Understanding Technical Analysis

Global Markets Economic Research
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Important disclosures appear on the back cover of this publication.
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Section I: Introduction

Advances in behavioural finance have led to increased interest in the psychological traits of investors. The Efficient Market Hypothesis suggests that information flow will be reflected rationally in investors’ decisions. However, the emotional pull of the market place as a whole leads to behaviour that is often far from rational. Crowd behaviour fluctuates from periods of pessimism, fear and panic to optimism, confidence and greed. This irrationality is one of the basic tenets of technical analysis; the charting of market action reflects the psychology of the investor crowd.

Much of current western technical analysis derives from the theories that Charles Dow put forward in the early part of the 20th century. His work was based on the closing prices of the Industrial and Rail (now Transport) indices that bear his name. It was assumed that investors only trade the major trend. Dow’s intent was to capture the middle portion of a market move. The main beliefs of Dow Theory are:

- The averages discount everything – every factor affecting supply and demand is reflected in the price.
- The market is composed of three trends: primary, with a duration of greater than 1 year and usually a move of greater than 20%; a secondary reaction of duration 3 weeks to 3 months which retraces ½ to ⅔ of the primary move; minor waves of 1 day to 3 weeks duration.
- Primary trends have three phases: the first, an accumulation phase led by informed traders; the second, accompanied by increased corporate earnings and the third, encompassing retail participation. In a bear market these would be classified as the distribution phase, panic, and then distress selling.
- The averages (Industrial and Rail) should confirm each other.
- Volume confirms the trend and should expand as the trend develops.
- The trend remains intact until it gives a definite reversal signal.

Technical analysts study the effect of price movement rather than its cause, believing that price action purely reflects the supply and demand from participants as new information is assimilated into the market. The fundamental approach examines relevant economic factors affecting supply and demand to determine an intrinsic price. However the true nature of this fundamental model is unknown and prices will often fluctuate around a perceived fair value. The
technical and fundamental approach will often confirm each other, but are most noticeably in conflict at turning points, when the fundamentals do not support or explain the price action. A number of technical practitioners such as Elliott and Gann searched for a perfect order in markets; conversely, the Random Walk theorists eschew the predictive power of technical analysis, asserting that prices are serially independent. There is evidence that investors do indeed base their expectations, and therefore trading decisions, on their memories of past price performance. This suggests a middle ground between these two extremes of market behaviour. A knowledge of technical analysis can be a useful addition to the investor’s decision making process.

Much of the available technical analysis literature falls into two main categories: Heavyweight texts running to many hundreds of pages, often with a notable bias towards stock market analysis; or the promotion of a single proprietary trading system often devised by the author. We have recognized a demand for a concise publication that outlines the principal patterns, trend indicators and oscillators widely used in a technical analysis framework. Whilst not exhaustive, we aim to detail the most commonly used technical tools and ones that, for the most part, can be used across all asset classes.

Kevin Edgeley CFA
March 2004
Section II: The Basics

Chart Construction

- The traditional bar chart shows a vertical line marking the high and low price traded in the particular time period. A small tick to the left of the bar indicates the opening price and a tick to the right of the bar marks the close.

- Candlestick charts show the same information, but give greater importance to the open and close by drawing a box around these prices and colouring the candle body black if the market closed below the open and white if the market closed above the open. A long white candle body shows that buyers are in control, while a long black candle body shows that sellers dominate. Originally a Japanese method for determining trend reversal, candlesticks give a more pictorial reference to the trend and momentum of the market. A number of the commonly used signals are detailed in the section on Japanese Technical Analysis.

- A more basic line chart usually joins successive closing prices, but can also be drawn using average prices.

- Most charts are plotted on an arithmetic scale, but there is some advantage in using a logarithmic scale for long term stock price charts as it will allow easier comparison of historic percentage moves.
A point and figure chart reflects price only, updating as the market moves by a certain amount (the box size). As prices rise, a series of Xs are plotted vertically; when the market subsequently reverses, a series of 0s are plotted in the next vertical column. The reversal criteria is usually set at 1, 3 or 5 boxes (i.e., if the box size is 5 ticks of price movement, then a 3 box reversal will require a reversal of 15 ticks (5×3) from the highest plot in the current column before plotting the first 0 in the subsequent column). The 1 box reversal is traditionally used for intra-day charts and the 3 and 5 box for longer term analysis. The P&F chart is useful for showing congestion areas; by measuring the width of a congestion range and multiplying it by the reversal count, a target from the congestion low or high can be measured. From a basing pattern, the target is given by \( P_L + (W \times R) \), where \( P_L \) is the low price for the congestion range, \( W \) is the horizontal width of the pattern and \( R \) is the reversal criteria (1, 3 or 5 box). Trend lines are usually drawn at a 45 degree angle when using the 3 and 5 box reversal method. Other traditional patterns such as triple tops and triangles (see chart patterns) can also be identified. The S&P chart shows a 12 box wide congestion range forming above 1030. The upside
target at 1068 is calculated by multiplying the pattern width (12) by the reversal count (3) and adding the result (36) to the low point of the congestion at 1032.

- Market Profile™ was devised by Peter Steidlmayer and is under copyright to the Chicago Board of Trade (CBOT). Every half hour trading period is assigned a letter which is plotted horizontally against a vertical price scale for each price traded in that period. Each 30 minute block is known as a Time/Price Opportunity (TPO). As the chart builds over time, a normal day will form a bell shaped curve. A value area can be plotted to identify the range where 70% of TPOs occurred and to provide future support and resistance levels. Subsequent breaks of the value area indicate the start of a new trend. A trending day will have a value area towards one end of the distribution. In the Bund futures chart below, the opening 30 minutes of trading on 1/29 was between 113.88 and 114.07, plotted with the letter k; the next 30 minutes had a range of 113.95 to 114.09, plotted with the letter l. As the day progresses, further letters are added sequentially for each 30 minute time period. Tick volume can also be added to show the...
distribution of trade activity. The value area is shown as a vertical line between the price and volume chart for each day (at 113.78-114.07 for the first day shown). With the value area towards the upper bounds of the market profile, the first day on the chart is identified as a trend day; the third day (2/2) shows a more normal bell shaped distribution.

Cycles

It is common for agricultural commodities to exhibit seasonal cyclical price action, but other asset classes can also be influenced by factors such as dividend disbursements, seasonal retail trade or the cycles of US presidential elections. Longer term economic activity has been analysed with respect to the 9 year Juglar cycle and 50-54 year Kondratieff cycles. Moving averages can be used to smooth price action for easier identification of the prevailing cycles, and combined with oscillators to indicate overbought/oversold conditions.
Section III: Trend Lines and Channels

- Market prices move in a series of zigzags – the direction of successive peaks and troughs constitutes the trend, and can give support and resistance to subsequent price action. Bull trends join two or more rising troughs, bear trends join two or more declining peaks; subsequent tests will validate the line. Some chartists prefer to ignore panic spikes at the top or bottom of a move and initiate the trend line from the next minor wave high for a bear trend or low for a bull trend.

- Trends reflect the changing expectations of investors; the steepness of the trend indicates the emotional intensity of the crowd. The volume of trades should expand with the trend; once volume momentum starts to slow, the market is warning of potential trend exhaustion.

- Trends on longer term charts are considered more significant; these should be identified first.
• A parallel channel (or return line) line can be drawn from a prominent mid-point extreme of the initial trend points to give potential resistance to bull trends and support to bear trends. A failure to reach this return line shows deterioration in the strength of the trend. A break of a bull channel support line or a bear channel resistance line gives a parallel extension target at the height of the initial channel.

• A measured target at the height of the price peak (or trough) to the trend line prior to the break can give an objective if no channel line is apparent.

• When a trend line is broken it will subsequently act as support or resistance to any pullback. If volume increases as the market pulls back to the trend, the breakout is more likely to be false.

• If the market fails to extend on a break of a tentative trend formed from two points only (i.e. not validated), then it is often better to amend the line to incorporate the new price extreme. If the existing trend line has been validated, then it is usually preferable to retain this as the dominant line.

• A filter, such as a percentage breakout, may be used to confirm a trend violation.
An alternative filter for a long term trend break might use the fan principle. After the break of a third successive trend line, the reversal is confirmed. The EURUSD chart below shows the initial trend line from the 1998 highs through the October '99 peak being broken in December 2000. The second line, also from the '98 peak, through the January '01 top was broken in August '01. The break of the third trend from '98 through the Sept '01 top occurred in April '02 and confirms the major trend reversal.
- Speed lines - measure a vertical line at a significant market peak or trough, then divide the line into thirds. Bull lines from the low or bear lines from the high, crossing the vertical line at the ⅓ and ⅔ points give potential support/resistance. The chart also shows Fibonacci Fan Lines which cross the horizontal at 38.2% and 61.8% (see under Elliott Wave for an explanation of the Fibonacci number sequence).
Gann lines relate price and time and are plotted from major highs and lows. Gann believed the perfect balance between price and time was when the trend was at 45 degrees (1 unit of price to one unit of time – 1×1). Other lines can be plotted at −1×2 (26.25°), 1×4 (15°), 1×8 (7.5°), 2×1 (63.75°), 4×1 (75°), 8×1 (82.5°). As each line is broken, the market is expected to move to the next line. The S&P chart below shows the break of the 75° line in early December prompting a trend move down to the 63.75° line in late December. When that line was broken in mid January, there was a sharp sell off to the 45° line in late January. The 15° line gave support to the March ’03 spike down and was the base for the subsequent recovery.
Section IV: Chart Patterns

As a general rule, chart patterns are grouped as below, but a minority of traditional reversal patterns develop into continuation patterns and vice versa.

Traditional Reversal Patterns

- *Head and Shoulders* – the market rallies to a first peak (the left shoulder) on good volume, then declines before rising to a higher second peak (the head), ideally on lower volume. A further decline is followed by third peak (the right shoulder) which fails below the head on yet lower volume. A trend line joining the two shoulder lows is known as the neckline and usually slopes up at a head and shoulders top and down at an inverse H&S bottom; a downwards sloping neckline on a head and shoulders top is considered more bearish and an upwards sloping neckline on an inverse head and shoulders more bullish. A penetration of the neckline on increased trading activity confirms the reversal and gives a target at the height of the head to the neckline, extended from the neckline break. Once broken, there is often a pull back to retest the neckline on low volume. However, a closing break back through the line would indicate potential failure of the pattern. An inverse H&S is the mirror image of the topping pattern and is a signal of bear trend failure. The daily US Bond futures chart below shows the neckline being broken in June ’03 at 115.10 giving a target from the height of the pattern (a) at 110.06 which was reached in mid-July ’03.
• *Triple top/bottom* – a similar pattern to the head and shoulders, but with both shoulders and the head at the same level. Volume should decrease on each extreme and increase on a breakout. The USDJPY daily chart shows a triple bottom forming from November '99 – January '00. The reversal confirmation with the break of the mid-point high at 103.85 in early January' 00 gave a target at 106.40, which capped the rally in mid-January.
- **Double top/bottom** – two similar price peaks/troughs, ideally 2 weeks to 2 months apart, with declining volume at the second peak/trough. A break of the mid-point extreme gives a measured target at the height of the pattern, extended from the mid-point. A bull trap occurs when the 2nd peak extends but fails to hold above the first top. The EURUSD mid-point break at 1.1630 in June '03 gave a target at 1.1330 which was reached in early July.
- **Saucer** — a slow change in trend with volume decreasing then increasing as the saucer develops from the low or high and the new trend emerges.
- **Broadening pattern** – diverging trend lines with expanding volume as the pattern develops. This pattern often occurs at major market tops.
- **Diamond** – a broadening pattern followed by a symmetrical triangle. A measured move from a breakout is given by the height of the pattern, extended below the low point or above the high point.
- **V-Reversal** – a rapid reversal of trend often at a key reversal or island top/bottom (see section on gaps).

- **Key Reversal** – a) Bullish - higher high, lower low and close above the previous high. b) Bearish - higher high, lower low and close below the previous low. Should be at a significant market low or high, respectively, and be on above average volume.
Traditional Continuation Patterns

- **Triangles** – a consolidation phase to a prior trend. Volume should diminish as the pattern develops and then increase as the converging trend lines are broken. For maximum acceleration, the pattern should be broken between 50% and 75% of the move to the apex. If no breakout occurs, the market is likely to continue to drift sideways through the apex. A breakout target for all three types of triangle is given at the height of the pattern when first established, extended from the subsequent confirmed break of trend. A symmetrical triangle (also known as a coil) has two converging trend lines. The Bund example shows a breakaway gap (see under gaps below) on the break of the pattern and the objective at 111.11 reached within two days. An ascending triangle is usually bullish with a rising base line and flat congestion top. The closing break above the pattern top in the Soybeans futures contract in early April ’03 reached the target two weeks later, with an interim continuation gap reinforcing the impulsive nature of the breakout. A descending triangle usually indicates a break lower, having a descending resistance line and a flat base. The example in the Dow Jones has a confirmed break of the 10163 base line in late August, reaching the objective at 9644 the following week.
• **Flag** – a short term (usually less than 4 weeks) profit taking congestion area after a dynamic market move. The flag, with parallel support and resistance usually slopes against the prior trend. Volume should decrease within the pattern, and then expand on the breakout. If volume is high within the flag, then it is more likely to be a reversal than a continuation pattern.

• **Pennant** – converging trend lines forming a short term triangle with similar characteristics to a flag. Both flags and pennants usually “fly at half mast”, to give a breakout target symmetrical to the initial trend move.
- **Wedge** – a sloping symmetrical triangle against the prevailing trend (usually of 2-8 week duration). A falling wedge is bullish and a rising wedge is bearish. In contrast to triangle patterns, the price development within a wedge often extends further towards the apex of the converging trend lines. The breakout should retrace all of the ground made or lost within the wedge pattern. An interim target is similar to that for triangles – the height of the pattern when initiated, extended from the confirmed trend break. The upper trend line of the declining wedge in EURNOK was tested and validated in early January '03, before a breakout at 7.2550. The sharp acceleration reached the interim target on the day following the confirmed breakout, then reversed before rallying again through the primary target, 7 sessions after the trend break.
• *Rectangle* – a parallel non-trending congestion area with an objective on a breakout at the height of the pattern extended from the breakpoint. The DJI chart shows the target was reached seven sessions after the break of the base support. Note the final rally falling short of the rectangle top – a sign of upside failure.
Gaps

An area where no trading takes place. Not all gaps are filled.

- *Common (area) gap* - in thinly traded markets or in an existing trading range. Has no forecasting significance and is often quickly filled.

- *Breakaway gap* - after completion of a price pattern. Gaps on heavy volume; the greater the volume on the breakout, the less likely the gap will be filled.

- *Continuation (runaway or measuring) gap* - during an existing trend, usually at the half way point of longer term trend.

- *Exhaustion gap* – at the end of a move, prices consolidate and return to the gap fairly quickly. Usually closed within a few days. Often occurs after 2 or 3 continuation gaps.

- *Island reversal* – a gap in the direction of a prevailing trend move, then a gap in the opposite direction, leaving the initial gap unfilled. Usually on high volume.
Section V: Volume and Open Interest

- **Volume** should increase in the direction of the price trend as it reflects investor participation in the market. Volume in trading ranges is usually low, but should increase on breakouts. A breakout on low volume shows a lack of commitment to the new trend. A loss of momentum in a trend may show in the volume figures before a reversal signal is given in the price charts. Stock market volume can be measured by the number of shares, currency value of transactions, the number of trades or the number of price changes.

- **On Balance Volume (OBV)** – If the market closes higher, the day’s volume is added to a notional base number; if the market closes lower it is subtracted, giving a running cumulative total. The direction of the indicator is important and should mirror the trend. An alternative method would be to multiply the volume by a percentage price change to give a higher weight to more impulsive moves.
Advance/Decline Indicators measure the relationship between advancing and declining issues and volume in the stock market. They indicate the degree to which movement in a market index is supported by its constituents. The fewer issues that move with the trend, the more likely the market is to reverse. The advance/decline line acts as a leading indicator of trend exhaustion. Divergence between the A/D line and the trend of the index gives potential for a greater reversal. The Traders Index \( TRIN = \frac{AdvancingIssues/DecliningIssues}{AdvancingVolume/DecliningVolume} \)

Open Interest (OI) - measures the number of outstanding longs or shorts in the market. It will increase with a new buyer and seller and will decrease with position liquidation. As with volume, it should increase with the direction of the trend.

It is common to look at a short term moving average of volume and open interest figures and compare to its seasonal norm to assess whether the move is significant or not.

Sentiment Indicators – the Commitment of Traders report is published weekly by the CFTC and shows the open positions of commercial (hedgers) and non-commercial (speculators) investors. Relative positions should be compared to the seasonal average, but can give a good indication of the overbought/oversold nature of current speculative sentiment. Market Vane publishes the Bullish Consensus, which is a measure of the trading recommendations of Commodity Trading Advisors. When the majority of advisors are bullish (often close to market tops), a contrary opinion will assume that there is less buying power remaining in the market and that a corrective reversal is due.
Section VI: Moving Averages

- These are the basis for most trend following systems. The moving average will smooth the price action (typically the closing price) to give a clearer view of the prevailing trend. The inherent lag, which cannot be eliminated (only reduced by using a shorter term average), means that such a system will not capture the top or bottom of a market move.

- They measure the average value of a security over time on a simple or weighted basis. Weightings can be set exponentially (greater weight to the most recent price action), trianularly (giving more weight to the middle of the period) or based on volatility. The disadvantage of a simple moving average is that it will adjust twice - once with the addition of the latest data and second with the subtraction of the old data. However, it remains the most commonly used of the methods.

- If a dominant cycle can be identified, an optimal moving average could be set at half the length of the cycle.

- A trading signal is given when prices trade through the moving average or, in the case of a two moving average model, when the moving averages cross. Japanese technical analysts coined the phrase “Golden Cross” for a positive crossover of a short and long term moving average and “Death Cross” for a negative crossover. These terms are often used in relation to crosses of the 50 and 200 day moving averages.

- A reversal in direction of a moving average can often be a more reliable signal than a price crossover.

- If two moving averages are used, the longer one can be used for identifying the trend, the shorter one for market timing. A stop and reverse system on moving average crossovers would maintain constant participation in the market, but alternatively, a neutral position could be held when the market is trading between the two averages.

- A moving average system will perform well in a trending market but, due to its lagging nature, will fail when the market enters a congestion range. If a MA method is used in a non-trending market, the term of the average should be shortened.

- A filter can be used, such as a percentage break or the requirement of a full day’s price action through the average before a signal is confirmed.
- Envelopes, providing a breakout filter, can be drawn around a moving average on a percentage or volatility basis.

- Each market will have its own optimum moving average, but this is unlikely to be constant over time, giving risk of a back fitted system that is constantly in need of re-optimization. 10, 20, 40, 50, 100 and 200 day moving averages are commonly used.

- In the EURUSD chart below, the 10 and 20 day moving average crossover system is unprofitable during the congestion range, but generates positive returns during the trend period after the market breaks above the congestion range top in April ’03. To determine the trending nature of the market, the ADX indicator, detailed in the Directional Movement section below, can be used.
Section VII: Oscillators

- Markets spend more time in congestion phases than in trends. Oscillators assume a cyclical rhythm and measure the amount that a security’s price has changed over time; momentum is often used as a generic term for this relative performance.

- When the oscillator is at its upper extremes or historic high it is said to be overbought, when at the lower extreme or historic low, then oversold. As such, they can be used to predict reversals within a congestion range or non-trending market.

- The basic rules are to trade the extremes – buy when the oscillator is oversold in an uptrend, sell short when the oscillator is overbought in a downtrend.

- The overbought/oversold boundaries should ideally be adjusted to encompass 95% of the price action, although, practically they are usually set according to the time period of the oscillator.

- Oscillators must be subordinated to basic trend analysis as they can give misleading signals at the start of trend moves. Extreme overbought conditions at the start of a bull market can indicate further strength.

- Trend line breaks of the oscillator can give important signals and usually occur prior to trend line breaks on price charts. Look at oscillators over different time spans (daily, weekly and monthly) to gauge short and long term market momentum.

- Divergence - when the oscillator fails to confirm a move to a new price high or low. Warns of a trend reversal, but should be confirmed with a trend line break or completion of a price pattern. Multiple divergences will give an even stronger signal. Three types of divergence are recognized, with declining levels of significance:-
  
  A) Price at new high, oscillator at lower high (bearish). Price at new low, oscillator at higher low (bullish).
  
  B) Prices at double top, oscillator at lower top (bearish). Prices at double bottom, oscillator at higher low (bullish).
  
  C) Prices at new high, oscillator at double top (bearish). Prices at new low, oscillator at double bottom (bullish).

- **Rate of Change** – a ratio of the most recent close to that x periods ago. This can be used as a leading indicator of the price action. As an
overbought/oversold measure, ROC will work poorly in a strong trend as it is unbounded.

- **Relative Strength Index (RSI)** – the formula keeps the oscillator bounded at 0 and 100, with overbought/oversold conditions usually set at 30 and 70 for the default 14 day indicator and 20 and 80 for a shorter term 9 day. The shorter the time period used, the more sensitive the oscillator and the greater the wave amplitude.

- A failure swing is the failure to exceed the previous wave extreme of the oscillator followed by a break of the mid-point level (see chart for Bollinger Bands).

- Formula: \( 100 - \left( \frac{100}{1 + RS} \right) \),

  where \( RS \) is the 14 day average of up price closes divided by the 14 day average of down price closes.

- **Stochastic** – compares where a market closed relative to its price range over a given time period. As a rally develops the market tends to close towards the upper bounds of the day’s range. Stochastic plots two lines - %K and %D.

- Fast Stochastic %K = \( \left( \frac{close - lowx}{highx - lowx} \right) \times 100 \),

  where \( lowx \) is the low of the past x periods, and \( highx \) is the high of the past x periods. The original default period was 5 days.

- %D = 3 day moving average of %K.

- The slow stochastic is more often used as it smoothes the volatility of the fast indicator. The fast %K is dropped and the fast %D becomes the new slow %K, the slow %D is a 3 day moving average of the new slow %K.

- The basic rules in a non trending market are to buy when %K or %D falls below 20 and then rises above again, or to buy when the %K rises above the %D (this signal is stronger if the %K crosses to the right of the %D low). Sell when the %K or %D rise above 80 then reverse below, or sell when %K falls below %D. Ordinarily the %K will change direction first, but if the %D is the first to turn, the change in direction is likely to be slower and more stable.

- Divergence is an important trend reversal indicator.
The GSCI chart shows confirmation of the Type A divergent top in August with the gap below the bull trend line in early September. The first stochastic high in early August entered the overbought area, but the second divergent top two weeks later fell short.

Overbought/oversold extremes can range between 75 and 90 to the upside and 10 to 25 on the downside, depending on the time period used. Greater extremes are likely with a shorter term indicator.

A bear set up (reverse divergence) is given when there is a lower low in stochastic, but not in prices.

Moving Average Convergence Divergence (MACD) - measures the difference between two exponential moving averages (defaulted to 26 and 12 day). A signal line or trigger is plotted as a 9 day EMA of the base MACD. The system is most effective in wide swinging markets. A trading signal is given when the base MACD falls below or rises above its trigger line. The oscillator is unbounded, so overbought/oversold levels
need to be set for each market, by looking at historical extremes. As with other oscillators, divergences are a potentially strong reversal signal.

- A histogram can be plotted as the difference between the MACD and the signal line. A rising slope to the histogram shows that bulls are becoming stronger. A sell signal is given when the MACD histogram is greater the zero and the slope turns down, a buy signal when MACD histogram is below the zero line and the slope turns up.
Section VIII: Trading Systems

Whilst chart patterns, moving averages and oscillators are used in conjunction with basic trend analysis, the methods detailed below are often used on a more stand-alone basis.

Bollinger Bands

- An envelope of 2 standard deviations is plotted either side of a 20 day simple moving average, to contain c 95% of price action and show whether prices are high or low on a relative basis. If the moving average period is changed, then the standard deviation measure also needs to be altered. For a 10 day MA use 1.5 SD, for a 50 day MA use 2.5 SD.

- Based on the mean reversion of volatility, sharp price movements often occur after a narrowing of the Bollinger Bands. The system is quick to react to large market moves.

A move that originates at one band will often extend to the other. Conversely a close outside the bands indicates trend continuation. A top
(bottom) formed outside the bands followed by a top (bottom) back inside is a warning of potential breakout failure.

- The bands should be used in conjunction with an oscillator such as RSI to confirm the signal.
- The band width can be used as a measure of the trending/ranging nature of the market. As the market enters a congestion range, volatility will fall and the bands will narrow. As the market breaks out, volatility will increase and the bands will widen.

**Elliott Wave Theory**

- Devised by R.N. Elliott, inspired by Dow Theory. Each action is followed by a counter reaction. Elliott identified 5 waves constituting the trend (1, 3 and 5 are impulse waves in the direction of the trend, and waves 2 and 4 are interim counter-trend corrections). One of the three impulse waves is often longer than the other two (wave extension).
- Each wave is subdivided into waves of lesser degree and is itself part of a wave of greater degree.

In a bull trend, wave 1 is usually the shortest and forms part of a basing process. Wave 2 often retraces most of wave 1, producing double bottoms or inverse head and shoulder patterns. Wave 3 is usually the longest and often the most dynamic, but should never be the shortest. The volume is often at its highest and the market is prone to gaps within this wave. The wave 4 correction should never overlap the top of wave 1 and should be of
alternative form to wave 2. Triangles often occur in wave 4. Wave 5 is the final impulse wave and often shows divergence at its high; a 5th wave can sometimes fail to extend beyond wave three’s high (truncation). Occasionally a wedge can form in the 5th wave; each of the 5 waves in the wedge being sub-divided into 3 waves.

- A three wave correction is lettered A, B and C. Wave A is often initially seen as a minor consolidation to the previous impulse, wave B usually has light volume, potentially forming the right shoulder of a head and shoulders pattern. Wave C will then break the head and shoulders neckline.

- Corrective waves can be categorized as zigzags (sub-divided into a 5-3-5 wave sequence), flats (subdivided into a 3-3-5 sequence), and triangles (of 3-3-3-3-3 composition) or can be a more complex combination pattern.
Elliott Wave theory uses the Fibonacci sequence as its mathematical basis for potential wave and time targets and for retracement support.

*Fibonacci sequence* – each number is the sum of the preceding two. i.e. 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, etc. The ratio of one number to the next approaches 0.618 as the sequence progresses. The ratio of alternate
number approaches 0.382. These two relationships give the important Fibonacci retracement levels at 61.8% and 38.2%. Their inverse gives potential wave extension targets at 1.618 and 2.618 of previous waves.

- The S&P chart shows retracement levels to various market moves. The initial sell off from 1553 in March 2000 to 1081 in March ’01 retraced 50% to 1316 in May ’01. The longer term move from March 2000 to September ’01 was retraced 38.2% to 1177 in January ’02.

- Fibonacci fan lines work in a similar way to speed lines to give trend support/resistance, but using the 0.618 and 0.382 percentages instead of fractions (see chart of speed lines).

**Directional Movement**

- Directional Movement is defined as the largest portion of the day’s range outside the previous day’s range. If the greater range is to the upside, directional movement is positive (+DM); if below then negative (-DM).
The True Range is the largest absolute value of 1) today’s range, 2) today’s high minus yesterday’s close, and 3) today’s low minus yesterday’s close.

The Directional Indicator (+DI and -DI) divides positive and negative directional movement (+DM and -DM) independently by the True Range:

\[ +DI = \frac{+DM}{TrueRange}, \quad -DI = \frac{-DM}{TrueRange} \]

and then calculates a 14 day moving average of the positive and negative DI. When the +DI 14 day average is greater than the -DI 14 day average, the trend is up.

ADX evaluates the trending characteristics of a security. It measures a 14 day moving average of:

\[ \frac{\left(\frac{+DI}{-DI}\right)}{\left(\frac{+DI}{-DI}\right)} \]

If the trend is healthy, the spread between +DI and -DI will widen and ADX will rise.

The ADXR rates markets according to their trending nature.

\[ ADXR = \frac{ADX_t + ADX_{t-14}}{2} \]

The system works best when ADXR is greater than 25.

Use trend following indicators when ADX is rising. If ADX turns lower, the market is becoming less directional. When ADX declines below +DI and -DI then the market is non-trending.

Trade long positions when +DI is greater than -DI and the ADX is rising. Trade short positions when -DI is greater than +DI and ADX is rising.

### Parabolic Stop and Reverse

A trailing stop system with an acceleration factor to keep the stop price as a function of price and time development. The Acceleration Factor (AF) increases with each day that a new high (bull trend) or low (bear trend) is made.

The initial stop is at the lowest point reached in the previous short trade (highest point in the previous long trade). The AF increases at 0.02 per day to a maximum of 0.2, but the stop never enters the previous trading session’s range. After the maximum AF is reached, the stop becomes a function of price only.
- $SAR_t = SAR_{t-1} + AF(EP - SAR_{t-1})$, where $AF$ is the acceleration factor and $EP$ is the extreme high price for long trades, extreme low price for short trades.

- The system maintains constant participation in the market. The stops are triggered on an intra-day break to close the existing position and initiate the new. The Parabolic method, as with moving averages, is profitable in trending markets but suffers whipsaws in congestion ranges.
Section IX: Japanese Technical Analysis

Candlestick Patterns

- These patterns were developed in the 1600’s to chart Japanese rice prices. The real body (the difference between the open and the close) is considered of primary importance. Candle bodies are coloured black if the market closes below the open and white if the close is above the open. The price action outside the real body is referred to as the shadow. A long upper shadow indicates buyers taking profits. The candle patterns give no prediction of the subsequent move but can reflect the psychology of the market and provide potential reversal signals. If the open is at the same level as the close, a turning point (doji) is indicated.

- **Abandoned Baby** – a doji candle gapping above the prior and the following session, similar to an island top.

- **Dark Cloud Cover** – a bearish reversal signal. A long white candle followed by a black candle that reverses from a higher open to retrace substantially into the previous candle body.
- **Doji** – open and close are at equal level. A reversal signal. Dragonfly doji – open and close are at the high. Gravestone doji – open and close are at the low.

- **Engulfing Pattern** – bullish when a white candle body is outside the previous black candle body. Bearish when a black candle body is outside the previous white candle body.

- **Evening Star** – signals a major top. A tall white candle is followed by a second smaller candle body gapped higher, then a long black candle reversing into the first white body.
• **Hammer** – a small candle body at the top of the day’s trading range and a long lower shadow. A reversal signal at a bottom. A hammer at a market top is called a hanging man. Look for confirmation from the next candle body.

  ![Hammer, Hanging Man](image1)

• **Harami** – a small candle body inside the previous day’s larger body. Indicates conclusion of a trend.

  ![Harami](image2)

• **Morning Star** – a long black candle body followed by a small candle body gapping lower, then a long white candle body reversing into the first black candle. Sign of a market bottom.

  ![Morning Star](image3)
• **Piercing Line** – a reversal signal at a base. After a downtrend the market gaps lower on the open then reverses substantially back into the previous body.

![Piercing Line](image)

• **Shooting Star** – a bearish signal after an uptrend. A long upper shadow with the small candle body at the lower end of the range. A similar pattern after a downtrend is bullish and is called an inverse hammer.

![Shooting Star, Inverse Hammer](image)

**Ichimoku Kinko Hyo**

• Ichimoku – at a glance, Kinko – balance, Hyo – chart.

• A Japanese trending system suitable for daily and weekly charts. It is based on a series of moving averages with different lead and lag times.

• The Tenkan Sen is an average of the high and low of the last 9 days.

• The Kijun Sen is an average of the high and low of the past 26 days. Crossovers of these two averages give potential buy (Koten) and sell (Gyakoten) signals.
- The Senkou Span A is an average of the Tenkan and Kijun plotted 26 days ahead.

- The Senkou Span B is an average of the high and low of the last 52 days plotted 26 days ahead. The difference between these two lines forms the “cloud” which identifies the trend of the market. If the candlesticks are above the cloud, the trend is for higher prices, if below for lower prices. A bullish Tenkan/Kijun crossover above the cloud gives a stronger buy signal than a crossover below the cloud. The thicker the cloud, the less likely the market is to manage a sustained break.

- The Chikou Span is the most recent close, plotted 26 days behind current prices. If the Chikou breaks above the candle, then current sentiment is bullish.

- The rising cloud gave good support to the correction down in October '03. The break of the horizontal cloud in December '03 prompted successive upside gaps.
Further Reading

General Texts on Technical Analysis

“Technical Analysis of the Financial Markets” Murphy, J. NYIF.

Technical Trading Systems

“Trading System and Methods” Kaufman, P. John Wiley and Sons Ltd.
“The Elliott Wave Principle” Prechter, R and Frost, A. John Wiley and Sons Ltd.
“Japanese Candlestick Charting Techniques” Nison, S. Prentice Hall.

Goldman Sachs’ Technical Analysis can be found online at:
https://portal.gs.com/gs/portal/research/econ/econmarkets/techanalysis/
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