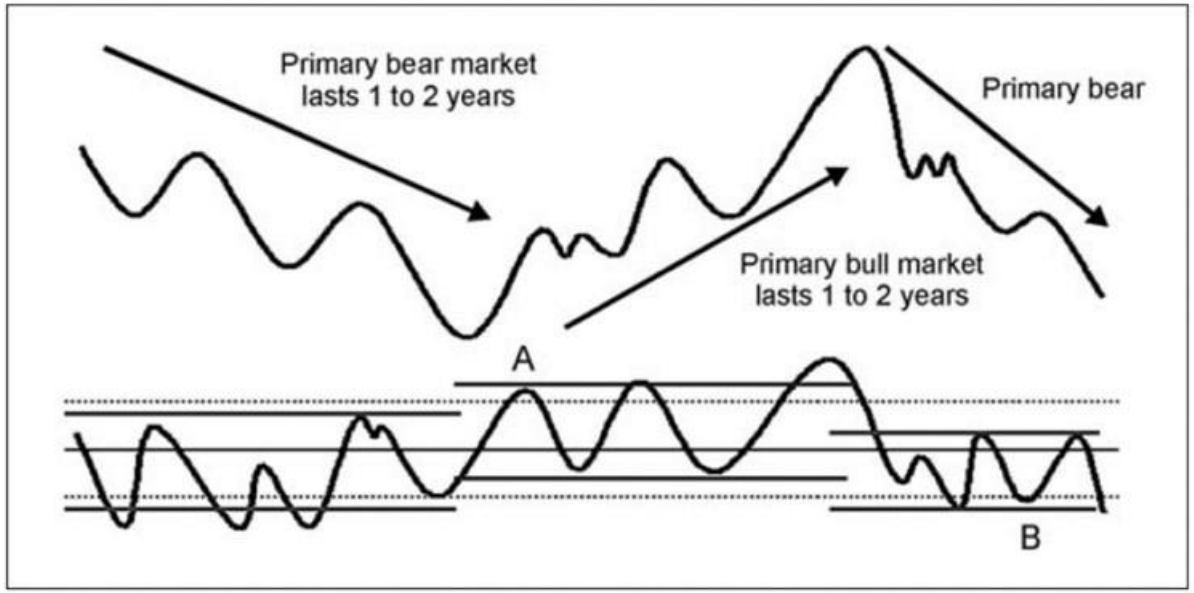


Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland,

Momentum (Oscillator) Characteristics in Primary Bull and Bear Markets

Introduction

- Oscillators behave in different ways, depending on the direction of the primary trend
- In a bull market, oscillators tend to move into an overbought condition very quickly and stay there for a long time
- In a bear market, they can and do remain in an oversold condition for a long time



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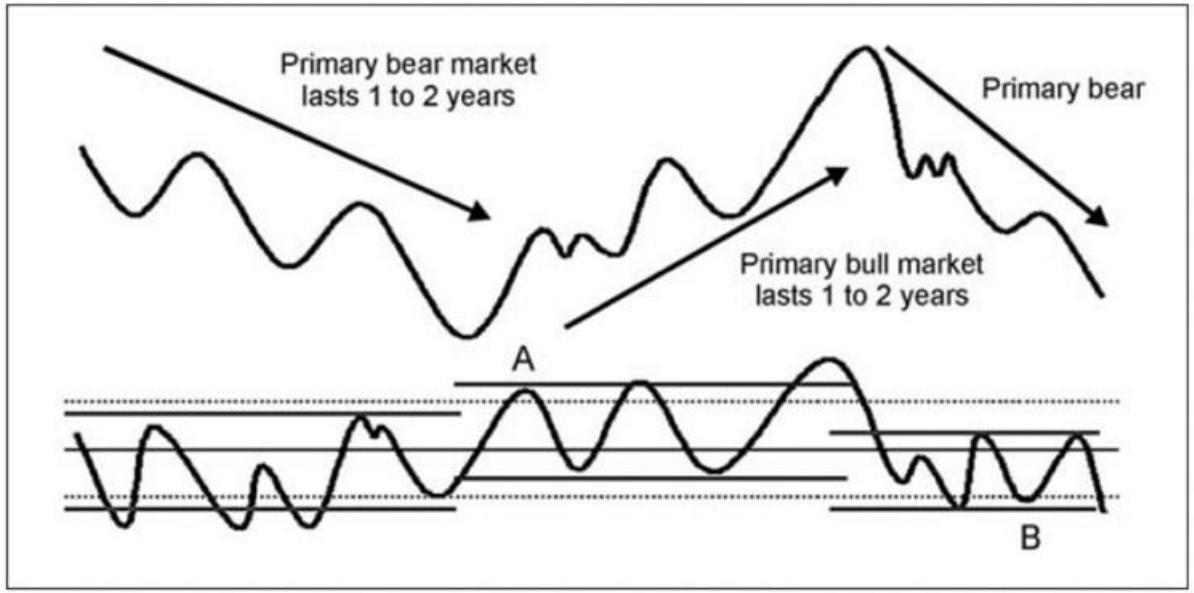
Introduction

- In a bull market, the price is extremely sensitive to an oversold condition

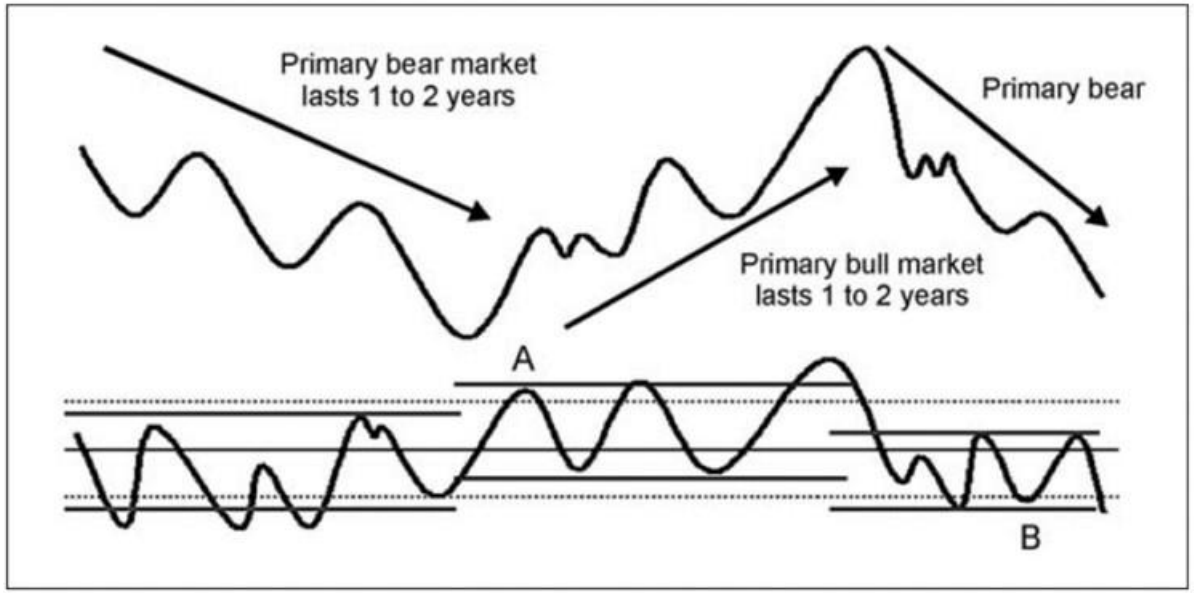
- The reason for this sensitivity lies in the fact that the oversold reading very likely reflects an extreme in short-term sentiment



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

Introduction

- Market participants are focusing on the latest bad news and using that as an excuse to sell
- Since this is a bull market, they would be better served by remembering the positive long-term fundamentals that will soon emerge and using this weakness as an opportunity to buy



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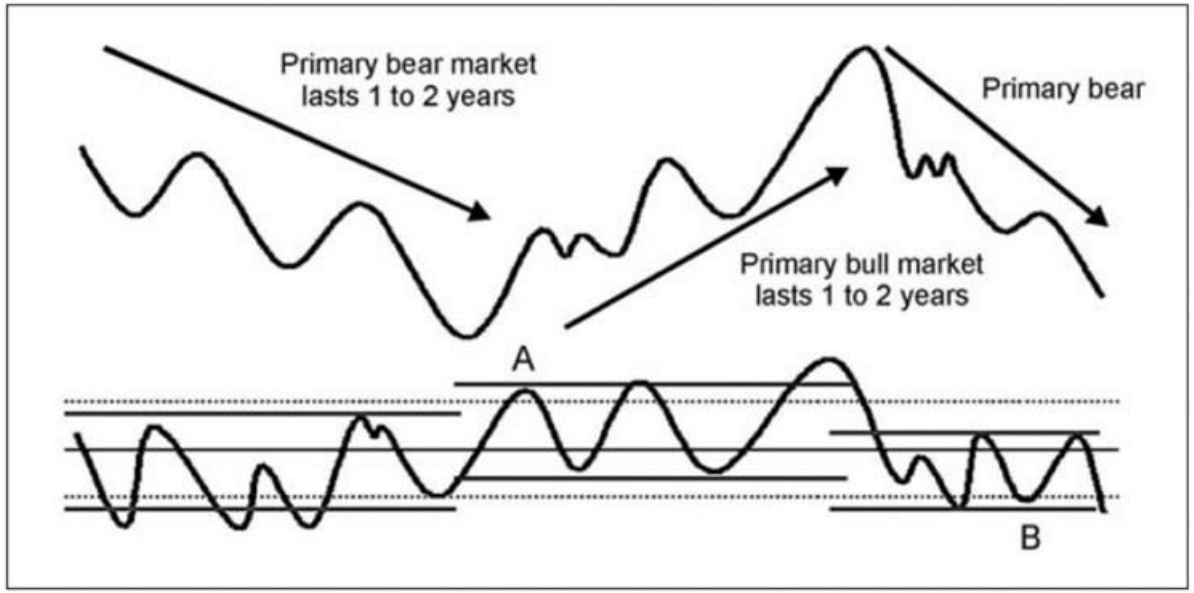
Introduction

- The same thing happens in reverse during a bear market

- Traders are focused on bad news, which sends the price down; then, some unexpectedly good news hits the wires and the price rallies



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Oscillator Characteristics in Primary Bull and Bear Markets

- However, when it is fully digested, most people realize that things really haven't changed at all and the price declines again
- Thus, the overbought reading more often than not will correspond with the top of a bear market rally
- Looking at it from another perspective, during a bull market, the price will be far less sensitive to an overbought condition
- Often, it will be followed by a small decline or even a trading range

Oscillator Characteristics in Primary Bull and Bear Markets

- The rule, then, is don't count on a short-term overbought condition to trigger a big decline (in bull market) because the odds do not favor it
- In a bear market, a market or stock is far less sensitive to an oversold reading, often failing to signal a rally, or possibly being followed by a trading range
- The maturity of the trend, whether primary or intermediate, often has an effect on the limits that an oscillator might reach
- For example, when a bull market has just begun, there is a far greater tendency for it to move quickly into overbought territory and to remain at very high readings for a considerable period of time

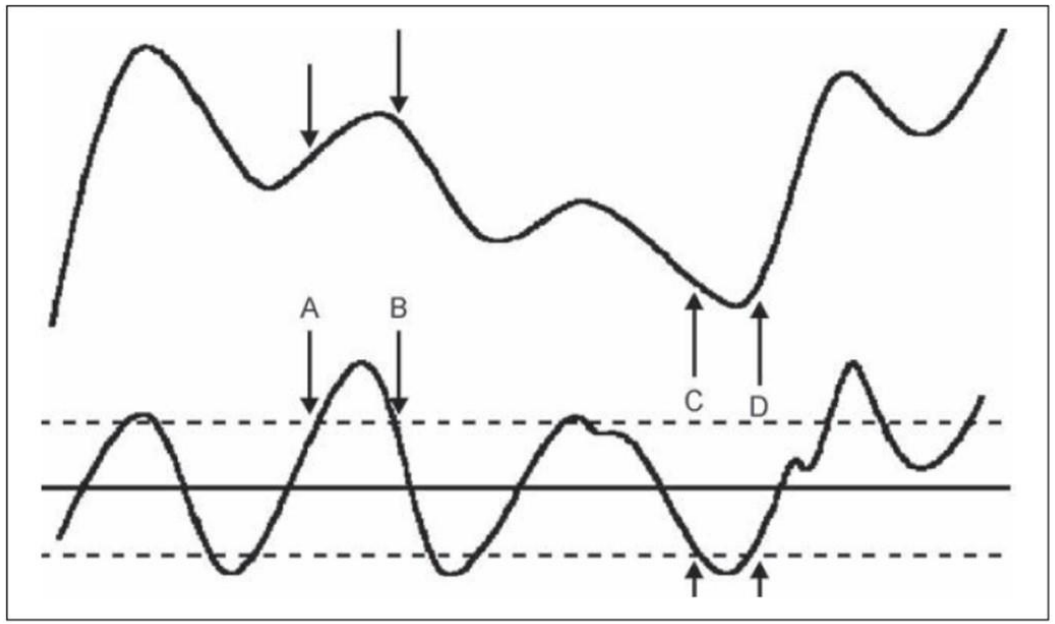
Oscillator Characteristics in Primary Bull and Bear Markets

- In such cases, the overbought readings tend to give premature warnings of declines
- During the early phases of the bull cycle, when the market possesses strong momentum, reactions to the oversold level are much more responsive to price reversals, and such readings, therefore, offer more reliable signals
- It is only when a bull trend is maturing, or during bear phases, that overbought levels can be relied upon to signal that a rally is shortly to be aborted
- The opposite is true for a bear trend

Overbought/Oversold Re-crossovers

Overbought/Oversold Re-crossovers

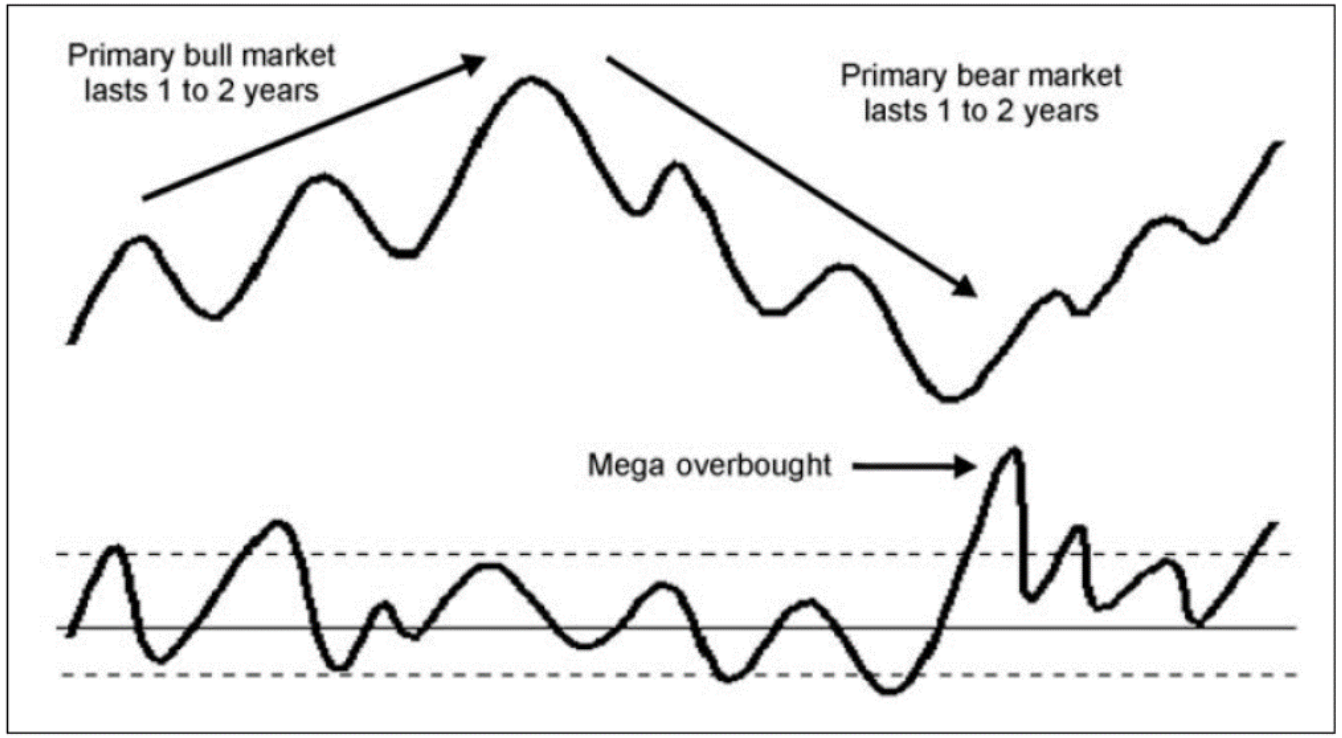
- Buy and sell alerts are generated when the momentum indicator exceeds its extended overbought or oversold boundary and then re-crosses back through the boundary on its way to zero



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

Mega Overboughts

- A mega overbought is the initial thrust in a bull market following the final low



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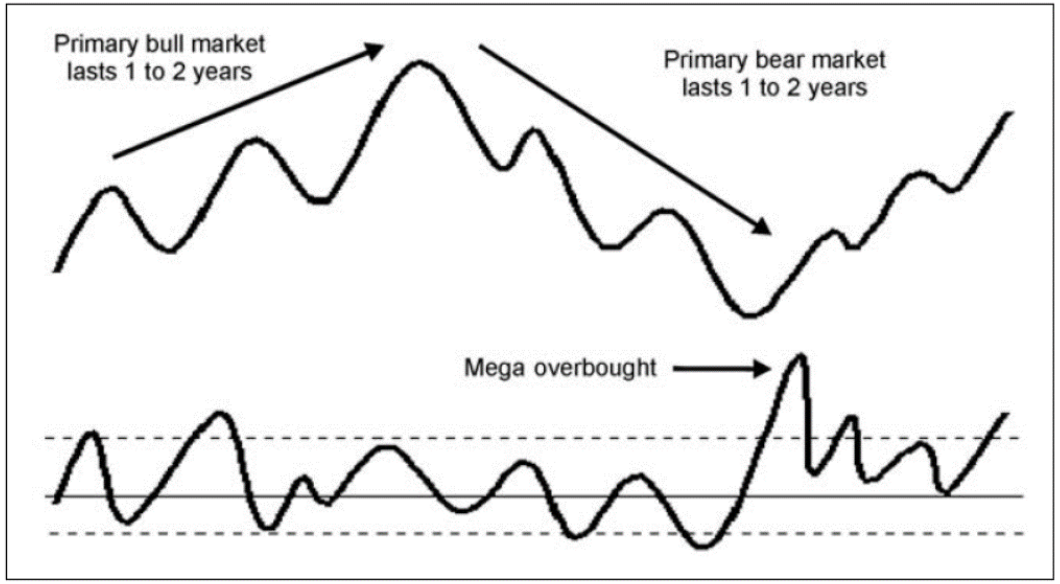
Mega Overboughts

- It's a reading in the momentum indicator that takes it well beyond the normal overbought condition witnessed in either a preceding bull or bear market: a multiyear high for the oscillator concerned

- Such conditions are usually a sign of a very young and vibrant bull market

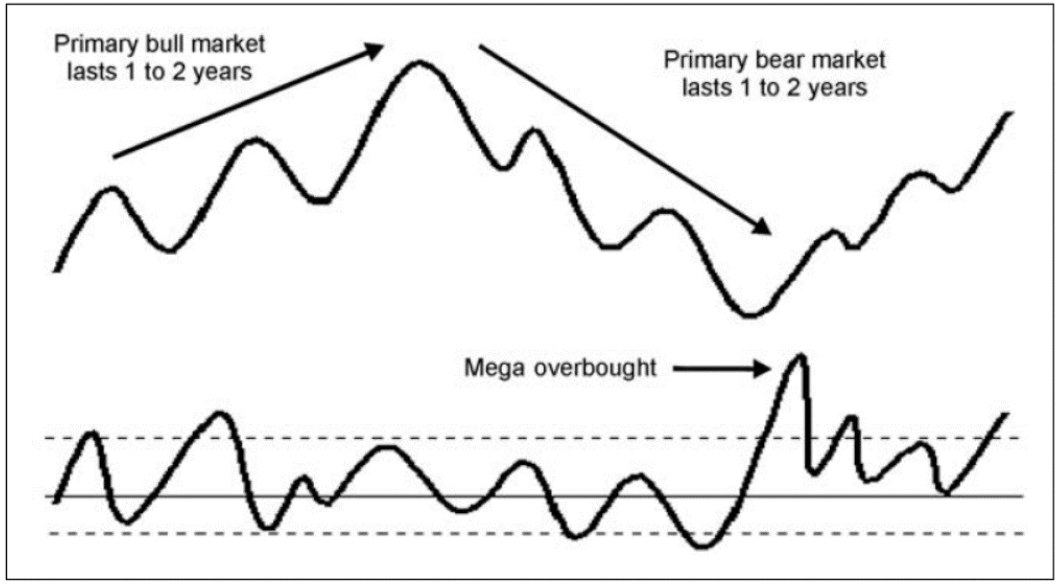


Source: From Martin Pring, Trading Systems Explained, Marketplace Boo
Columbia, Maryland, 2008.

Mega Overboughts

- Mega overbought the only instance when opening a long position from an overbought condition can be justified

- Whenever an oscillator experiences a mega overbought, higher prices almost always follow after a short-term setback or consolidation

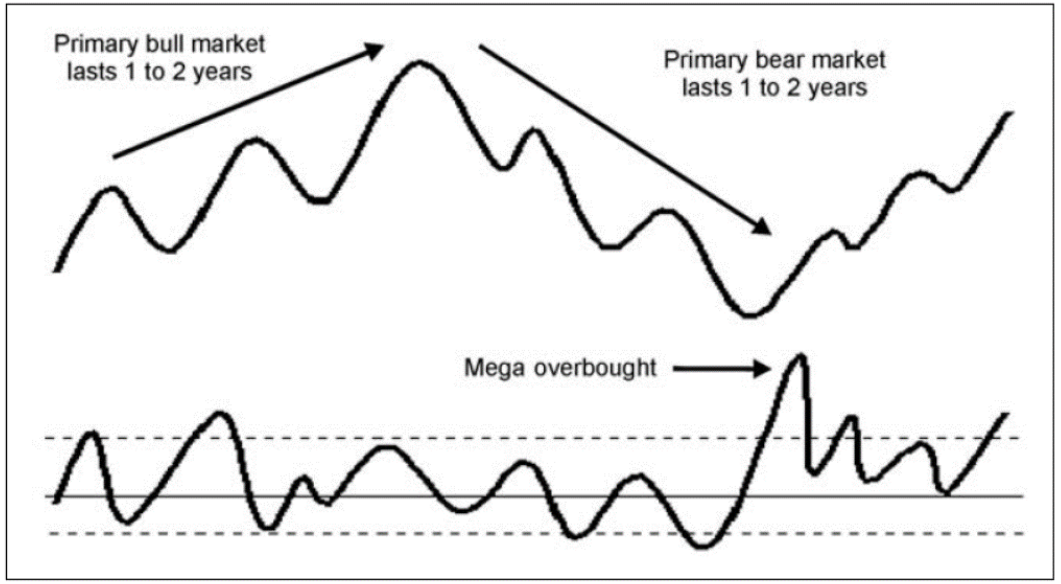


Source: From Martin Pring, Trading Systems Explained, Marketplace Boo
Columbia, Maryland, 2008.

Mega Overboughts

- Since a mega overbought is associated with the first rally in a bull market, it's a good idea to check and see if volume is also expanding rapidly

- If it takes the form of record volume for that particular security, the signal is far louder because record volume coming after a major decline is typically a reliable signal of a new bull market



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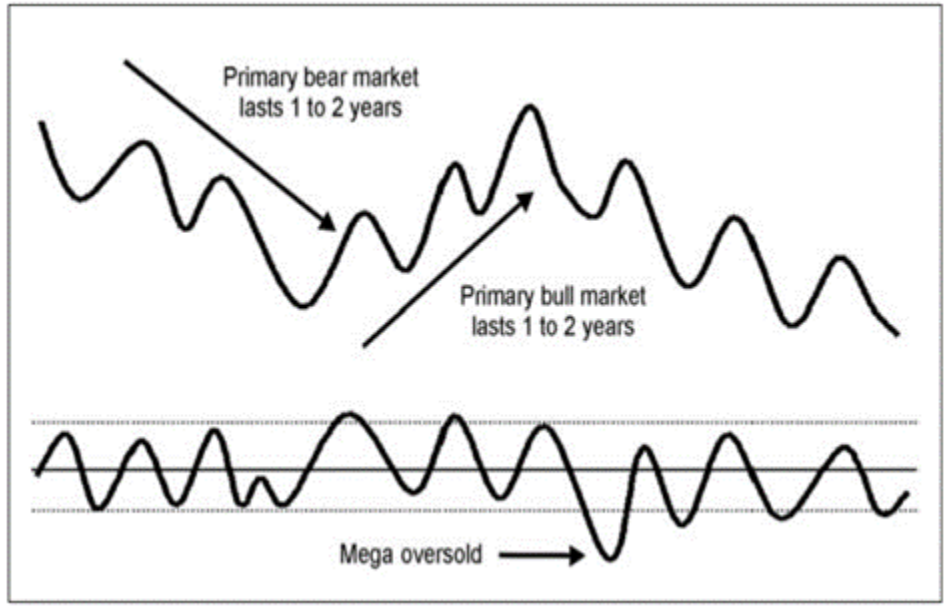
Mega Oversold

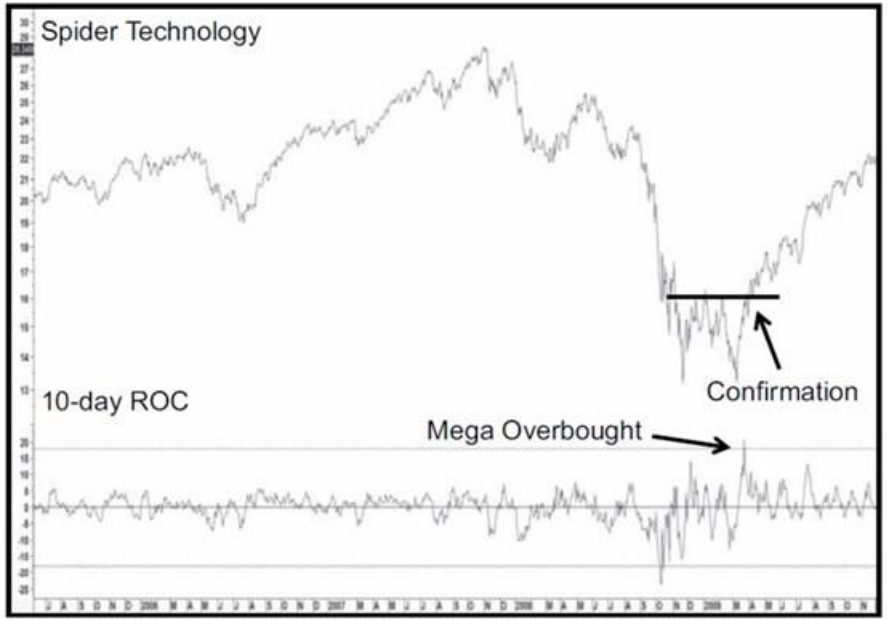
- Expanding volume is a more or less necessary condition since it is consistent with the idea that buyers now have the upper hand and that the psychology has totally reversed
- Consequently, when a price decline following a bull market high pushes a momentum indicator to a new extreme low, well beyond anything witnessed either during the previous bull market or for many years prior to that



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

Mega Over- Bought/sold

- The implication is that sellers now have the upper hand
- Mega and extreme conditions represent preliminary signals of a primary trend reversal
- Confirmation by the price usually puts the issue beyond reasonable doubt



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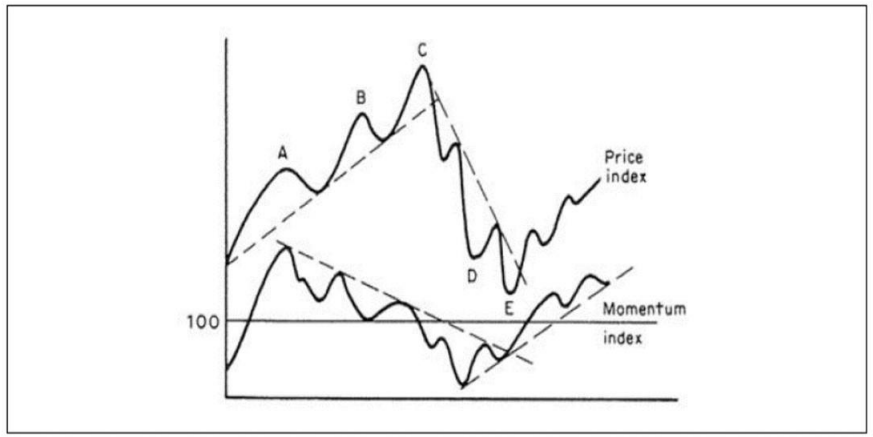
Momentum and price divergence

Momentum and price divergence

- Prices in financial markets usually reach their maximum level of momentum ahead of the final peak in prices
- If the price makes a new high, which is confirmed by the momentum index, no indication of technical weakness arises

Momentum and price divergence

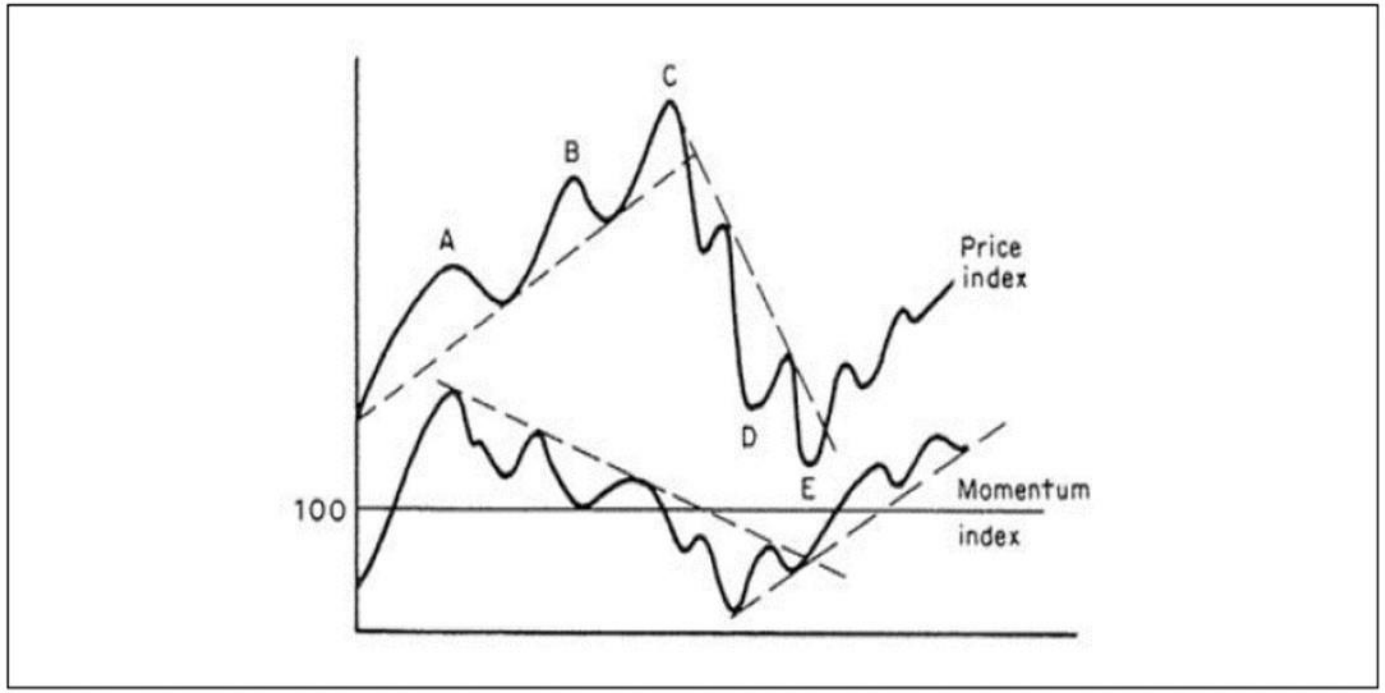
- On the other hand, if momentum fails to confirm (point B), a negative divergence is set up between the two series, and a warning of a weakening technical structure is given
- Such discrepancies normally indicate that the price will undergo a corrective process. It can take the form of either a sideways or a horizontal trading range, or (more likely) a downward one



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

Momentum and price divergence

- The Fig. also shows a positive divergence. In this instance, the price makes its low at point E, but this was preceded by the oscillator, which bottomed at D



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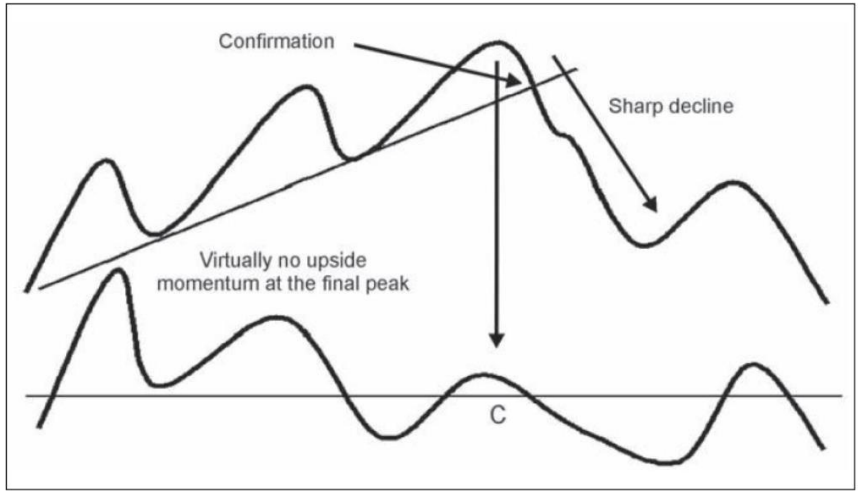
Momentum and price divergence

- It is extremely important to note that divergences only warn of a weakening or strengthening market condition and do not represent actual buy and sell signals

- Whenever any divergence between momentum and price occurs, it is essential to wait for a confirmation from the price itself that its trend has also been reversed

Extreme Bearish Divergence



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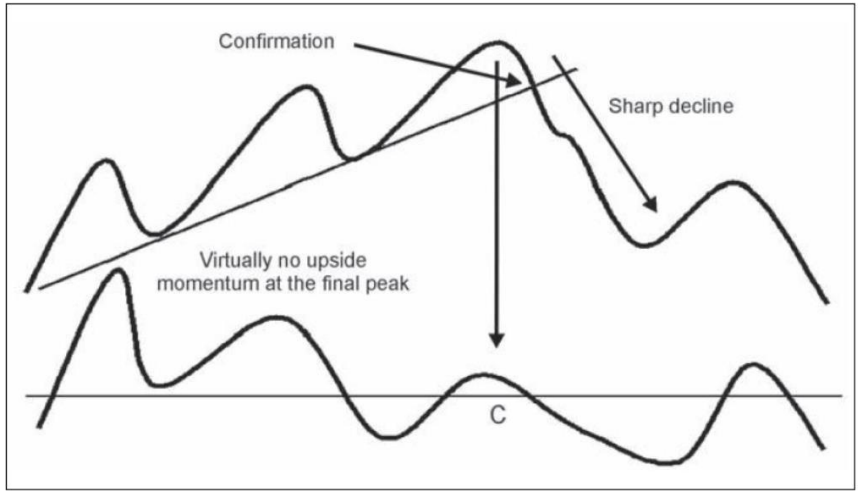
Momentum and price divergence

- This confirmation can be achieved by: (1) the violation of a simple trendline, (2) the crossover of a moving average (MA); or (3) the completion of a price pattern
- At point C, the price moves to a significant new high, but the momentum indicator is barely able to remain above the equilibrium line
- When accompanied by a trend break, it is usually a sign of extreme technical weakness and is often, though certainly not always, followed by a very sharp decline.

Extreme Bearish Divergence

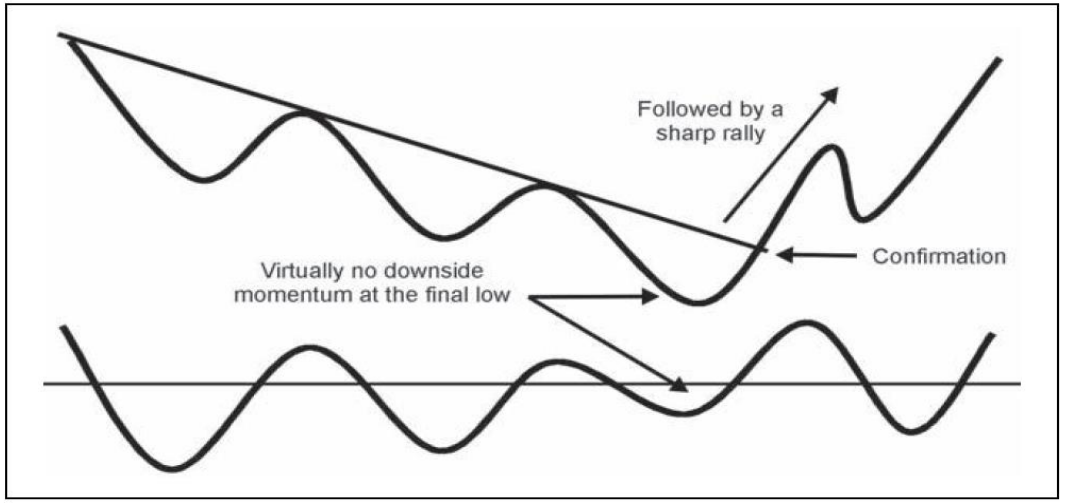


Source: From Martin Pring, Trading Systems Explained, Marketplace Boo
Columbia, Maryland, 2008.

Momentum and price divergence

- The opposite type of situation in a bear market should be viewed as a very positive characteristic, especially if the upward trend break in price is accompanied by high volume. The more explosive the volume, the more reliable the signal is likely to be

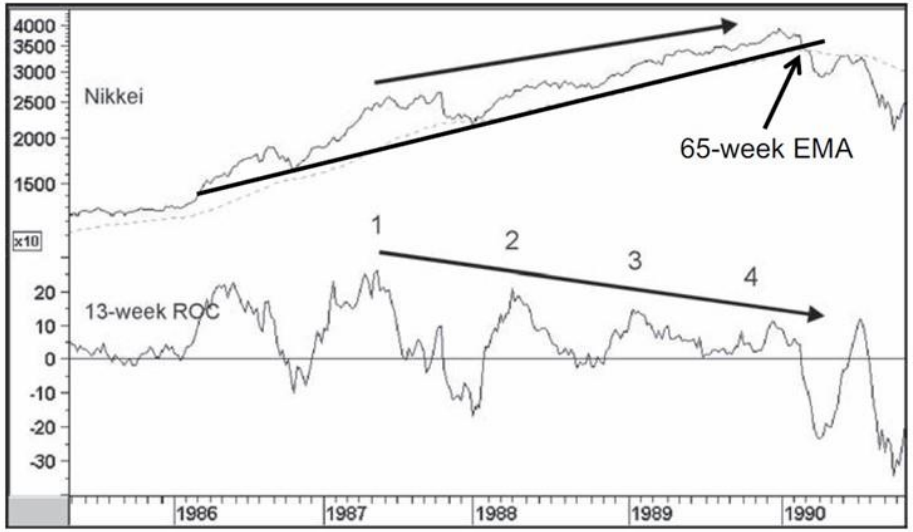
Extreme Bullish Divergence



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

Momentum and price divergence

- In the Fig., Nikkei Index violating an important 3½-year secondary trendline after the 13-week ROC indicator had negatively diverged several times with the index
- A very timely signal is generated by a confirmation in the form of a trend break in the index itself through a negative 65-week EMA crossover

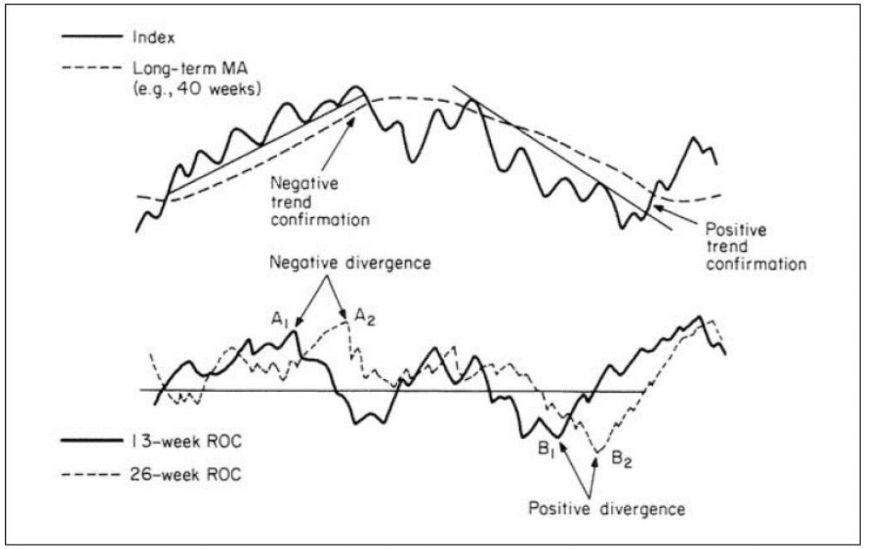


Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland, 2008.

Complex divergence

- It is always a good idea to compare several different momentum indicators based on differing time spans

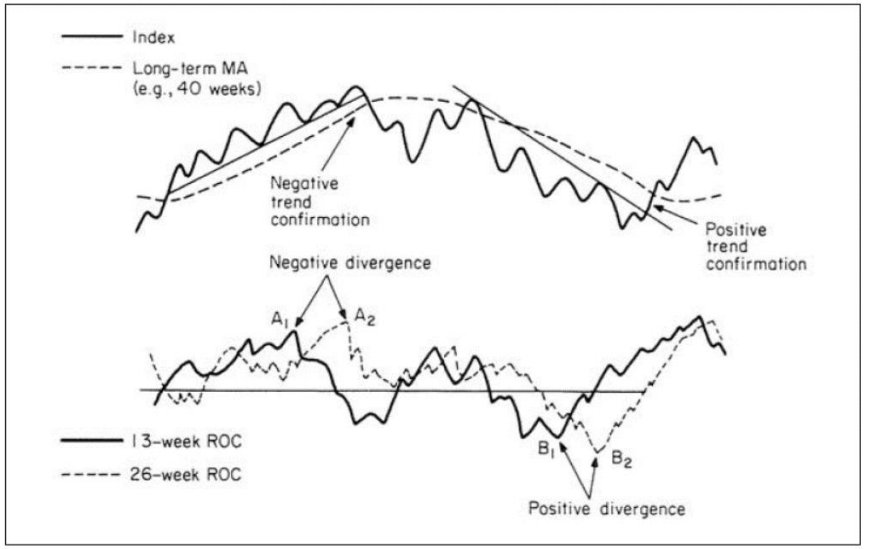
  - Different time-spans capture the influence of different cyclic phenomenon
  - One approach is to plot two momentum indicators of differing time spans on the same chart



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

Complex divergence

- When the longer-term indicator reaches a new peak and the shorter one is at or close to the equilibrium line, they are clearly in disagreement or out of gear (A2)
  - It is very important to make sure that any such divergence is confirmed by a reversal in the price trend itself
  - Complex divergences also occur in a positive combination, as indicated later on at point B1
  - This indicates that a reversal in trend will take place, and it is usually an important one



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

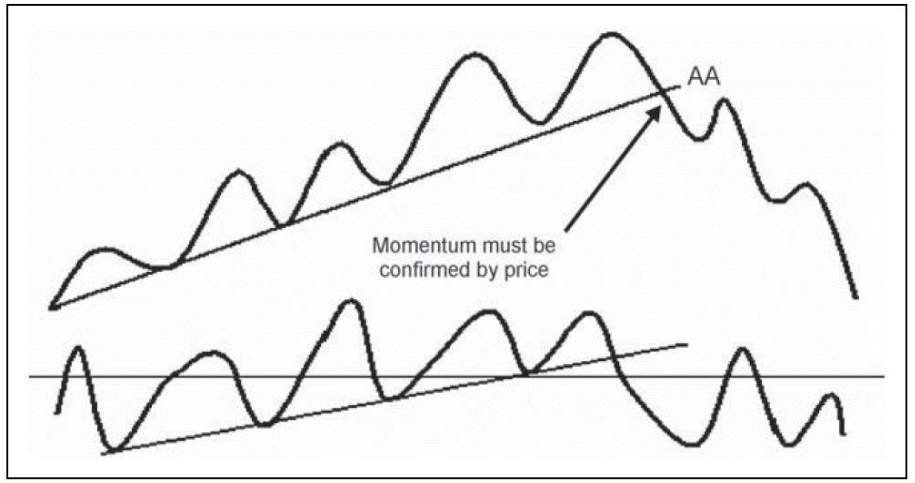
Momentum Trend Reversal Techniques

Momentum Trend Reversal Techniques

- Basic concepts such as trendline, moving average crossovers, price patterns can also be applied to momentum indicators

- Momentum indicators can be smoothed by incorporating MAs
- An example for an uptrend reversal is shown in the Figure here. When the line is violated, a trend reversal signal for the oscillator is generated

Bearish Momentum Trend Break

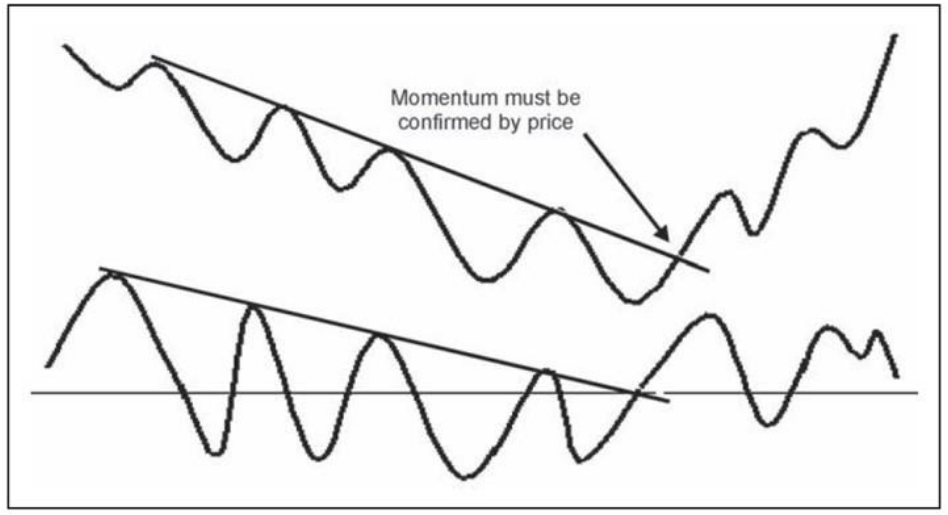


Source: From Martin Pring, Trading Systems Explained, Marketp
Books, Columbia, Maryland, 2008.

Momentum Trend Reversal Techniques

- Warnings of trend reversal in the price would be offered by a reversal in the smoothed momentum index itself
- Or penetration of MA by a designated overbought and oversold levels

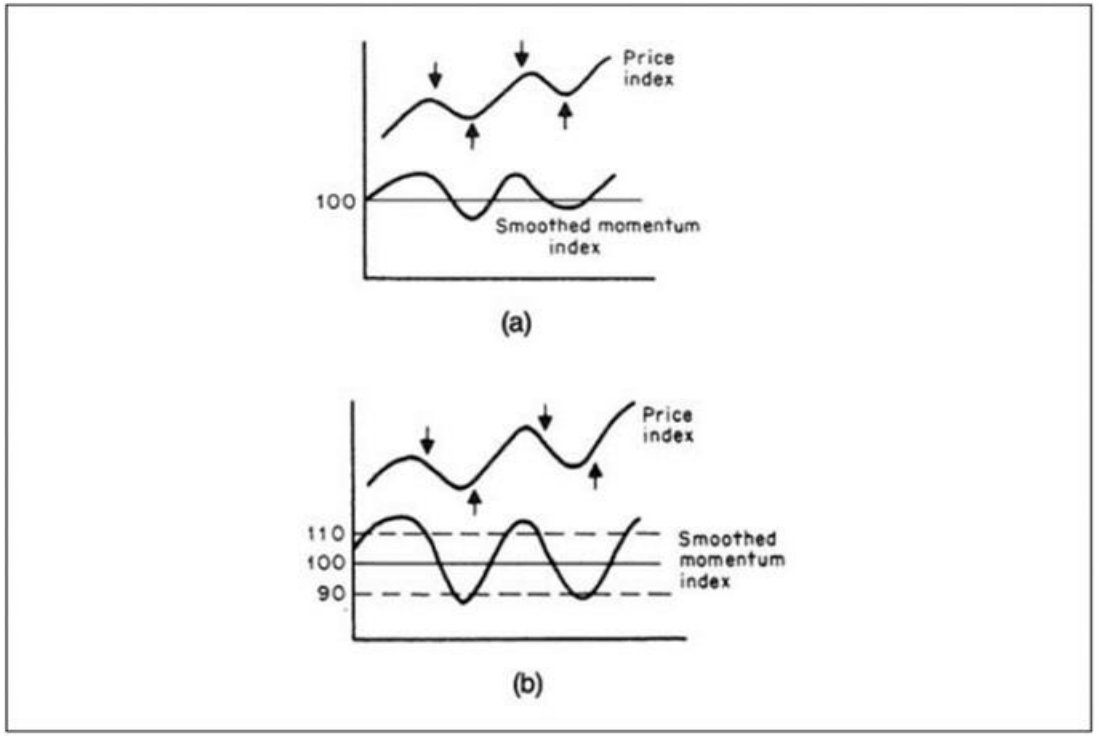
Bullish Momentum Trend Break



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

Momentum Trend Reversal Techniques

- The fig. here provides (a) Directional Changes of Smoothed Momentum MAs. (b) Overbought and oversold Re-crossovers of Smoothed Momentum MAs



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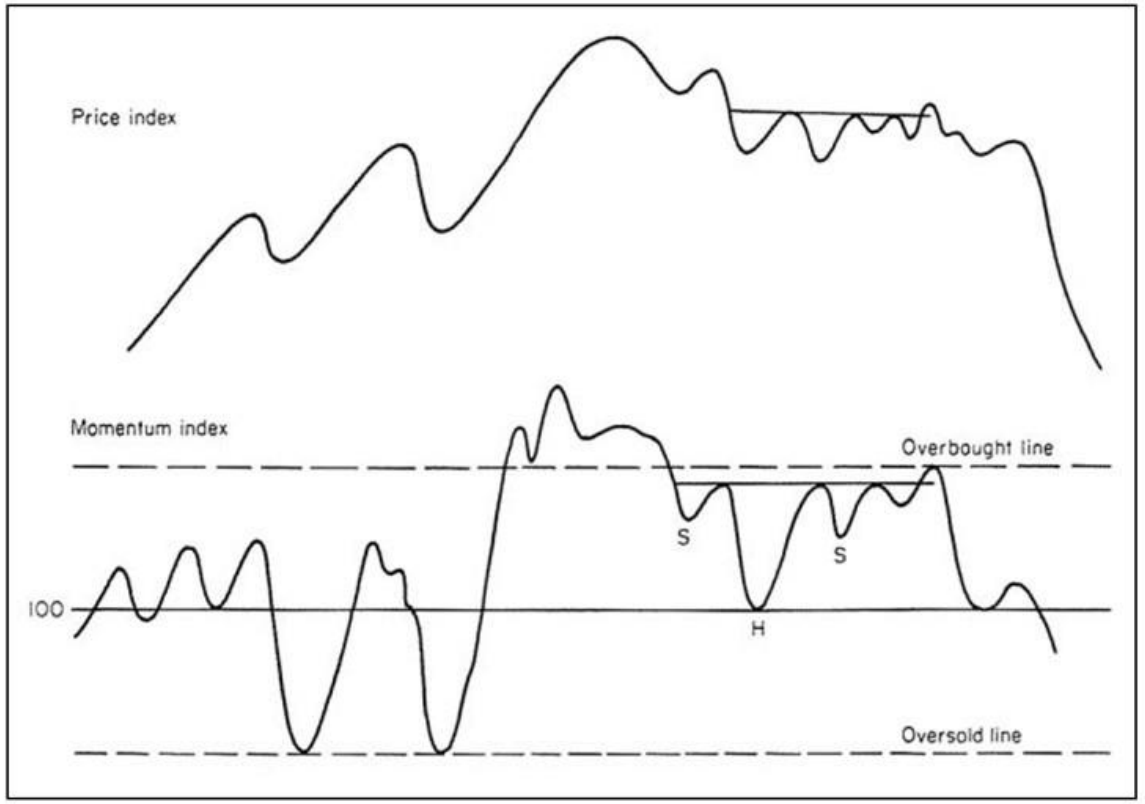
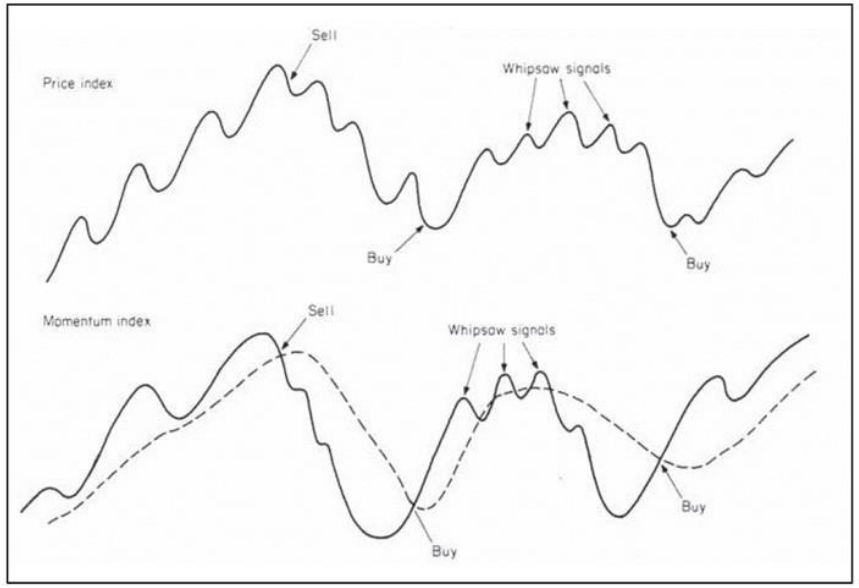
Overbought Momentum Pattern Completion



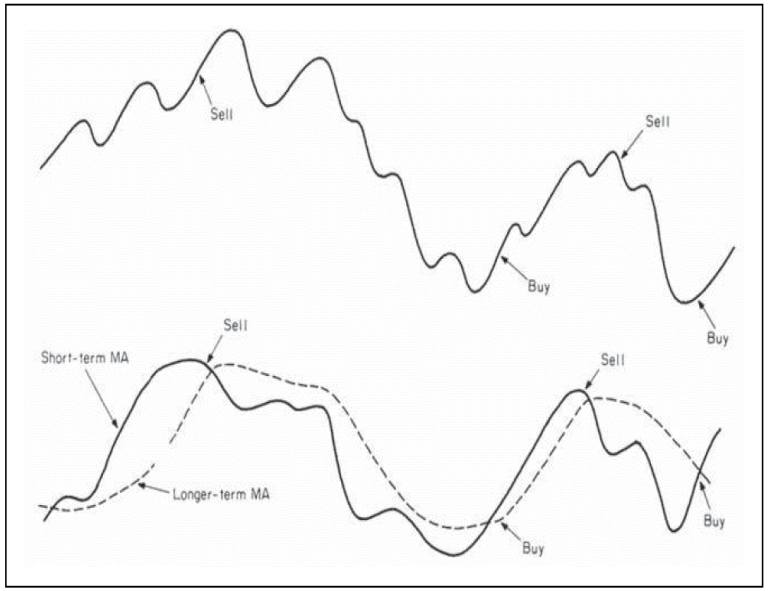
Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland, 2008.

Momentum and Moving Averages

Momentum MA crossovers



MA crossovers smoothed



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

Summary

Summary

- Momentum is a generic term embracing many different types of oscillators
- Momentum measures the rate at which prices rise or fall
- It gives useful indications of latent strengths or weakness in a price trend
- This is because prices usually rise at their fastest pace well ahead of their peak and normally decline at their greatest speed before their ultimate low
- Since markets generally spend more time in a rising than a falling phase, the lead characteristic of momentum indicators is normally greater during rallies than during reactions

Summary

- Oscillators reflect market sentiment and have different characters in primary bull and bear markets
- There are two basic methods of interpreting momentum: momentum characteristics and momentum trend reversals
- Momentum signals should always be used in conjunction with a trend reversal signal by the actual price

Relative Strength Indicator (RSI)

Relative Strength Indicator (RSI)

- The formula for RSI is provided below
- $RSI = 100 - \frac{100}{1+RS}$
- Here RS= the average of x days' up close prices divided by the average of the x days' down prices (can also compute in diff./return form)
- X here can be 28 days or any suitable period (e.g., 30 days, 45 days, 60 days) which is justified by the past price movements
- The indicator helps in the following manner:
  - Erratic price movements are smoothened; these movements would have affected RoC
  - It offers a constant trading band for comparison purposes; the indicator fluctuates within a constant band of 0 to 100

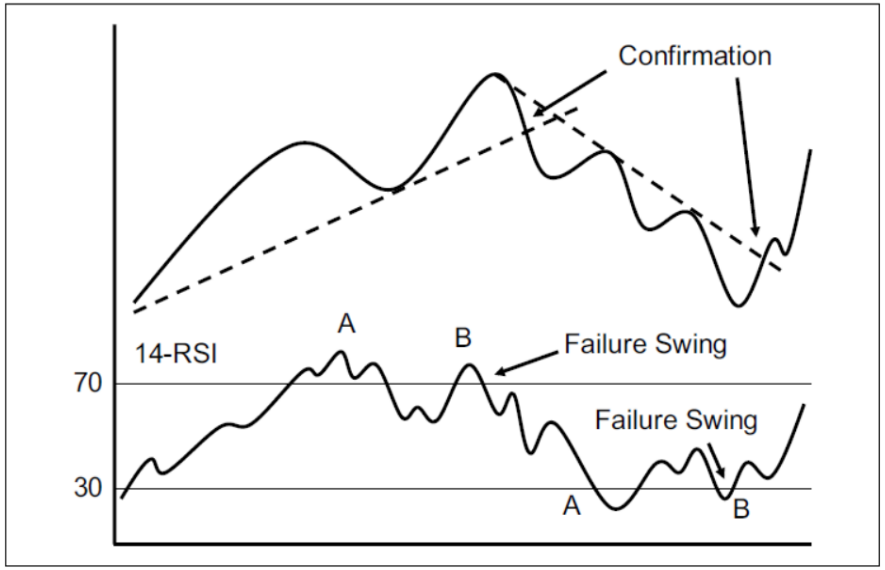
Relative Strength Indicator (RSI)

- The RSI Is Useful for Making Comparisons Between different Securities on the same chart
- Easier to establish universal standard for overbought and oversold benchmarks (e.g., 30 for oversold and 70 for overbough or 20/80, etc)
- Extreme values would mean less violations but strong signal
- Shorter time-span cause wider RSI oscillations and larger time-spans cause narrower swings: the breakout points can be appropriately adjusted

RSI interpretation

- Any time an RSI moves above its overbought or below its oversold zone, it indicates the security in question is ripe for a turn
- The significance depends upon the time
- The second crossover of the extreme level at points A and B usually offers good buy and sell alerts
- These divergences are often called failure swings
- The RSI can also be used in conjunction with trendline violations and pattern completions
- RSI can also be smoothed with MA techniques

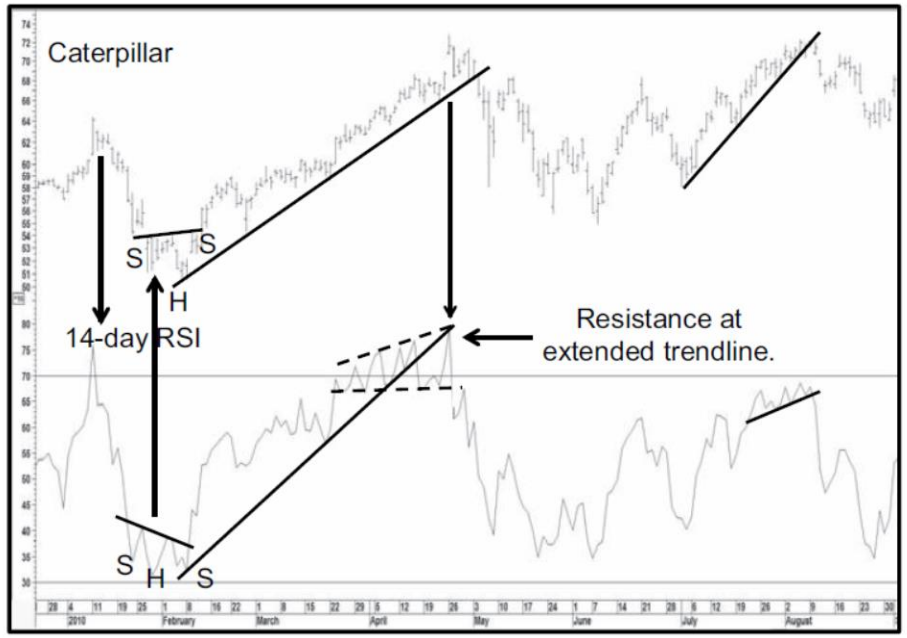
RSI Failure Swing



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

Trendline Violations and Pattern Completions

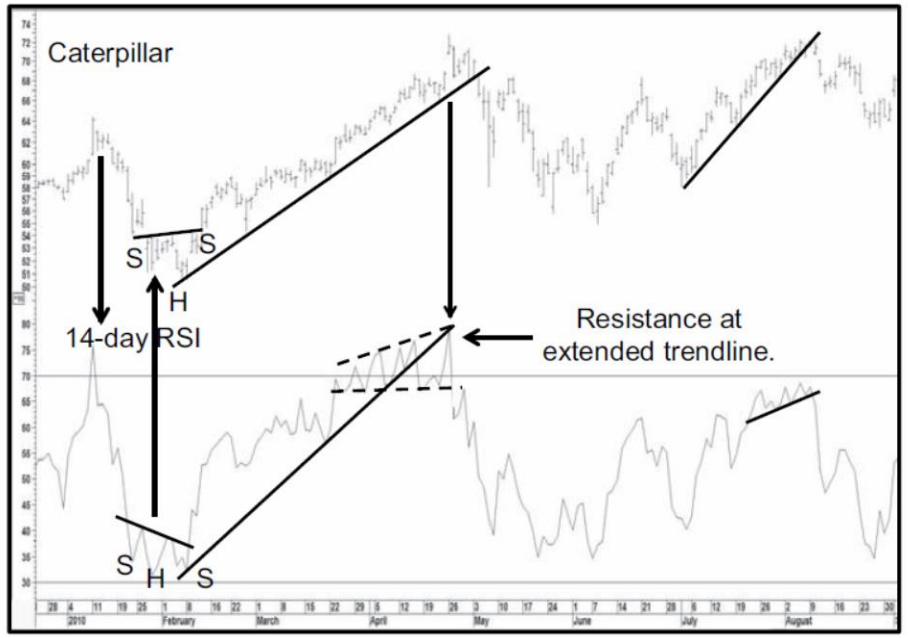
- The RSI often traces out a series of rising or falling peaks and troughs, which, when reversed, offer important buy or sell alerts
- Important signals are generated when trendlines for both price and the RSI are violated within a relatively short period
- The RSI forms a reverse head-and-shoulders pattern, which is more or less simultaneously confirmed by the price



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

Trendline Violations and Pattern Completions

- After a good rally materializes, the RSI violates this up trendline. We can also construct a trendline for the price
- Finally, the RSI completes a broadening formation, and a downside breakout
- The next rally peak also experiences a small RSI top, which is confirmed with a trendline violation by the price



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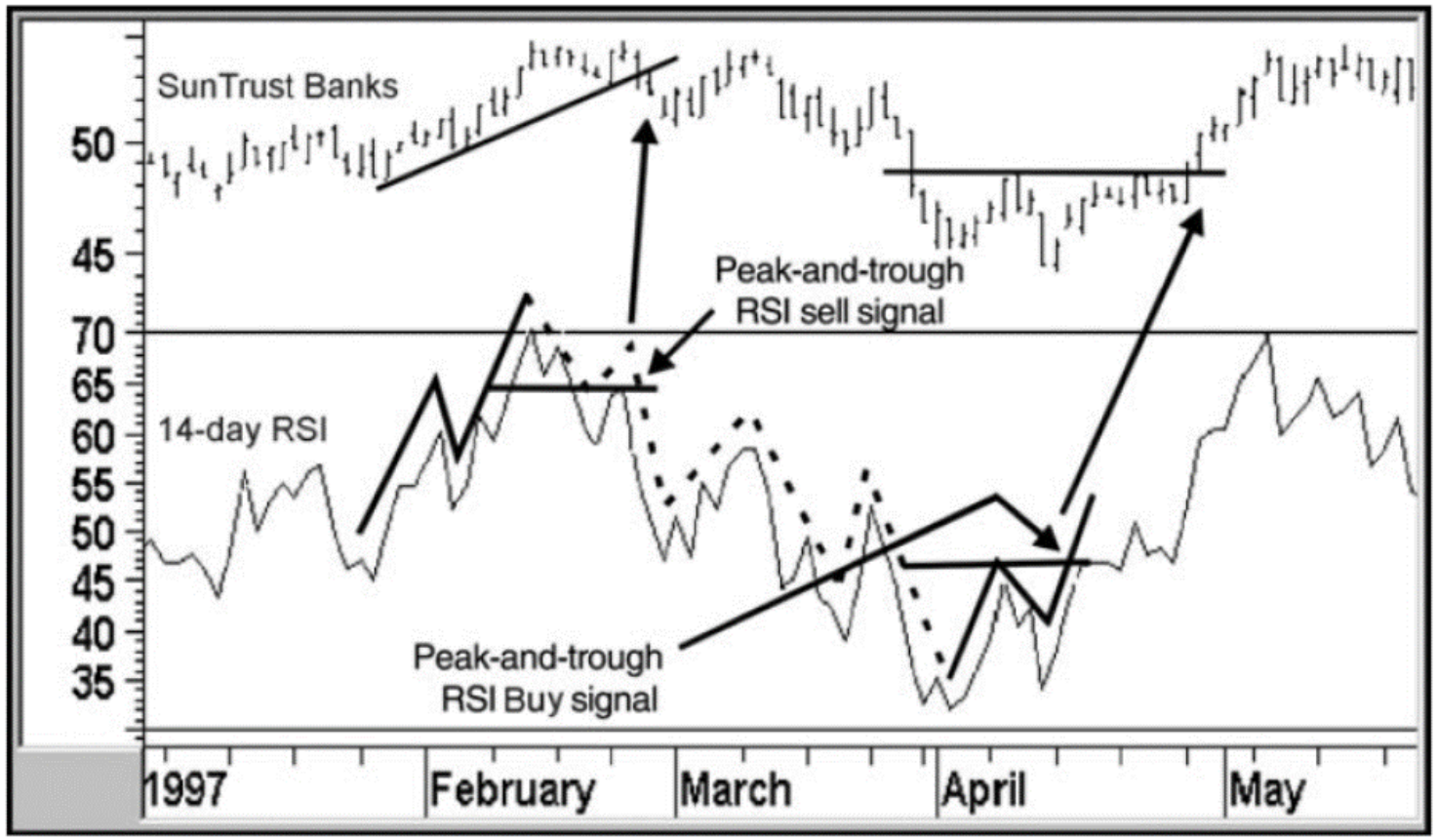
RSI and Peak-and-Trough Analysis

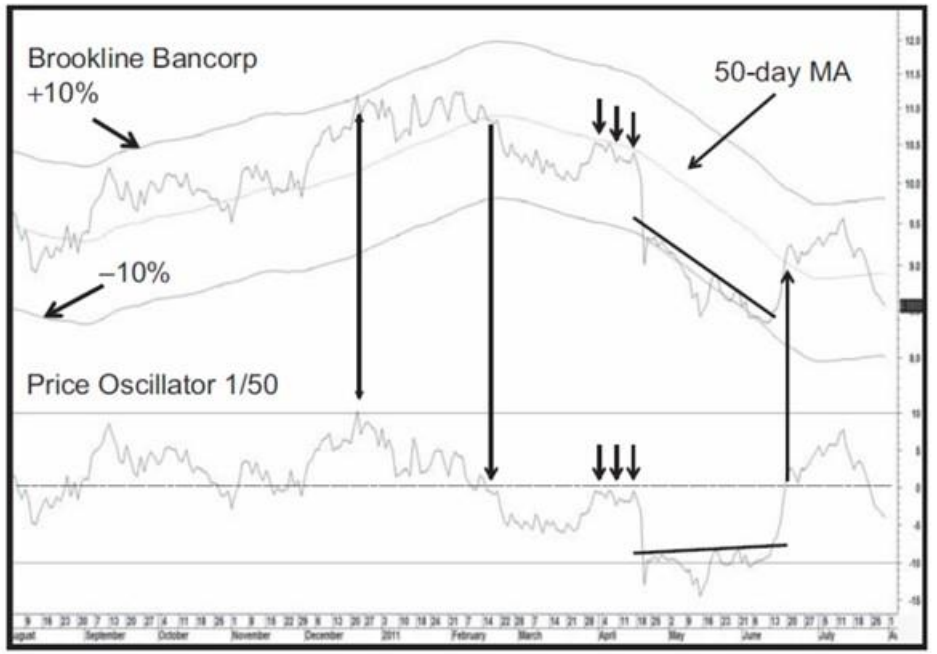


Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland, 2008.

Trend deviation/Price oscillator

Trend deviation/Price oscillator

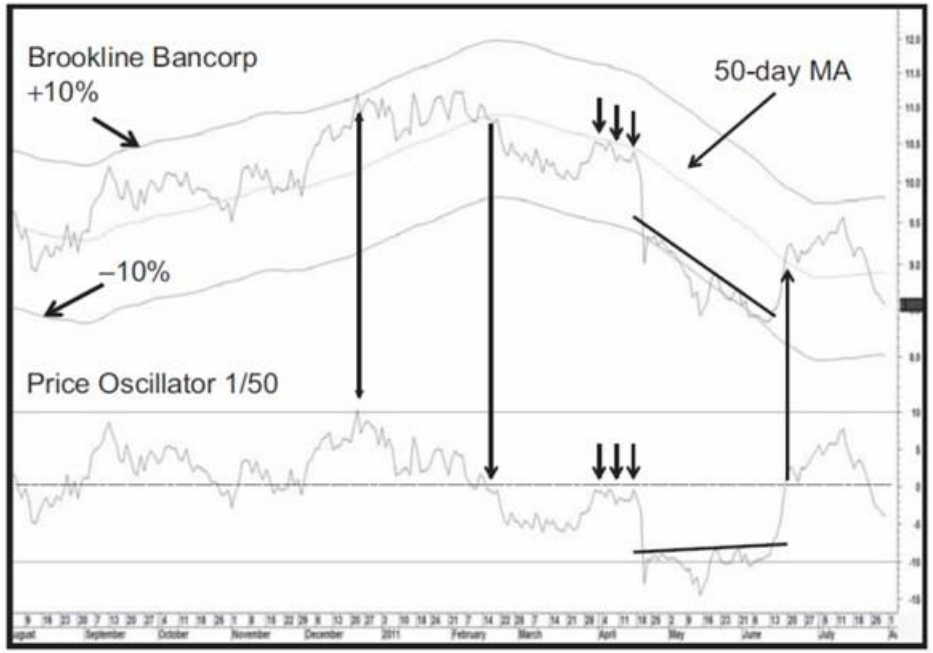
- 1/10 Price oscillator: 1day MA (close) is divided by 10-day MA
- The Fig. shows the price of Brookline Bancorp and its 50-day MA. Two bands at +10 and –10 percent of the 50-day MA have been plotted above and below it
- The bottom panel represents the same data but expressed in momentum (price oscillator) format



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

Trend deviation/Price oscillator

- The interpretation of a trend-deviation indicator is based on the same principles described earlier. This method can be used to identify divergences and overbought and oversold zones, but it appears to come into its own when used in conjunction with trendline construction a



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

Moving-average Convergence Divergence (MACD)

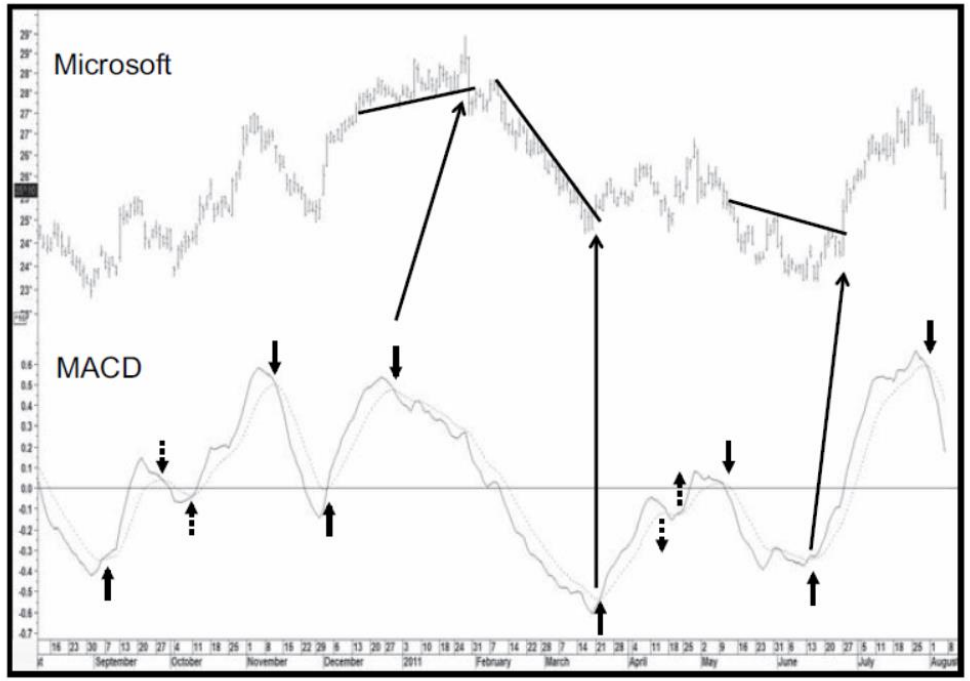
MACD Interpretation

- MACD is form of trend-deviation indicator using two exponential moving averages
- The difference between the 2 EMAs: 8 Week- 17 Week
- The MACD is then smoothed by a third EMA, which is also plotted on the chart
- This final EMA is called the signal line; for which the crossovers generate buy and sell signals
- The two EMAs continuously converge and diverge
- The configuration can be for example: 8/17/9, 12/25/9 etc.

MACD Interpretation

- The dotted arrows indicate whipsaw signals, and the long arrows indicate those signals that were confirmed with a trendline break of some kind

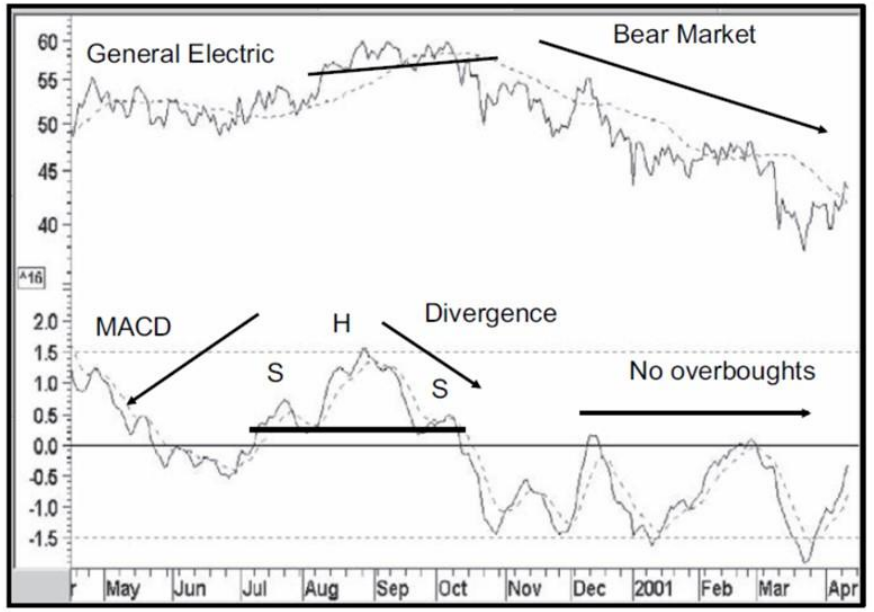
- MACDs can be employed with overbought/oversold levels, trendlines, and price patterns



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

MACD Interpretation

- Both series complete head-and-shoulders patterns. The MACD also experiences a negative divergence
- Neckline violation at second shoulder
- Note also that the indicator remained below the equilibrium point and touched its oversold level several times during



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

Stochastic Indicator (%k-%D) indicator

Stochastic Indicator

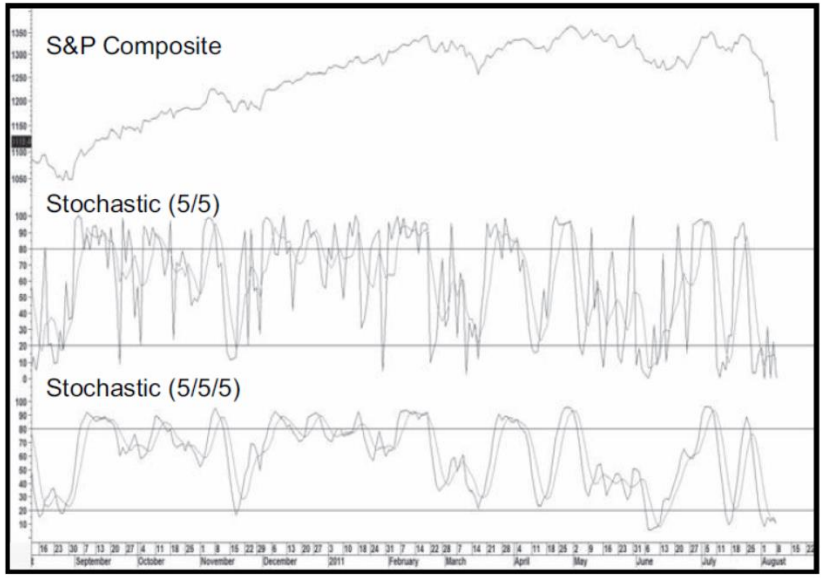
- Theory: Prices tend to close near the upper end of a trading range during an uptrend. As the trend matures, the tendency for prices to close away from the high of the session becomes pronounced
- In a downward-moving market, the reverse conditions hold true
- The stochastic indicator, therefore, attempts to measure the points in a rising trend at which the closing prices tend to cluster around the lows for the period in question, and vice versa, since these are the conditions that signal trend reversals
- It is plotted as two lines: the %K line and the %D line
- The %D line is the one that provides the major signals and is, therefore, more important

Stochastic Indicator

- $\%K = 100\left[\frac{C - L_n}{H_n - L_n}\right]$
- Where C is the most recent close, and Ln and Hn are the are the lowest and highest of the low and high price for the last n traded periods (can be 5, 9, etc.)
- %D is some MA of % K (may be 3 period, 5 period etc.)
- This results in a momentum indicator with 2 lines fluctuating between 0 and 100
- Overbought and oversold levels can be plotted in 75%-85% on upside and 15%-25% on the downside

Stochastic Indicator

- An overbought indication is given when the %D line crosses the extreme band, but an actual sell alert is not indicated until the %K line crosses bel
- When the two lines cross, they behave very similarly to a dual MA system
- 10/5 would represent a value of 10 for %K and 5 for %D
- The stochastic can be further slowed by using %D instead of %K and further using some MA of %D as signal line (instead of %D): 5/5/5 uses a factor of 5 to slowdown %D

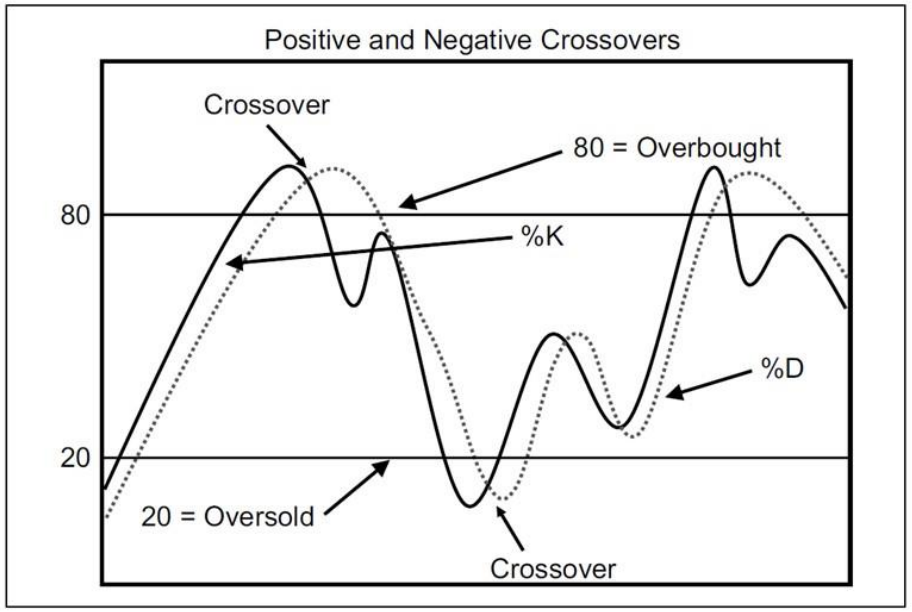


Source: From Martin Pring, Trading Systems Explained, Marketplace Books, Columbia, Maryland, 2008.

General Interpretation

- **Crossovers:** Normally, the faster %K line changes direction sooner than the %D line. This means that the crossover will occur before the %D line has reversed direction

- **Stochastic Positive and Negative Divergences:** %K fails to confirm a new high or low in the price, thereby setting up a divergence, which when confirmed, signals a change in trend



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Thanks!