


IFTA Journal

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Traffic on the Golden Gate Bridge at dusk.
—Photo by Dalzell Photography



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Letter From the Editor

by Aurélie Gerber, MBA, CFA

Dear IFTA Colleagues and Friends:



Technical analysis turns the market into an endless stream of opportunities, and 2013 was no exception. One thing is certain: no one can know the future! Technical analysis is a method that organises collective behaviour into identifiable patterns and exploitable statistical advantage likely to recur in the future, thus providing an edge. It has evolved and become innovative in ways that allow individuals to make structured and systematic investment decisions.

The International Federation of Technical Analysts (IFTA) is true to this mission, and this year's 26th Annual IFTA Conference to be held in San Francisco with the theme "EVOLUTION TO MASTERY: Technical Analysis, Systems and Execution" will draw the interest of many practitioners and professionals from all corners of the world.

Most valuable is IFTA's ability to bridge international exchanges on technical analysis to a body of knowledge continuously evolving with the highest standards of professional ethics and competence. We pay homage to this concept with the picture of the Golden Gate Bridge on this *Journal's* cover page.

The *IFTA Journal* is—through its global distribution to professionals in the field—one of the most important forums for publishing leading work in technical analysis. This year, the *Journal* has four separate sections.

The first section includes six articles submitted by IFTA colleagues from the Egyptian Society of Technical Analysts (ESTA), the Market Technicians Association (MTA), the Society of Technical Analysts (STA), and the Vereinigung Technischer Analysten Deutschlands (VTAD). ESTA's contribution covers the building of relative performance candle charts and a new charting method of supports and resistances. The MTA submission coordinates bar and figure charts for trading using the Wickoff Matrix, and STA offers information on the profitability of a combined Bollinger and ADX signal approach. Some of the papers are abbreviated versions of prize-winning papers from local technical societies. For this, a special thank you goes to the German society VTAD, which helped motivate its local prize winners to rewrite their papers for us. One article deals with the smoothing of financial time series for optimal trading purposes, and another develops a volume divergence indicator and determines trends using a linear combination of moving averages.

In the second section, we have published four Master of Financial Technical Analysis (MFTA) research submissions. This body of work offers fresh ways of looking at the behavior of markets and is testament to the high standing of the MFTA designation. Additionally, we are pleased to publish a paper from another organisation, and with the permission of the National Association of Active Investment Managers (NAAIM), we have included this paper by Dave Klein, winner of the NAAIM Wagner Award 2013. We hope that you find this paper informative.

We conclude with a book review contribution from Regina Meani, CFTe, one of IFTA's previous board members and former *IFTA Journal* editor and director.

A number of changes occurred with the *IFTA Journal* this year. Rolf Wetzter, our editor for the last two years, stepped aside to take on the role of IFTA president. He took the *Journal* to a high-quality level with an international flavour. Thank you very much, Rolf!

I would like to thank all the authors from around the world for their contributions. Through their work, passion and dedication, the *IFTA Journal* continues to strive for excellence.

This year's *Journal* was produced by a new team, which, like IFTA itself, is truly international. I would like to thank Elaine Knuth, Jacinta Chan Lionel Charon, and Mark Brownlow for their help in editing the *Journal*. Last but not least, I would like to thank Linda Bernetic and Jon Benjamin for the layout and their tireless effort in putting the *Journal* together.

...one of the most important forums for publishing leading work in technical analysis.

The Wyckoff Matrix: Coordinating Bar Charts With Figure Charts

by Hank Pruden, Ph.D.

Under the Wyckoff Method, it is significant for the technical analyst to appreciate that the Figure Chart (i.e., Point and Figure Chart) plays a supplementary and complementary role to the Vertical Line Chart (i.e., Bar Chart).

With its component of volume, the bar chart /vertical chart was looked upon by R.D. Wyckoff as a superior instrument for the diagnoses of trends and trading ranges. Therefore, the technician-trader should start with the bar chart, comparing successive waves of buying and selling, comprising price and volume, over time. That diagnostic process should reveal the relative power of demand vs. supply forces in the market. This diagnosis would also uncover the intention of the powerful interests operating in the stock market. They were referred to as the “smart money” and conceptualized as “the composite man” or “the composite operator” by Wyckoff.

Wyckoff asserted that “three market laws” enabled the trader-analyst to discern the intentions of the dominant forces operating in a stock, a commodity, or a market as a whole. The first and by far most prominent law was that of supply and demand. Simply stated, this law said that if demand was more powerful than supply, then price would rise. Likewise, if supply were dominant or in control, then prices would decline. Hence, the law of supply and demand was the proper tool to diagnose and explain the present position and probable future trend of price in a market. Wyckoff counseled analysts and traders to rely upon the Vertical Line or the Bar Chart because it was the

superior instrument for diagnosing small as well as large price swings in the market.

Closely allied to the law of supply and demand was the law of effort vs. result. When a divergence or disharmony between price and volume action occurred, the trader-analyst would become alert for a possible or probable change in trend direction. Thus, the law of effort (volume) vs. result (price) was valuable for alerting the analyst-trader to an imminent change in trend direction.

The third law for ascertaining the intention of the Composite Man was the law of cause and effect. Essentially, this third law said that a sideways trading range would create a cause, and the subsequent trend would be the result of that cause. Furthermore, the law stated that there existed a direct proportion between cause and effect. Likewise, for every effect there would be a preceding cause built up. In other words, the buildup of a cause in a trading range could measure the exact extent of accumulation or distribution by the Composite Operator. The resulting trend was then the realization of that buildup.

In sum, a significant quantifiable law linked the cause to the effect. The quantitative relationship between cause and effect was that of equal proportionality or a one-to-one relationship.

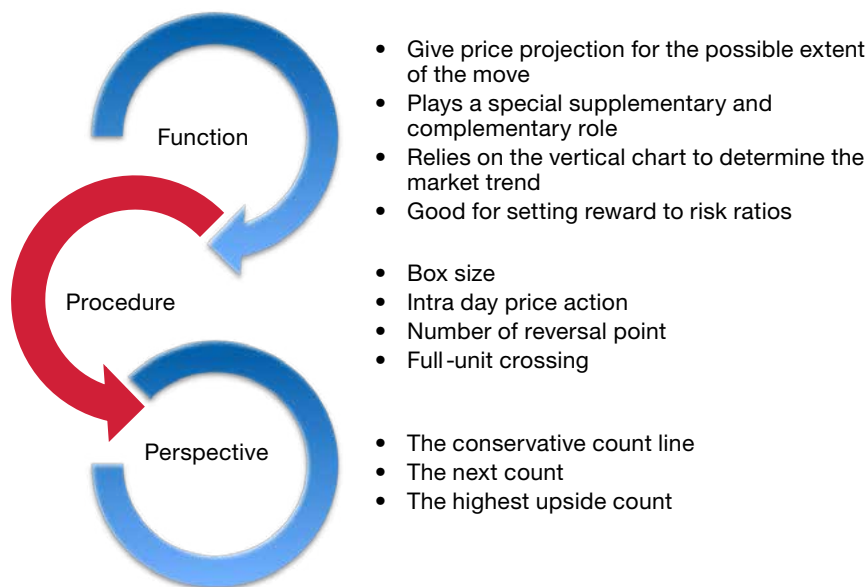
The instrument used by Wyckoff to measure the extent of a cause built up during trading range was the Figure Chart. This powerful and unique quantifiable procedure was the special

function of the Figure Chart, according to Wyckoff and his associates.

During the early 1930s, Wyckoff and Associates promulgated guidelines for the proper construction of Figure Charts and for the appropriate interpretation of Figure Charts. These evolved into what ultimately became known as the Wyckoff Count Guide.

Both the Figure Chart and the Bar Chart grew out of the old-time trader’s (19th and early 20th century) reading of the ticker tape of transactions. One of the initial appeals of the Figure Chart was its simplicity and ease for recording price changes. On the other hand, the Bar Chart was capable of displaying a rich array of price and volume activity. The bar chart was an excellent instrument for capturing the pulse of a market. The bar chart had the requisite sensitivity needed to discern the motives of the Composite

Figure 1: Chart for Wyckoff Method



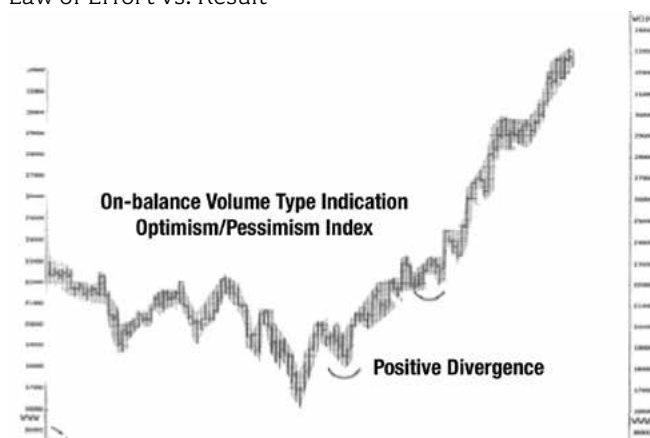
Man on one side and the behavior of the crowd (i.e., the general public) on the other. The flow of information and logic placed the Bar Chart in a leading analytical position. The information furnished by the Bar Chart was ideal for the application of the law of supply and demand and for interpreting the law of effort vs. result.

In your own technical work leading to action, the Bar Chart should commence your analysis. This necessitates the proper interpretation of the phases within a sideways trading range. It is crucial to judge the culmination of the sideways trading range or the transition point separating markup from accumulation and markdown from distribution. That juncture is known as the last point of support after accumulation (LPS) or the last point of supply after distribution (LPSY). An excellent depiction of the Wyckoff Method of understanding the phases of a trading range was furnished in the widely read article that appeared in the 1994 issue of the *MTA Journal* (i.e., Jim Forte, CMT, "The Anatomy of a Trading Range").

Once the boundaries a trading range have been established and the LPS or LPSY has been identified on the bar chart, the analyst-trader is then ready to consult the Figure Chart of the same trading range in order to conduct the quantification of the potential (i.e., "the count").

Figure 2: Wyckoff Laws

Law of Effort vs. Result



Law of Supply and Demand



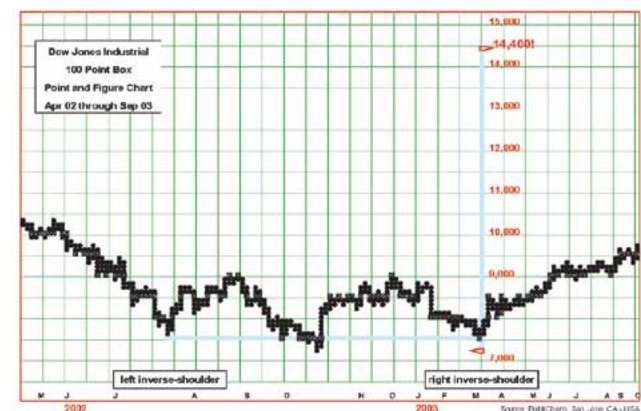
The Matrix Illustrated

A Bullish Case

Figure 2 illustrates an inharmonious relationship between volume and price. The Optimism/Pessimism (OP) Index is a Wyckoff/SMI generated index that is approximately equivalent to a chart of on-balanced volume or an accumulation/distribution indicator. Figure 2 shows a case where considerable downside volume effort during June and July did not result in a commensurate degree of downside price weakness. This divergent action would put the trader-analyst on the alert for a possible (probable) price trend reversal to the upside. An upside reversal in the Wyckoff wave price index occurred during August and September 2003.

Figures 2 and 3 demonstrate a procedure that is central to the Wyckoff method: the coordination of Bar Charts and Figure Charts. In general, the procedure is to first identify the completion of a pattern of horizontal accumulation or distribution on the Bar Chart. This first step is facilitated by the identification of an "action and test" on the right hand side of the chart in Figure 2. The action is shown as the breakout above the recent trading range at \$8,000 around August 15; the test is shown by the pullback to the breakout point at \$8,100. This

Figure 3: Wyckoff Law: Law of Cause and Effect



pullback ending point at \$8,100 is referred to by Wyckoff as the Last Point of Support (LPS). The LPS is the point of departure for measuring the cause on the Figure Chart as well as for entering a position on the long side of the market.

A Bearish Case

The Engelhard Minerals and the Chemicals charts (Figures 4 and 5) are a case study of distribution and decline. The uptrend was halted first around \$57 and then emphatically stopped at \$62, from which point the horizontal resistance line is drawn. Following the halt at \$62, Engelhard finds support at \$49, from which point the horizontal support line is drawn. There is another attempt to reestablish the uptrend from \$49 to \$64, but this is followed by the sharp price breakdown on expanding volume from \$64 down to \$52. This bearish action, where supply is clearly in control, is labeled "Sign of Weakness." The subsequent rally on diminishing price and shrinking volume constitutes the test, the end of which is the LPS. A sale or short-sale could be made at that point.

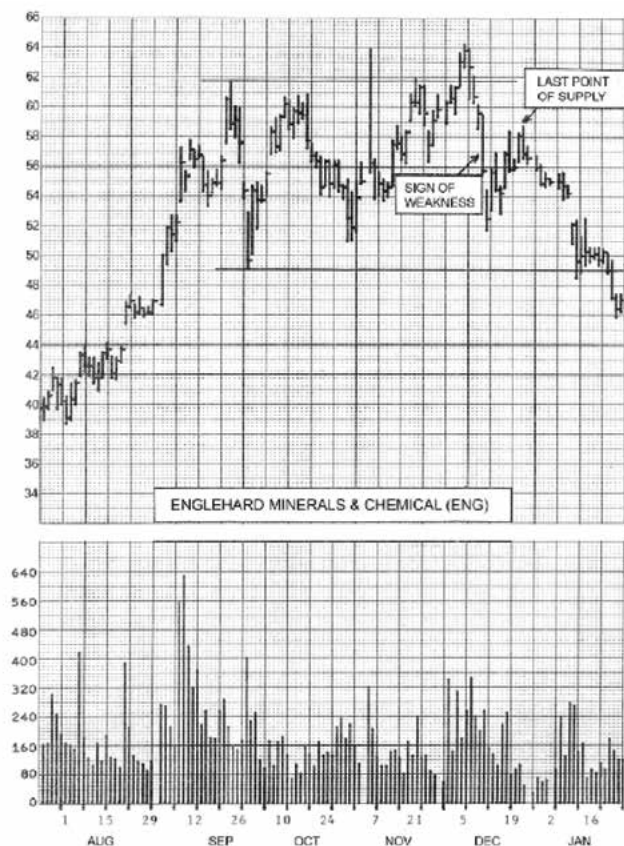
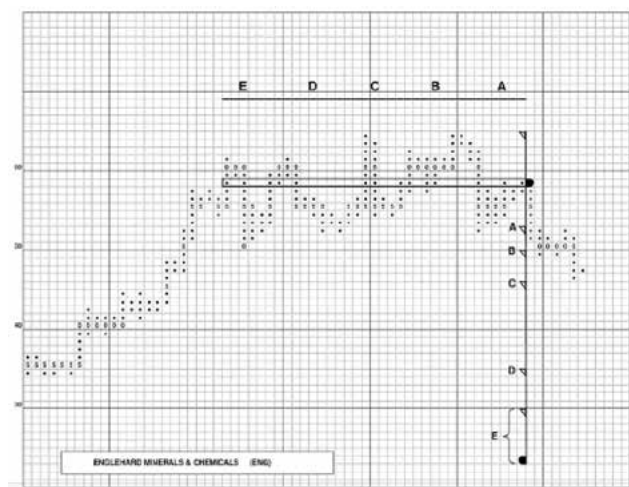
Figure 4: Pattern Recognition and Discretionary Trading**Figure 5: Basic Elements of Figure Charting**
Downside Potential (Effect) Generated by Distribution

Figure 5 shows the downside potential (effect) generated during the distribution trading range of Engelhard. This effect reflects the cause measured along the \$59 level on the Figure Chart. The flagged points A, B, C, D, and E on the downside are signal levels for the trader-analyst to “stop, look and listen” for possible halting price-action on the downside as Engelhard reaches those targets. Note that here, too, in the case study of Engelhard, we witness the importance of coordinating Bar Chart and Figure Chart action.

Individual Case Studies: Coordinating Bar Charts and Figure Charts

Case #1: Bank of America (BAC)

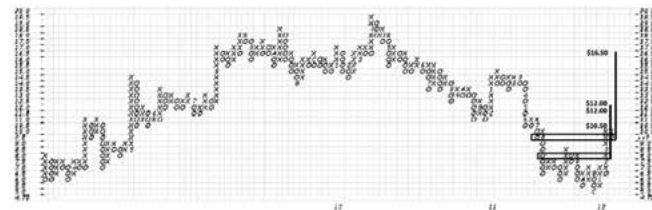
Bar Chart (A) of BAC reveals a classic structure of accumulation (Figure 6). The steeply declining bear market from February 2011 until December 2011 entered a phase of panic-selling in August. Prices plunged downward into a selling climax (SC) in August. The large relative expansion in volume as price stopped at \$6 and bounced immediately had the earmarks of strong hands (i.e., The Composite Man) entering the market on the buy side. That climax was then followed by a secondary test and then an even more vigorous rally off the lows. This indicated that demand was matching supply. It further suggested that if BAC was under accumulation, that phase would have started here and now.

Figure 6: Wyckoff Analysis of BAC (short term – daily chart)

Subsequently, BAC went into a trading range that ended with a terminal shakeout in December at below \$6/share.

BAC then witnessed a powerful rally all the way to the resistance level (i.e., the creek) around \$7.70. Our Wyckoff trader labeled this as a “a Sign of Strength (SOS)” and a “Jump Across the Creek (JAC).” Thus, BAC was judged to have been approaching the springboard at the LPS. Hence, it was at the LPS that Richard Alberta, our analyst-trader, was ready to consult the Figure Chart (B), Figure 7, of BAC and apply the Wyckoff Count Guide.

The Figure Chart (B) disclosed an accumulation base of eight points on the one-half point figure chart. Adding that count to the low at \$2.50 and also to the count line itself yielded upside projections of \$10.50 to \$16.50.

Figure 7: Wyckoff Price Projection of BAC (short term – 1 point reversal)

Case #2: Boeing Co. (BA)

Another chart and another student, Mark Kaehler, furnishes us with a different view about coordinating Bar Charts and Figure Charts in applying Wyckoff's law of cause and effect. In this case, the Bar Chart is of BA weekly from March 2011 to March 2012. Here, this Wyckoff student perceived accumulation occurring in the trading range between \$57 and \$68 that occurred from August to December 2011. He judged that a conservative LPS was \$63 in December 2011. Using a one-point reversal Figure Chart with a one-point box size yielded upside counts of \$78 to \$84.

If a position were entered at \$63 to \$65 and a stop-loss ordered placed below the bottom of the trading range at \$56, the trader would have had an acceptable 3-1 reward to risk ratio. That reward/risk would have justified taking a position in BA.

Figure 8: Wyckoff Analysis of BA

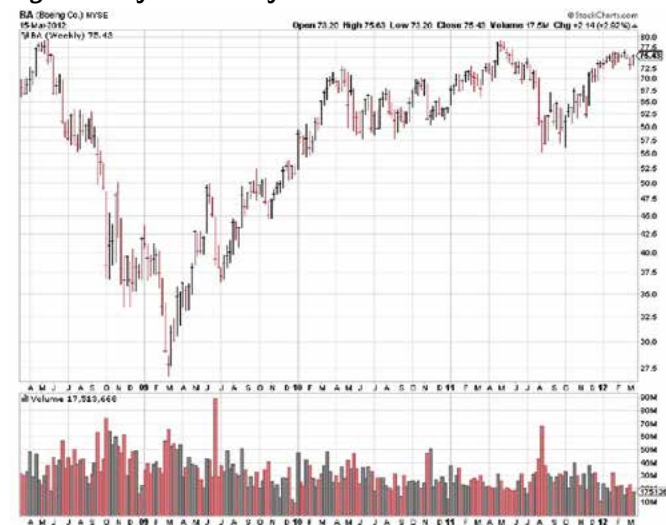
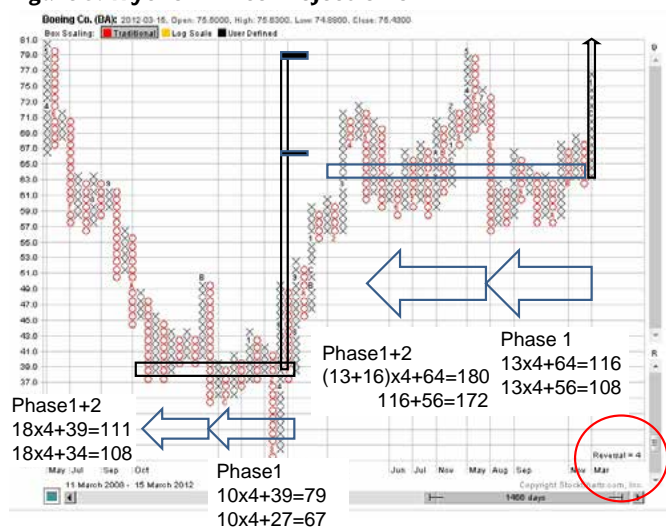


Figure 9: Wyckoff Price Projection of BA



Case #3: Newmont Mining (NEM)

The next charts cover NEM, 2011 to 2012. In this case, NEM encountered a very different set of circumstances than the preceding two cases. NEM was exhibiting relative weakness compared to the S&P 500 index at that time. Indeed, this Wyckoff student-analyst, Patrick Garcia, discerned a distribution top in NEM followed by a counter-trend decline. Therefore, this would necessitate a counter-to-the-market trade. Assuming that taking counter-trend positions were acceptable in his trading plan, this Wyckoff trader-analyst would want to determine if enough distribution had taken place to justify taking a short position in NEM: was there a 3-1 reward to risk relationship between the downside price target given by the Figure Chart to cover a possible loss to be encountered if NEM rallied to take out a stop-loss order placed above the November 2011 high of \$70?

Figure 10: Wyckoff Analysis of NEM



Figure 11: Wyckoff Price Projection of NEM



Turning to the Bar Chart of NEM shows the diagnosis of distribution by this Wyckoff student. He identified \$64 in January 2012 as the LPSY. In addition, he had bracketed the distribution top trading range, starting with preliminary supply and a buying climax. However, you might want to study where he labeled the LPSY and the PSY. The Wyckoff count guide explained that PSY and LPSY often occurred at the same price level. And when they did so, it added validity to counting the Figure Chart points registered

between the LPSY and PSY.

The companion Figure Chart of NEM gave a horizontal count along the \$64 line that helped to economize and to clarify the preceding bar chart analysis of distribution. After the sign of weakness drop to \$57, which took NEM to a lower-low below \$59 and which broke the long-term trend line (T-T), NEM rallied back to \$64 for an important LPSY in Feb 2012.

The resulting distribution formation rendered a count of 69 (3 Points/Column x 23 columns by counting along the \$64 level). Thus, even taking a short position in NEM at \$56 as it broke down below support of \$57 would still be condoned by the Wyckoff 3-1 reward-to-risk requirement.

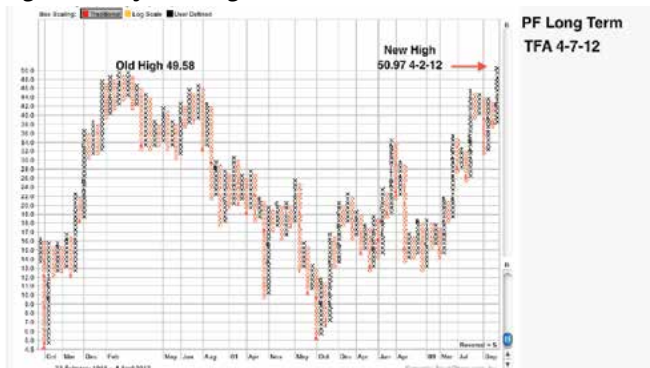
Case #4: ASML

The fourth and final case study offers another opportunity to see the Wyckoff Method applied to the coordination of Bar and Figure Charts for the purpose of making price projections and thus enabling the analyst-trader to ascertain an acceptable level of reward-to-risk in a given trade. In this case, the company under study is a high tech firm, ASML.

Figure 12: Wyckoff Analysis of ASML



Figure 13: Wyckoff Figure Chart of ASML



Our Wyckoff analyst-trader, Tom Accinelli, determined from his study of ASML's bar chart that a long-term base of accumulation had occurred between the years 2002 and 2012. Chart (A) shows the monthly candlestick chart of ASML with volume. It is annotated to show major Wyckoff junctures within a trading range that started with PS and a SC in 2002 and ended with a terminal shakeout LPS in 2009. Hence, we were seeing a possible "long base" candidate or one of the most favorable of investment opportunities.

The Figure Chart of ASML suggests at best two significant zones of accumulation. The first and most conservative zone of accumulation happened between April 2001 and March 2009. A quasi "inverse head and shoulders" appearing bottom can be observed. A count taken from an LPS at \$14 can be counted from right-to-left along that \$14 level for a total of 41 columns. Assuming a value of ½ point/box and a 3-box reversal pattern, the total count becomes 41 x 3 x 0.5 = 62 points. Added to the low at \$5.00 and also added to the count line at \$14.00 renders upside price targets from \$67 to \$76.

Since the current price of ASML at the time of this case (April 2012) was approaching that target zone, this Wyckoff analyst-trader was obligated to consider the more ambitious count taken from the LPS following the more important SOS and the backup to the trading range (BU to TR on Figure 12) at \$25.00. Assuming that one half the Figure Chart data were below \$20 and hence ½ point in value, while the remainder were 1 full point in value, the resulting upside targets ranged from \$135 to \$155 for ASML.

In sum, the major long-term base of accumulation should become extremely rewarding to the longer term investor.

Summary and Conclusions

This article has defined, described, and illustrated a matrix interlinking Bar Charts with Point and Figure (Figure) Charts. The matrix joined the Wyckoff law of supply and demand with the Wyckoff law of cause and effect.

The Wyckoff Count Guide defined the matrix connecting the law of supply and demand and its use of Bar Charts to the law of cause and effect and its use of Figure Charts. The ultimate outcome or goal of the Count Guide is to render price projections for setting price targets, making reward to risk calculations, and calibrating trading range pauses during a trend.

Four case studies demonstrating the application of the Wyckoff Figure Chart Count Guide were presented in this article. Each case study reflected the work of an individual student enrolled in an advanced Wyckoff course (FI 355) at Golden Gate University during the Spring 2012 trimester. These studies of four different common stocks illustrated different nuances in the interpretation of charts and the application of the Wyckoff Count Guide. Those interpreting were in keeping with the judgmental aspect of the Wyckoff method. The case studies aptly illustrated and upheld the Wyckoff Count Guide and the matrix linking Bar Charts with Figure Charts.

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Relative Performance Candlestick Charts: Enhancing the Value of Relative Performance Analysis Through Japanese Candlestick Charting

by Mohamed El Saïid, CFTe, MFTA

1. Abstract

This paper presents a new technical analysis (TA) application called Relative Performance Candlestick Charts (RPCCs). RPCCs are constructed by applying the principles of the Japanese candlestick charting method to the Relative Performance Analysis (RPA) technique. The proposed application can provide substantial improvement over conventional Relative Performance Line Charts (RPLCs). Another contribution of this paper is the introduction of a new concept in RPA, called RP Volumes. This concept allows us to analyze and better understand the depth (health) of RP trends through the application of the principles of various volume-based TA indicators on RP charts. The paper provides numerous examples that illustrate the construction, use, and advantages of the RPCC tool and the RP Volumes concept.

2. Introduction

2.1 The definition of Relative Performance Analysis (RPA)

RPA, also referred to as Relative Strength Analysis (RSA) or Relative Strength Comparative (RSC), is a form of analysis frequently used in the TA field. RPA measures the performance of a specific security relative to another security, in which the latter represents a form of reference or benchmark. The comparison is generally applied through a division operation, and the outcome is commonly referred to as a ratio.¹ The benchmark (the denominator) can be 1) the broader market index in which the underlying security trades, 2) the underlying security's sector index, 3) another traded security within the same sector, or 4) another asset class. The selection of the benchmark security (or denominator) depends exclusively on what we wish to observe in a comparative analysis. The main

objectives of RPA are to be able to rank or select potentially more suitable investments on a relative basis and to apply the technique to futures through spread trading techniques. Another potential value of RPA is that it can allow us to understand the inter-market relationships among various assets.²

2.2 Existing RP calculation approaches and methods

Several methods can be used to calculate RP. The simplest and most common is the method in which RP is calculated by dividing the closing value of the underlying security by the closing value of a benchmark or security (Figure 1, upper window).³ Another method normalizes the starting point of the RP chart (e.g., to a value of 1), so as to allow the RP values of this security to be compared to the RP values of another security, both relative to a common benchmark. This process works better if we wish to rank the RP values of several securities (Figure 1, lower window).⁴ More recently, Relative Rotation Graphs (RRG), a groundbreaking RP visualization methodology developed by Julius de Kempenaer (JDK), was introduced. This method aims to measure the relative strength of all securities (or asset classes) in a universe in such a way that the numerical results are all comparable, both to a common benchmark and to each other. RRG is composed primarily of two main oscillators: 1) the JDK-RS Ratio line and 2) the JDK-RS Momentum line. The JDK-RS Ratio line captures the relative performance of a security in an oscillatory (rotating) behavior rather than a trending one, whereas the JDK-RS Momentum line indicates the relationship between the JDK-RS Ratio line and a trigger line. This relationship is expressed as a normalized version of the rate of change of the JDK-RS Ratio line. The calculated JDK-RS Ratio line and JDK-RS Momentum line of each security in the

desired portfolio are then plotted as (x,y) coordinate values for each security in a quadrant-segmented graph (Figure 2). The x-axis of this graph represents the JDK-RS Ratio line scale, while the y-axis represents the JDK-RS Momentum line scale. After plotting each security's coordinate-values over time, the RRG visually displays the RP-rotation mechanism that is experienced by various securities and asset classes over time. As a result, RRG offers a very interesting performance trail that ultimately aids in determining the direction and pace of the RP movement for each security.⁵

Figure 1: Google Inc. vs. NASDAQ Composite Index – simple vs. normalized RPLCs – daily values – normal scale

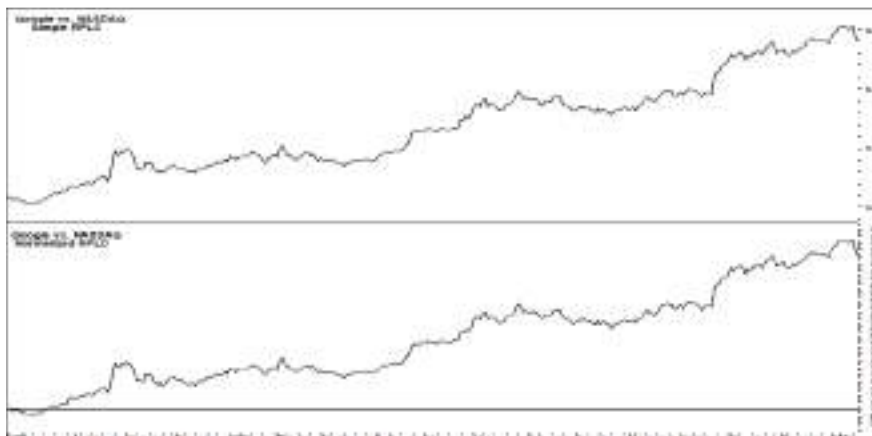
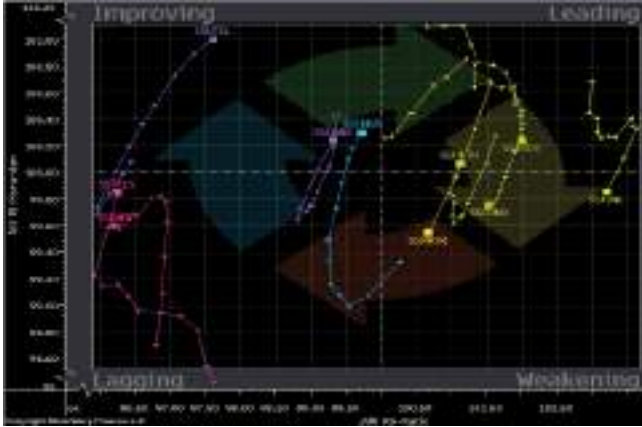


Figure 2 displays the RP-rotation of the S&P 500 Consumer Discretionary (CD), Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology (IT), Materials, Telecommunication Services, and Utilities sector indices vs. the S&P 500 Economic Sectors Index on the RRG chart.

Figure 2: S&P 10 sector indices vs. S&P 500 Eco Sectors Index – RRG – weekly values

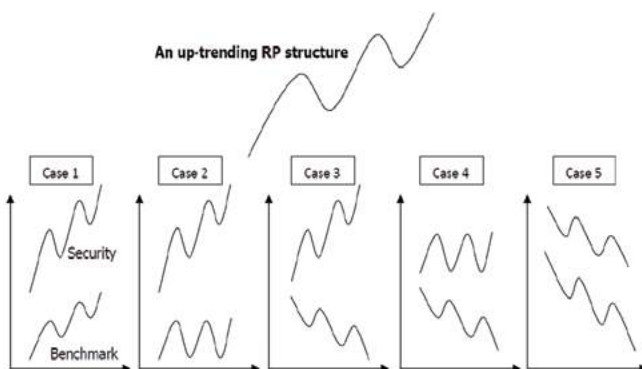


2.3 Interpretations and benefits of RPA

Regardless of the RP mathematical formula used, when comparing a security to a benchmark using RP, we arrive at three main outcome/structures as follows:

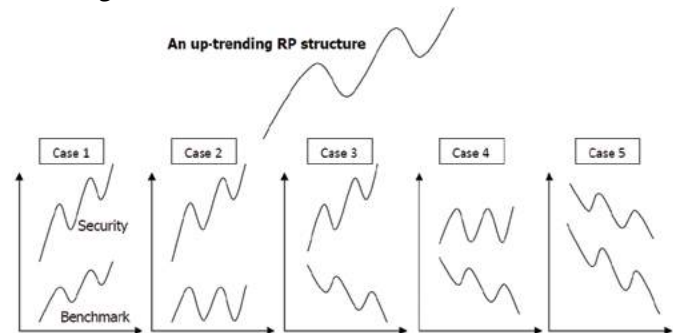
- I. An up-trending RP structure, which results from one of the following cases:
 1. An up-trending security and benchmark, whereby the security is rising at a higher pace or rate than the comparative benchmark.
 2. An up-trending security and a down-trending benchmark.
 3. An up-trending security and a sideways-moving or non-trending benchmark.
 4. A sideways-moving or non-trending security and a down-trending benchmark.
 5. A down-trending security and benchmark, whereby the security is falling at a slower pace or rate than the comparative benchmark.

Figure 3: The five primary cases that produce an up-trending RP structure



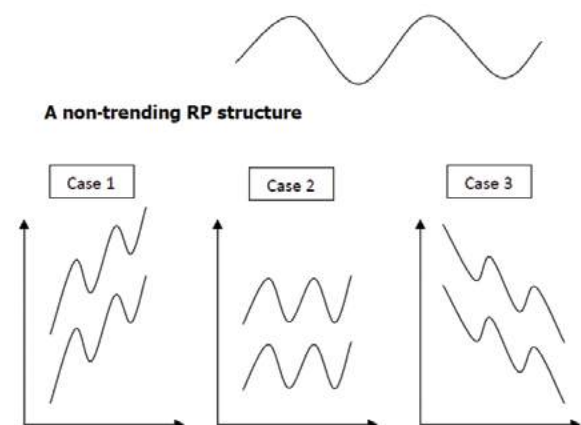
- II. A down-trending RP structure, which results from either one of the following cases:
 1. An up-trending security and benchmark, whereby the security is rising at a slower pace or rate than the comparative benchmark.
 2. A down-trending security and an up-trending benchmark.
 3. A down-trending security and a sideways-moving or non-trending benchmark.
 4. A sideways-moving or non-trending security and an up-trending benchmark.
 5. A down-trending security and benchmark, whereby the security is falling at a higher pace or rate than the comparative benchmark.

Figure 4: The five primary cases that produce a down-trending RP structure



- III. A flat or non-trending RP structure, which results from either of the following cases:
 1. An up-trending security and benchmark, with both rising at a similar pace.
 2. A down-trending security and benchmark, with both falling at a similar pace.
 3. A non-trending security and benchmark.

Figure 5: The three primary cases that produce a non-trending RP structure



These three different RP outcome/structures, along with the 13 cases previously presented, allow us to categorize and/or rank the various securities and asset classes in our portfolio with respect to which are the most and least desirable assets to hold.⁶ This ranking process can then be translated into recommended weights in a portfolio, or can simply be used for the purpose of favoring an investment in a specific security over another.

However, the limitations of the RPLCs are analogous to the limitations of line charts when compared with candlestick or bar charts. This is particularly evident when one attempts to locate the closing value with reference to the opening value or even the day's range. Locating the closing value on candlestick and bar charts allows us to better visualize and interpret market psychology.⁷ This will be further validated as we introduce RPCCs in the following section. Moreover, introducing the new concept of RP Volumes allows for a more in-depth view of RPA, as volume generally offers a third dimension to price chart analysis.

3. Introducing the Relative Performance Candlestick Charts (RPCCs)

This section introduces the calculation method for RPCCs and RP Volumes and conveys the means to construct and visualize them graphically.

3.1 RPCC calculation methodology

First, we calculate the RP of the underlying security vs. its benchmark on an intraday time interval (e.g., using the tick or one-minute frame closing values data).

Then, we highlight the RP open, high, low, and close as follows:

1. The daily RP open is the first RP value calculated between the underlying security and its benchmark at the session's start.

RP open = Security opening price/Benchmark opening value

2. The daily RP high is the highest RP value registered between the underlying security and its benchmark during the session.

RP high = Max. RP value of (Security intraday priceT/Benchmark intraday valueT)

Where T is a specific point in time during the intraday frame.

3. The daily RP low is the lowest RP value registered between the underlying security and its benchmark during the session.

RP low = Min. RP value of (Security intraday priceT/Benchmark intraday valueT)

Where T is a specific point in time during the intraday frame.

4. The daily RP close is the last RP value calculated between the underlying security and its benchmark at the session's end.

RP close = Security closing price/Benchmark closing value

Figure 6 shows a graphical explanation of the calculation methodology. Figure 6 visually explains the construction of a single (one-day) RP Candle-line for Apple Inc. vs. the NASDAQ Composite Index. As observed, RP open and RP close values can be calculated using end-of-day values; however, precise RP high and RP low values can be attained only from intraday RP calculations. A more convenient but less precise reconciliation method will be discussed later in section 6.2 of this paper.

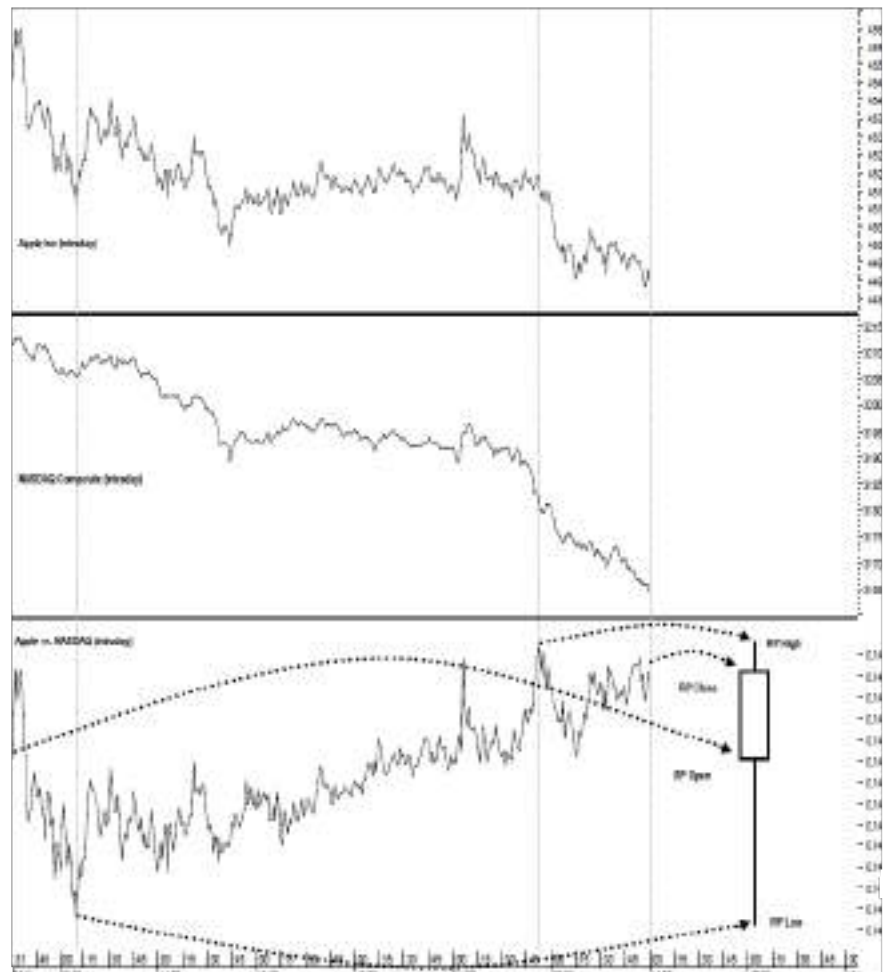
3.2 RP Volumes treatment

The calculation of RP Volumes is straightforward. We divide the total daily volume of the underlying security by that of its comparative benchmark.

RP daily volume = Security daily volume/Benchmark daily volume

Continuing with the previous example, we divide the volume of Apple Inc. by the volume of the NASDAQ Composite Index to get the day's RP Volume.

Figure 6: Upper window: Apple Inc. – intraday values – line chart – normal scale. Middle window: NASDAQ Composite Index – intraday values – line chart – normal scale. Lower window: Apple Inc. vs. NASDAQ Composite Index RP – intraday values – RPLC converted to an end-of-day Candle-line – normal scale



How do we interpret RP Volumes?

By definition, daily volume represents the amount of trading activity (buying/selling) in a security on a specific day.⁸ As such, RP Volumes are regarded as the excess/shortage volumes, relative to the benchmark's volumes, that substantiate (or refute) the RP's trend behavior.

To elaborate, if a security's RP trend is rising, this rise should be attributed to an increase in buying interest or inflow relative to the increase in the volumes of the underlying benchmark. In that sense, the increase in RP Volumes is viewed as confirming and supporting the sustainability of the rise in the RP trend, and vice versa for declining RP trends.

Figure 7: Apple Inc. vs. NASDAQ Composite Index – daily values – RPCC – normal scale



Figure 7 displays the RPCC (upper window) and RP Volumes (lower window) for Apple Inc. vs. the NASDAQ Composite Index. Each daily RP Volumes bar is calculated by dividing the daily volume of Apple Inc. by the daily volume of the NASDAQ Composite Index. Clearly, the general principles of classic volumes analysis apply just as well to RP Volumes, though on a relative basis rather than an absolute one.

4. Comparing the RPCCs with RPLCs

In principle, the advantages of RPCCs over RPLCs are analogous to the advantages of the candlestick price charts over the line (price) charts. In this section, we will highlight the benefits attained by applying RPCCs with regard to the following aspects:

- Classic; Trend analysis, Support/Resistance analysis, and Gap analysis
- Patterns exclusive to the Japanese candlestick charting approach
- Applying common TA indicators and oscillators
- Presenting the benefits of RP Volumes

Figure 8 compares the RPCC (upper window) with the RPLC (lower window) of a security traded on the Egyptian Exchange vs. its benchmark, the EGX30 Index. As seen in this example, the RPCC allows us to better visualize the highlighted support-turning-resistance level than does its RPLC counterpart. Meanwhile, Figure 9 depicts a similar comparison between the

RPCC (upper window) and RPLC (lower window) of Microsoft Corp. vs. the NASDAQ Composite Index. Figure 9 demonstrates how the RPCC is able to express *relative strength psychology* better than the RPLC through better visualization of the changing trends and highlighted pattern formations, which reveal the intensity of formation breakouts. This is observed in the identified breakaway gaps as well as in the revealed short-term patterns that are exclusive to the Japanese candlestick charting approach.

Figure 8: Upper window: EFG-Hermes vs. EGX30 Index – daily values – RPCC – normal scale. Lower window: EFG-Hermes vs. EGX30 Index – daily values – RPLC – normal scale



Figure 9: Upper window: Microsoft Corp. vs. NASDAQ Composite Index – daily values – RPCC – normal scale. Lower window: Microsoft Corp. vs. NASDAQ Composite Index – daily values – RPLC – normal scale



Figures 10 and 11 display examples of how various TA indicators/oscillators can lend themselves to RPCCs, in tandem with the classic and candlestick approaches discussed previously. Figure 10 offers several examples of various candlestick patterns, some of which occur at critical support/resistance areas, thereby magnifying their significance. Moreover, the example also highlights an important positive divergence signal offered by the Relative Strength Index (RSI) oscillator (November–December 2008). The signal was

later confirmed by the RP trend as the latter completed its bottoming phase (March 2009). Meanwhile, Figure 11 reveals the strength of the RP trend (October 2006–January 2007) as implied by the Stochastic oscillator, which later signaled weakness in the uptrend, confirmed shortly thereafter by the RP trend. Moreover, the Volatility-Based Envelopes (VBE) offered multiple (lower) overlap signals with the RP Candle formations, implying higher lows—and a further development of the rising RP trend.

Figure 10: Orascom Construction Industries (OCI). vs. EGX30 Index – daily values – RPCC – normal scale



Figure 11: Orascom Telecom Holding vs. EGX30 Index – daily values – RPCC – normal scale

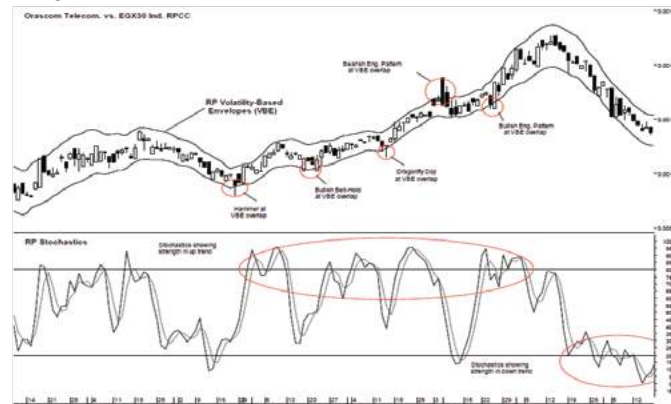


Figure 12 displays the S&P 500 IT Sector Index vs. S&P 500 Index RPCC (upper window) as well as the RP Bollinger Bandwidth indicator. This example highlights a classic case of volatility squeeze and volatility breakout, as described by John Bollinger.⁹

Figures 13 and 14 offer examples highlighting the benefits of RP Volumes when applied with RPCCs. Figure 13 presents a classic case of volume non-confirmation to an underlying trend depicted by the On Balance Volume (OBV) indicator. In this example, the RP OBV failed to form a higher high when the RP trend registered a higher high during August–September 2012. This was later confirmed by the RPCC trend (and supported by the RP OBV) in early November. Moreover, Figure 14 displays a security traded on the Egyptian Exchange (Commercial International Bank) vs. the EGX30 Index (upper window), as well as its RP OBV indicator. This example describes the critical pre-signal advantage of the RP OBV indicator during a key

trend reversal in the RPCC (January 2011)—later confirmed by the RPCC (mid-March 2011)—as well as the RP OBV's non-confirmation of the RPCC trend action at a later stage (November 2011), and, finally, a second pre-signal of further RP trend deterioration offered by the RP OBV (December 2011), which was confirmed by the RPCC in 2012.

Figure 12: S&P IT Sector Index vs. S&P 500 Index – daily values – RPCC – normal scale



Figure 13: Upper window: Apple Inc. vs. NASDAQ Composite Index – daily values – RPCC – normal scale. Lower window: Apple Inc. vs. NASDAQ Composite Index – RP OBV indicator – normal scale



Figure 14: Upper window: Commercial International Bank (CIBank) vs. EGX30 Index – daily values – RPCC – normal scale Lower window: Commercial International Bank vs. EGX30 Index – RP OBV indicator – normal scale



In the previous examples, the advantages offered by the RP OBV are generally similar to those it has over a regular price chart. This is true for cases in which the volume trends take the shape of the new trend before the actual prices do as well as for cases in which volume trends act as confirmation or non-confirmation of the price action.¹⁰

5. Normalizing RPCC Values

This section presents a key variation of the RPCC calculation methodology. As explained earlier, the method of normalizing RP charts allows for a numeric comparison of the RP values of different securities compared to a common benchmark. There are several existing approaches to normalizing RP values; we present one method and explain how it can be applied to RPCCs.

For a normalized RPLC calculation, instead of simply dividing the closing price of the security by a benchmark, we first divide the closing price of the security by another closing price of that same security at a specific (fixed) historical reference date (N). This date is usually identified according to its significance. For example, the date could mark the beginning (or end) of a significant trend. The same process is applied to the underlying benchmark (i.e., the closing value of the benchmark is divided by the closing value of that benchmark at the same [fixed] historical reference date [N]). Next, we divide the security's outcome by the benchmark outcome.¹¹

Figure 15: Normalized RPLC formula

$$\text{Norm RPLC (today)} = \frac{\text{Security's close (today)}}{\text{Security's Reference Close (at N)}} \div \frac{\text{Benchmark's close (today)}}{\text{Benchmark's Reference Close (at N)}}$$

For a normalized RPCC calculation, this same formula is calculated repeatedly during intraday (referenced to a closing value at N). Then, we extract the normalized RP open, high, low, and close as shown in Figure 6. Moreover, volume is normalized by a reference volume value (at N) using the same formula.

Figure 16: Upper window: MSCI EM IT Sector Index vs. MSCI EM Index – daily values – normalized RPCC – normal scale. Lower window: MSCI EM CD Sector Index vs. MSCI EM Index – daily values – normalized RPCC – normal scale



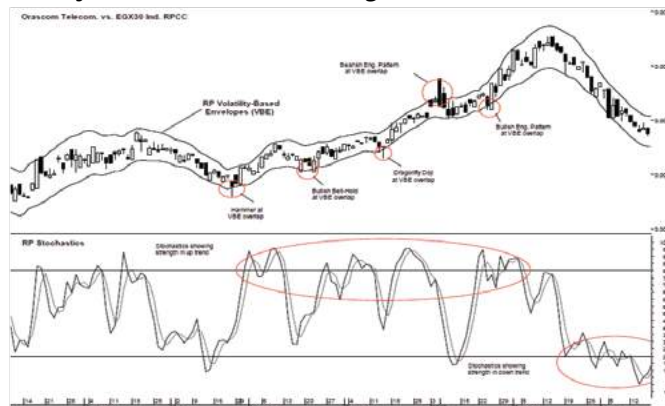
6. Discussions

This section discusses the construction of RPCCs over various timeframes and offers a more convenient calculation method for the RPCC.

6.1 RPCCs over longer timeframes

Once the daily RPCCs are constructed, they can conveniently be converted to weekly, monthly, or any other timeframe RPCCs, identically to the conversion of daily price charts to other timeframes.

Figure 17: Apple Inc. vs. NASDAQ Composite Index – weekly values – RPCC – semi log. scale



6.2 A more convenient but less accurate construction method

Realistically, calculating the RPCCs for a pool of securities could be considered tedious and would require a lot of computational power. A more convenient but less accurate approach is to calculate the RPCC by dividing the end-of-day open, high, low, and close values of the underlying security by the corresponding values of the comparative benchmark. Naturally, the RP open (first trade) and RP close (last trade) values will be identical to those calculated using the original method previously presented in Section 3. However, the RP high and RP low values will often vary from those calculated using the original method. These variations should not cause a notable impact on the integrity of the entire body of the RP Candle line except during specific trend conditions. Such conditions involve certain cases where the real body of the observed Candle line is relatively small, whereas the high (or low) values are large (such as in the case of a Hammer or Shooting Star formation). Because Japanese candlesticks are primarily focused on the relationship between the open and close values (the real body), the high and low values are deemed relatively unimportant.¹² This is especially true when the real body of the Candle line is relatively large. In addition, other common cases include when the actual RP high (or low) happens to be equal to the RP open (or close).

7. Conclusion

RPA is undoubtedly an essential concept in TA, especially when it comes to complementing, developing, and enhancing portfolio and asset management strategies. RPA can offer a stand-alone asset screening and/or ranking methodology for a portfolio or can be conveniently incorporated in larger-scope strategies that combine macroeconomic, fundamental, and

quantitative approaches and ranking processes.

This paper has offered an approach that increases the usefulness and advantage of RPA through the adaptation of the construction principles of a common and much-celebrated charting method—the Japanese candlestick charting approach. The paper has also introduced RP Volumes as a new concept in RPA. As presented in this paper, RP Volumes enhance our understanding and aid in our analysis of RP charts.

Like any tool or approach, the RPCCs are not without limitations; their construction requires constant updating and rigorous processing, and thorough follow-up analysis almost identical to that applied on price charts is necessary. Finally, its signals and interpretations are subject to whipsaws and human error, as in the case of price chart analysis. Nevertheless, the author believes that the overall benefits of RPA and, more specifically, RPCCs substantially compensate for their already tolerable limitations.

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Software and data

- Data courtesy of Bloomberg and Reuters.
- Charting software and charts courtesy of Bloomberg and Equis International MetaStock v.9.1.

Introducing the HE Chart and Its Application to Support Resistance Bands and Prices

by Hazem Helmy Ezzat, B.Sc., MBA

Abstract

This application is introduced as the HE Chart, providing a radar-like collective view over a vast number of investment instruments and their relative performance at a glance. The HE Chart works for any number of listed investment instruments, with its environment being any market and/or collection of markets, as per user requirements. Instead of single chart view per investment instrument, the specific investment instrument chart is transformed into one column with vertical movement of its respective price performance on the HE Chart. Adding a collection of investment instrument charts as columns on the HE Chart provides the radar-like relative performance of these investment instruments. The paper first demonstrates the use of technical analysts' set and then support resistance bands and their incorporation in the HE Chart as targets. With target sets, the HE Chart takes the form of HE Chart-Support Resistance (HE Chart SR), specifically useful to technical analysts. Without targets it takes the form of HE Chart Prices, useful for the

masses. Though practically speaking, the HE Chart could represent a paradigm shift in how information is viewed and processed, the conclusion emphasizes how it could trigger future research ideas capitalizing on the HE Chart capacities.

Introduction

When performing support resistance analysis, technical analysts are faced with two main tasks. First, the task of doing the analysis (finding the support and resistance levels) for the investment instruments they are following. Second, the task of following the investment instruments analyzed and their performance relative to the support and resistance lines indicated. It can be a real challenge following the charts on day-to-day basis and, in some cases, on a minute-by-minute or even real-time basis. One of the solutions is to follow the classic approach of tabulating the analysis of different investment instruments to follow all of them at once, and linking the prices to a real-time feed, as per Table 1.

Table 1: Last Price of Investment Instruments and Respective Support Resistance Levels

Investment Instrument	Last Price	1st Support	2nd Support	1st Resistance	2nd Resistance
Stock1	47.11	44.42	45.98	47.19	48.71
Stock2	46.32	43.56	45.19	46.15	47.28
Stock 3	8.70	6.90	6.40	8.40	9.80
Stock 4	18.00	21.60	17.60	25.00	27.60
Stock 5	12.30	8.30	7.50	9.90	11.00
Stock 6	34.00	43.50	40.00	48.00	50.00
Stock 7	135.00	185.00	165.00	215.00	237.00
Stock 8	19.80	21.50	18.90	24.50	27.70
Stock 9	20.95	21.30	19.00	24.70	26.30
Stock 10	2.11	1.50	1.25	1.75	2.00
Stock 11	10.00	10.00	8.20	11.83	14.50
Stock 12	9.51	8.00	6.90	9.50	11.50
Stock 13	30.5	31.50	28.00	35.50	40.00
Stock 14	34.00	24.00	20.80	28.00	31.00
Stock 15	15.00	10.00	8.00	12.00	14.00
Stock 16	1.10	1.50	1.30	1.75	1.90
Commodity 1	47.11	41.33	44.42	45.98	48.71
Commodity 2	51.97	44.68	48.87	52.11	55.79
Commodity 3	13.20	11.50	10.50	12.75	13.75
Commodity 4	4.50	3.50	3.20	3.80	4.30
Commodity 5	36.90	29.00	27.00	32.50	35.30
Index1	10467.5	10,056.88	10,432.54	10,560.37	10,870.80
Index2	1,542.63	1,395.23	1,459.50	1,504.21	1,552.65
Index 3	200.50	197.00	187.00	210.00	216.00
Index 4	34.50	32.50	29.50	34.50	37.00
Index 5	9.90	6.80	6.30	8.00	8.30
Composite 1	5.85	9.25	8.50	9.80	11.00
Composite 2	45.90	55.00	48.00	62.00	74.00
Composite 3	5.68	7.00	6.00	7.30	8.40
Composite 4	5.50	3.70	3.30	4.50	4.90
Composite 5	19.20	16.70	15.00	18.00	19.30

True, it does give an overview, but it clearly lacks the visual effect of allowing one to follow what is happening in the absence of clear relative performance of the population being followed.

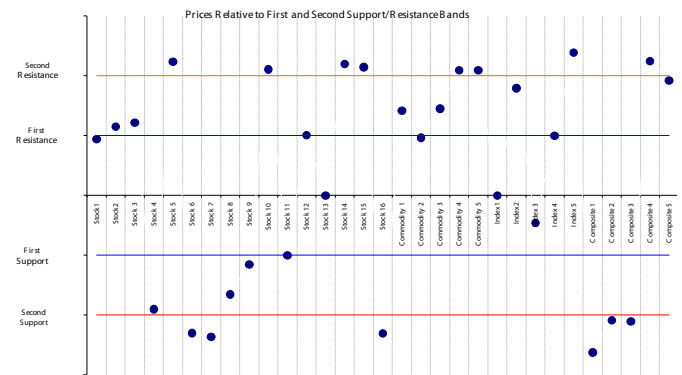
What is offered here is a step further than the classic approach of tabulation, to act as a paradigm shift for actually transforming the table into a picture (i.e., chart) and have it graphically represent real-time snapshots in the HE Chart-Support Resistance (HE Chart SR).

This chart takes a table to a different level, to monitoring all investment instruments followed on a single chart. The HE Chart SR introduced offers a radar-like view. Using the investment instrument information tabulated above, the HE Chart SR demonstrates how such a promise is realized.

Chart 1 is an example of the HE Chart SR. It basically shows a collection of investment instruments followed and their respective first and second resistance bands. This gives a live (provided there is a real-time price feed) graphical representation of the movement of each of the investment prices relative to their support and resistance lines, and relative to each other.

The HE Chart SR is a dynamic radar-like chart that incorporates all price movements of several investment instruments (31 in Chart 1) and their respective vicinities to their support and resistance levels, at one glance.

Chart 1: HE Chart-Support Resistance

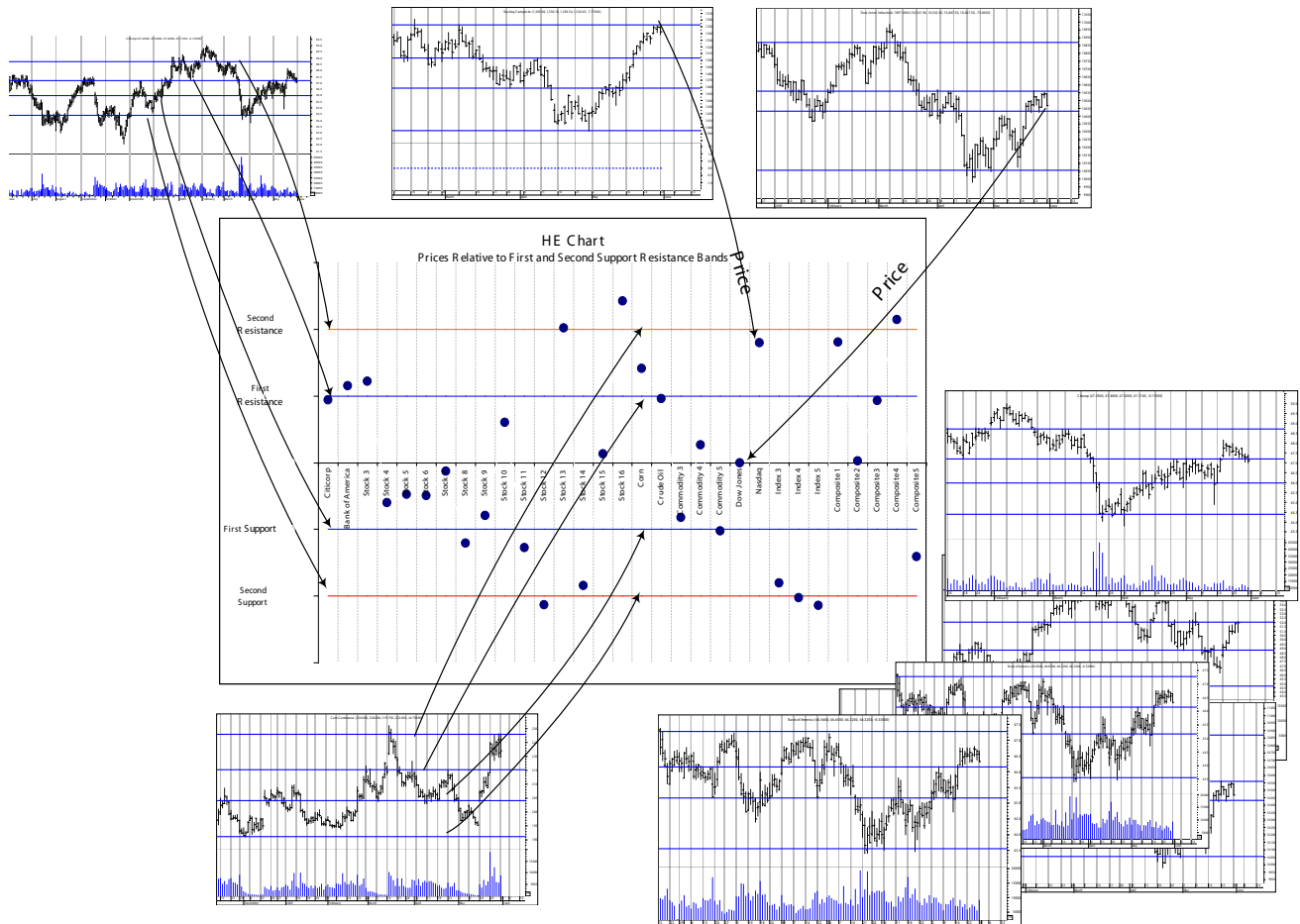


Notion Behind the HE Chart SR

Chart 2 dwells further on the HE Chart SR. It clearly outlays the fact that technical analysis is constructed on several investment instruments. The outcome of each of the charts is then filtered in the HE Chart SR.

In Chart 2, all the support and resistance lines for individual instruments are mapped on the HE Chart SR. This is possible through normalizing all the support and resistance levels for the instruments. The price of each investment instrument is then plotted relative to the respective support and resistance levels identified.

Chart 2: Illustration of How Many Different Charts Are Fitted in the HE Chart Support Resistance



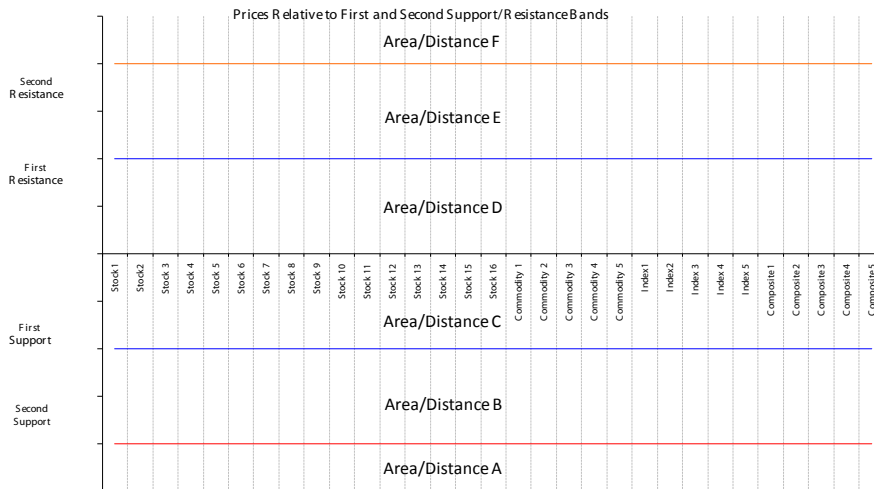
It now becomes clear that the HE Chart SR shows an overall radar-like graphical overview of how the investment instruments are performing according to the user's technical analysis.

Methodology

The methodology of the HE Chart is based on the normalization of the last price and the two support resistance bands for each of the investment instruments. As explained in Chart 3, the prerequisite is that the resistance and support levels for each of the individual investment instruments are set by the technical analyst himself beforehand.

The HE Chart is broken down into six different areas defining six respective distances, including Areas/Distances A, B, C, D, E, and F. Depending on where the last price falls on the chart, a different formula is used for normalization calculation so that the respective last price can be plot on the HE Chart SR.

Chart 3: HE Chart-Support Resistance



Area A: This is the area below the second support level. The formula for last price plot on the HE Chart SR is as follows:

$$2 * 2^{nd} \text{ Support} - \text{Price} * \frac{-2}{2^{nd} \text{ Support}}$$

Area B: This is when the last price is between the second support level and the first support level. The HE Chart SR plot calculation is as follows:

$$((\text{Price} - 1^{st} \text{ Support Level}) / \text{Distance B}) - 1$$

Area C: This is when the price falls between the first support level and the midpoint between the first support and first resistance levels. The HE Chart SR plot value is driven using the following formula:

$$(\text{Price} - (1^{st} \text{ Support Level} + 1^{st} \text{ Resistance Level}) / 2) \text{ distance C}$$

Area D: This is when the price falls in the area above the midpoint level between the first support level and the first resistance level. The HE Chart SR plot value is calculated as follows:

$$(\text{Price} - (1^{st} \text{ Support Level} + 1^{st} \text{ Resistance Level}) / 2) \text{ distance D}$$

Area E: This is when the price falls within the first resistance and second resistance levels. The respective HE Chart SR plot value is as follows:

$$(\text{Price} - 2^{nd} \text{ Resistance Level}) / \text{distance E} + 2$$

Area F: This is when the price breaks the second resistance level. The HE Chart SR plot value would be as follows:

$$(\text{Price} * 2) / 2^{nd} \text{ Resistance}$$

Normalization of the Support Resistance Bands

For the construction of the HE Chart, all the support resistance bands for all the investment instruments followed are normalized and unified at the set values below:

HE Chart SR Normalization

Level	Value
2 nd Support	-2
1 st Support	-1
1 st Resistance	1
2 nd Resistance	2

In short, for constructing the HE Chart SR, the support resistance bands are unified and fixed to preset values. This allows for the transformation of specific support resistance bands to the unified HE Chart SR's support resistance bands. As for the last price of individual investment instruments, this is mathematically treated to transform to the HE Chart relative to its own support resistance bands and in accordance with the HE Chart unified support resistance bands.

Numerical Example

The HE Chart SR presented above was compiled from the investment instruments tabulated above in the Introduction. For the purpose of demonstrating how the HE Chart is constructed, six different investment instruments are selected as examples, falling into the six areas defined. These are treated and normalized as per the aforementioned calculations to yield HE Chart SR plot values.

As can be seen in Table 2, all individual investment instruments' support resistance levels are normalized. The respective last price values are also adjusted in accordance with where the last price falls in relation to the support and resistance levels. A clear plot of the examples selected can be followed on the depicted HE Chart SR.

Testing

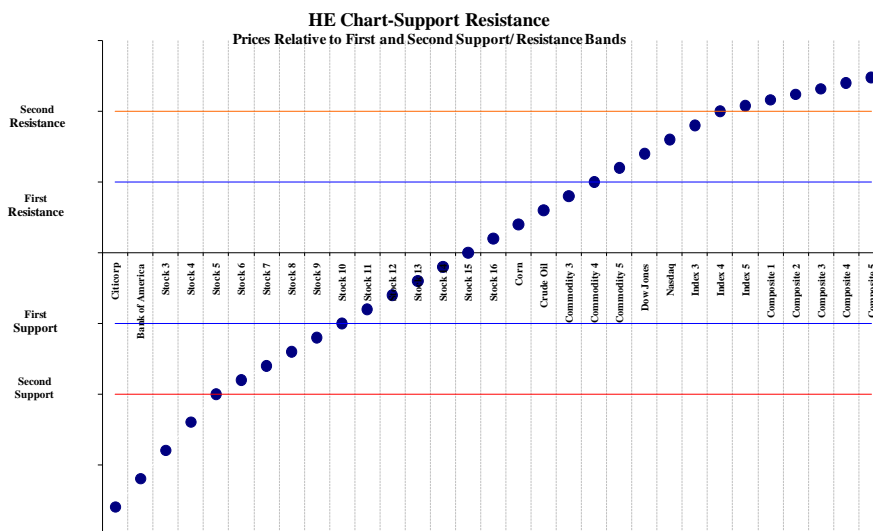
The HE Chart SR uses a set of calculations to normalize the last prices of investment instruments together with their respective support resistance bands. One potential concern with the HE Chart SR is the linearity issue.

Table 2: HE Chart SR Normalization Examples

Investment Instrument	Last Price	1st Support	2nd Support	1st Resistance	2nd Resistance
Area A : Falling below the 2nd support level					
Stock 6	34.00	43.50	40.00	48.00	50.00
HE Chart Plot Values	(2.30)	(1.00)	(2.00)	1.00	2.00
Area B : Falling above 2nd support and below 1st support					
Stock 8	19.80	21.50	18.90	24.50	27.70
HE Chart Plot Values	(1.65)	(1.00)	(2.00)	1.00	2.00
Area C: Falling above 1st support and below 1st support and 1st resistance midpoint					
Index 3	200.50	197.00	187.00	210.00	216.00
HE Chart Plot Values	(0.46)	(1.00)	(2.00)	1.00	2.00
Area D: Falling above 1st support and 1st resistance midpoint and below 1st resistance					
Stock1	47	44	46	47	49
HE Chart Plot Values	0.94	(1.00)	(2.00)	1.00	2.00
Area E: Falling above the 1st resistance and below 2nd resistance					
Commodity 1	47.11	41.33	44.42	45.98	48.71
HE Chart Plot Values	1.41	(1.00)	(2.00)	1.00	2.00
Area F: Falling above the 2nd resistance					
Composite 4	5.50	3.70	3.30	4.50	4.90
HE Chart Plot Values	2.24	(1.00)	(2.00)	1.00	2.00

For the purpose of testing linearity of the HE Chart SR, the resistance and support bands were fixed and the last price was changed with equal increments to see how this would be reflected on the HE Chart SR.

As shown in Chart 4, equal increments in last price values are reflected linearly in perfection on the HE Chart SR, with the exception of prices above the second resistance level and below the second support level. In effect, there is little need for following the stock price outside of these bands. This also indicates that the second support resistance band values would have to be revisited for analysis and value adjustment. Otherwise, Chart 4 delivers on its promise.

Chart 4: HE Chart-Support Resistance

Advantages of the HE Chart

Having the plots of the HE Chart SR and the corresponding support and resistance levels, the chart offers the following advantages:

- Combines a real-time summary of support resistance for numerous different charts into one.
- Eliminates the need to check individual charts (31 above, can be increased as required). True, the user can get alerts when a break happens, but this offers a radar-like view of when breaks or supports are about to happen.
- Offers an overview of the sequence of breaks by individual investment instrument (leadings stocks and the ones expected to follow).
- Forces the user to follow any investment instrument if incorporated in the HE Chart SR.
- Offers indicative signals where the original technical analysis chart has to be revisited for support resistance bands' review.
- Can indicate a collective synergy between support and resistance levels of different instruments. Normalizing the support and resistance levels offers a critique of the range of the support and resistance levels

indicated compared with others.

- Serves as a good management tool, reporting tool from subordinate to superior, and communication tool to investors summarizing stock performance. It is a differentiating tool to be incorporated in research reports for investors, clients, and others.
- Serves as a tool for following portfolios and potential investment.
- Provides timing sentiment of entering or exiting investments.

Additional Programmable Features

The HE Chart SR can be greatly enhanced with the following programmable features:

- Ruler (horizontal line) placed to indicate the data point plot and the respective investment instrument it refers to.
- Sorting capability according to investment instrument type, indexes, country, PE ratio, industry, market cap, etc.
- The user should be able to drag and cluster investment instruments together according to the user's preference.
- The plot data for price can use a simple plot point (colored blue or red according to up or down movement). A shadow can also be introduced to the point plot to indicate the range of movement within the set period (e.g., day, week, month). It can also take other forms such as bar or candlestick according to user preference.
- Detailed information should be presented when mouse is pointed at the data point or investment instrument. Details such as price, high, low, and last price. Double clicking as an example can be made to take the user to the original individual price charts for a closer look or analysis adjustment.
- This can also include information such as distance to and from resistance and support respectively (in percentage and/or price units).
- Play, Fast Forward, Rewind, and Pause. A play function can be used to retrieve the price movements of the investment instruments followed relative to their support/resistance levels over a time period (e.g., day, week, month). This would

help to visually inspect, for example, which investment instruments break first and which follow. A Fast Forward function can speed the movement (e.g., 8X, 12X), and a Pause function can pause the play function for meticulous visual inspection of the HE Chart SR.

Introducing HE Chart Prices

For the less sophisticated investor, and having no support and resistance analysis, the HE Chart SR can be stripped down to a simple HE Chart Prices. The Chart Prices can inherit all the benefits and features of the HE Chart SR. The HE Chart Prices is illustrated briefly in Chart 5.

As shown, the key factor behind the HE Chart Prices is plotting the last price of all investment instruments, in percentage gain or loss. The percentage change indicated on the chart could also be presented in price unit values instead of percentage values for additional information.

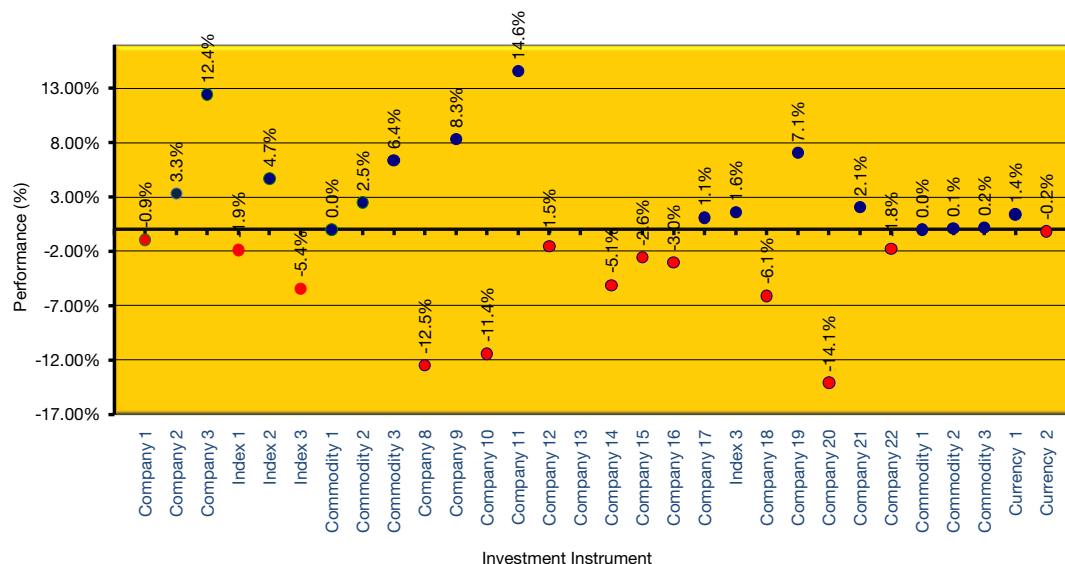
Conclusion

The HE Chart is offered as a paradigm shift in the way prices and technical analysis tools are presented. It has evolved naturally to a simple price quote, ticker tape, and real-time price tabulation. In the HE Chart, efficiency is maximized in a way to view and process information. As to what additional benefits the HE Chart offers, this will become apparent over time. As a possible hint for further research efforts, if a collective view is presented showing how a group of investment instruments approach their respective targets over time, future comparable velocities and acceleration can be calculated as attributes. To clarify, a similar model to CAPM can be derived using the HE Chart and the avenue it opens.

Software and Data

It is to be noted that for experimenting when building the HE Chart, prices were sourced from Bloomberg. Regarding the HE Chart, it is illustrated using Microsoft Excel. For schematics used in explaining the HE Chart in this paper, Microsoft Visio and captions from MetaStock were used.

Chart 5: HE Chart Prices



The Profitability of a Combined Signal Approach: Bollinger Bands and the ADX

by Shawn Lim, CFTe, MSTA, Tilman T. Hisarli, and Ng Shi He

1. Abstract

This article looks at the profitability of a trading rule based on Bollinger bands applied over 1995 to 2012 in six different equity markets using large-cap indices [CAC, DAX, FTSE, HSI, KOSPI, NIKKEI]. In addition, we also explore the performance of a trading strategy based on a combined signal approach with Bollinger band signals filtered using the ADX to avoid trending markets. While the trading strategy based solely on these indicators would underperform a buy-and-hold strategy in most of the markets studied, we find evidence supporting the use of Bollinger bands for tactical trades over short time horizons, as evidenced by return distributions with a strong positive skew. When comparing the performance of Bollinger bands with the strategy augmented by the ADX, we find little performance improvement when applied on a systematic basis as an initial filter. However, the ADX can still act as a useful tool when applied on a discretionary basis to limit losses.

2. Introduction

2.1 Bollinger Bands

Since their introduction by John Bollinger in the 1980s, Bollinger bands have broken into the mainstream of technical analysis and are a widely adopted indicator in the tool kit of technical analysts worldwide. Having evolved from the concept of trading bands, Bollinger was the first to introduce a dynamic approach to the setting of the band width through the incorporation of standard deviation. Since its introduction, a number of academic papers have emerged that test the profitability of this approach with varying results. Lento et al. (2007) find that a trading rule derived based on Bollinger bands cannot consistently outperform a buy-and-hold strategy after adjusting for transaction costs, while Kabasinkas and Macys (2010) suggest that Bollinger bands could be successfully adapted to design a profitable trading strategy in the Baltic markets. In addition, many studies have looked at the possibility of optimizing Bollinger bands, using innovations such as particle swarm optimization [Bulter and Kazakov, 2010] and data mining [Kannan et al., 2010] and have found positive results.

Bollinger bands consist of a set of three curves drawn in relation to the price of a security. The middle line is a measure of the trend and is often drawn using a simple or exponential moving average. Oleksiv (2008) studied the statistical properties of Bollinger bands and concluded that the simple moving average (SMA) was most representative; this is the approach that has been adopted in this study. The N -day Simple Moving Average at time t is the mean of the prices of the past N days and is calculated as follows:

$$SMA_N(t) = \frac{\sum_{i=t-N+1}^t P(i)}{N}$$

The width of the Bollinger band envelopes are determined by the standard deviation in the preceding period, and the N -day Bollinger bands with k standard deviations at time t is defined as:

Upper Band:

$$BB_N^{\text{high}}(t) = SMA_N(t) + k \times \sqrt{\frac{\sum_{i=t-N+1}^t [P(i) - SMA_N(i)]^2}{N}}$$

Lower Band:

$$BB_N^{\text{low}}(t) = SMA_N(t) - k \times \sqrt{\frac{\sum_{i=t-N+1}^t [P(i) - SMA_N(i)]^2}{N}}$$

Where N and k are chosen parameters that determine the time period for which the bands are calculated and the distance of the band from the moving average. Bollinger (2001) proposes a set of parameters based on the length of time studied, and we adopt one of the proposed combinations [$N=20$ and $k=2$] in this study, as it is the specification most commonly employed and hence likely to be of most interest to practitioners.

2.2 Average Directional Indicator (ADX)

The Average Directional Indicator (ADX) was introduced by Welles Wilder [Wilder, 1978] as a means of measuring trend strength without regard to trend direction. Although initially developed before the computer age, the indicator has stood the test of time and is still widely employed by technical analysts. The indicator is bounded between 0 and 100, and if the indicator moves above 30 it is generally indicative of a trending market. We adopt the time specifications proposed by Welles Wilder, and the calculated values for the ADX were extracted from Bloomberg for this study.

One of the principal criticisms of trading bands in general is the tendency to get whipsawed in trending markets. As contrarian indicators that rely on reverting back to the moving average, this can generate very unprofitable trades if a short position is initiated in an upward trending market or a long position is initiated in a downward trending one. Hence, one commonly suggested improvement is to combine these tools with a tool that can screen for a situation where the market is trending, thus preventing the initiation of such unprofitable trades. The ADX, as a directionless indicator of trend strength, is an often used and attractive candidate for such a screen. Hence, for the second part of the study, we evaluate whether the inclusion of the ADX as an additional screen prior to the

initiation of a trade can improve the performance of Bollinger bands, and we compare the results with the original strategy.

3. The Performance of Trading Strategies

3.1 Bollinger Bands

For the first strategy based only on Bollinger bands, we use only the closing prices (P_N) to determine when to enter a trade. The trading rules are as follows:

Long position signal:

If $P_N(t-1) < BB_N^{low}(t-1)$ and $P_N(t) > BB_N^{low}(t)$, long position initiated on next day opening.

When $P_N(t) > SMA_N(t)$, long position closed on next day opening.

Short position signal:

If $P_N(t-1) > BB_N^{high}(t-1)$ and $P_N(t) < BB_N^{low}(t)$, short position initiated on next day opening.

When $P_N(t) < SMA_N(t)$, short position closed on next day opening.

In other words, a signal for a long position is generated whenever the closing price crosses the lower band from below, and a signal for a short position is generated whenever the closing price crosses the upper band from above. Figure 1 provides a graphical illustration for the trading strategy.

3.2 Bollinger Bands + ADX

For the second strategy based only on Bollinger bands and the ADX, we use both the closing prices (P_N) and the ADX to determine when to enter a trade. The trading rules are defined as follows:

Long position signal:

If $P_N(t-1) < BB_N^{low}(t-1)$ and $P_N(t) > BB_N^{low}(t)$, and $ADX < 30$, long position initiated on next day opening.

When $P_N(t) > SMA_N(t)$, long position closed on next day opening.

Short position signal:

If $P_N(t-1) > BB_N^{high}(t-1)$ and $P_N(t) < BB_N^{low}(t)$, and $ADX < 30$, short position initiated on next day opening.

When $P_N(t) < SMA_N(t)$, short position closed on next day opening.

In other words, a signal for a long position is generated whenever the closing price crosses the lower band from below if the market is not trending ($ADX < 30$), and a signal for a short position is generated whenever the closing price crosses the upper band from above if the market is not trending ($ADX < 30$). Figure 2 provides a graphical illustration for the trading strategy.

Figure 1: Illustration of Strategy (Bollinger Bands)

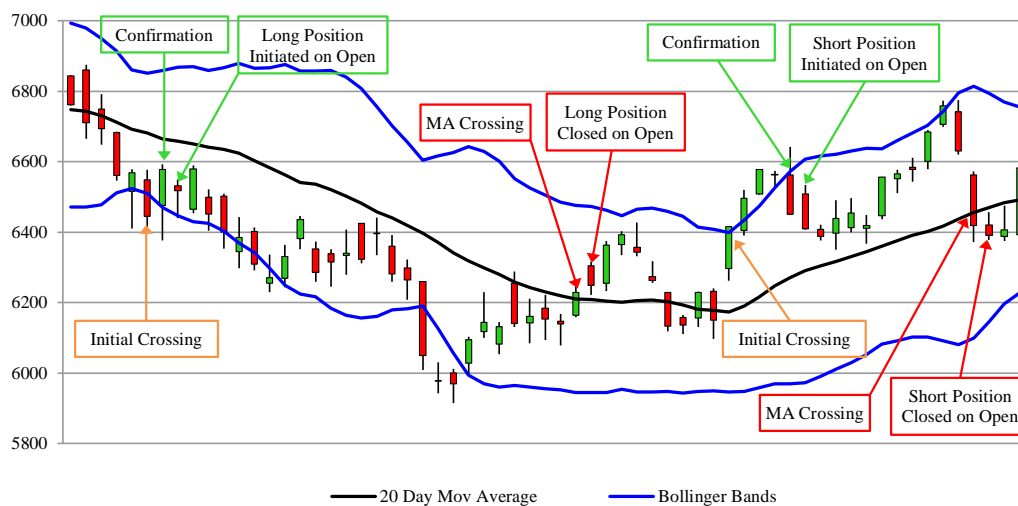
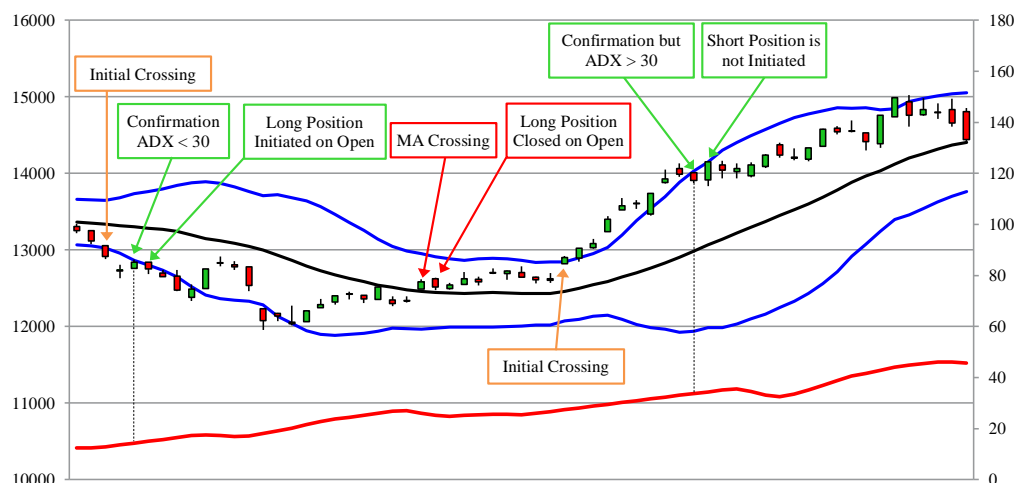


Figure 2: Illustration of Strategy (Bollinger Bands + ADX)



3.3 Return Calculation

Table 1 provides an example of how returns were calculated for this study. The signals used to trigger a buy or sell signal would be based on the closing prices, while the returns would be calculated based on the opening prices of the next day. This represents a strategy in which decisions are made before the next day, and trades will then be entered at the first available opportunity, assumed to be the next day's opening price.

Long position

For the long position, the signal to enter the trade is triggered on day 4 while the signal to exit the trade is triggered on day 6. For a long position, the return of the trade is calculated by dividing the index value when the trade is closed by the initial value when the trade is opened:

$$\text{Profit from Long Position} = \frac{\text{Open Price (Day 7)}}{\text{Open Price (Day 5)}} = \frac{120}{100} = 20\%$$

Short position

For the short position, the signal to enter the trade is triggered on day 10 while the signal to exit the trade is triggered on day 11. For a short position, the return of the trade is calculated by dividing the index value when the trade is opened by the final value when the trade is closed:

$$\text{Profit from Short Position} = \frac{\text{Open Price (Day 11)}}{\text{Open Price (Day 12)}} = \frac{129}{120} = 7.5\%$$

4. Results

4.1 Data

The data for this study were extracted from Bloomberg for six equity markets for the period January 1995 to September 2012. Figure 3 presents the performance of these equity markets over the time period for this study.

4.2 Predictive Ability

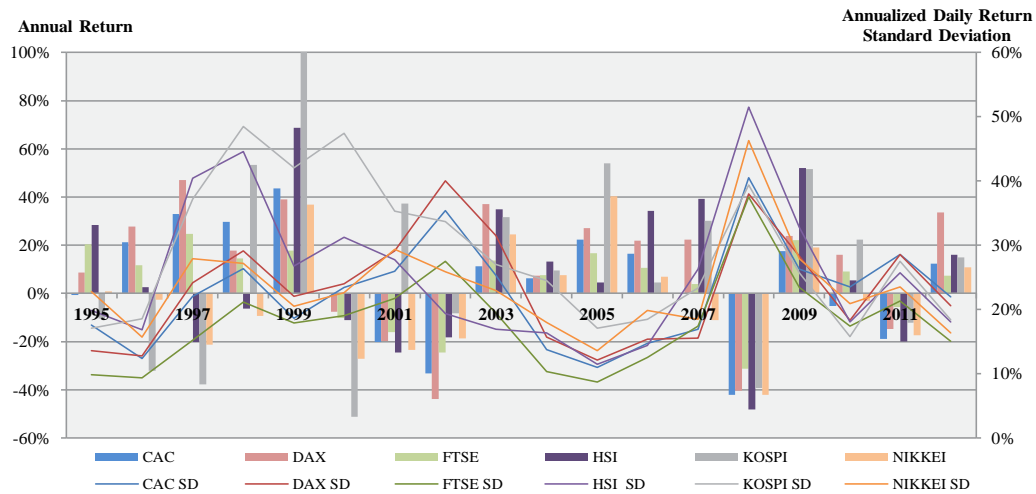
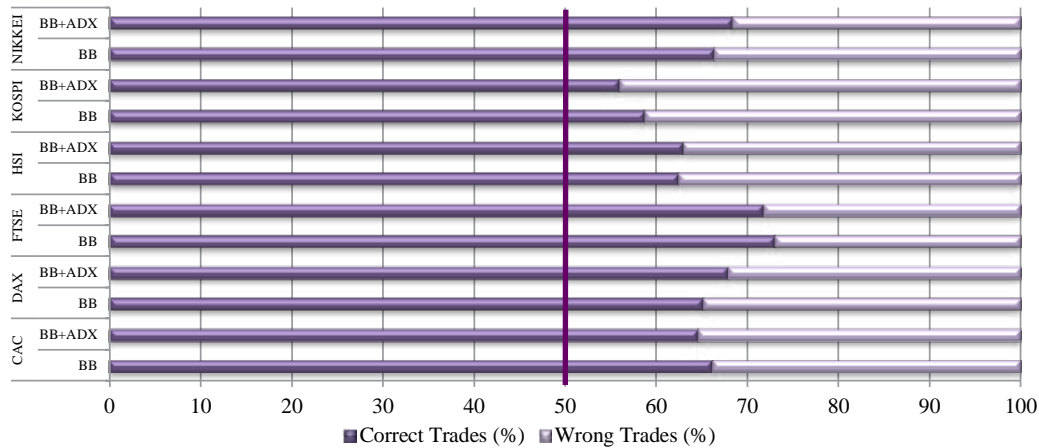
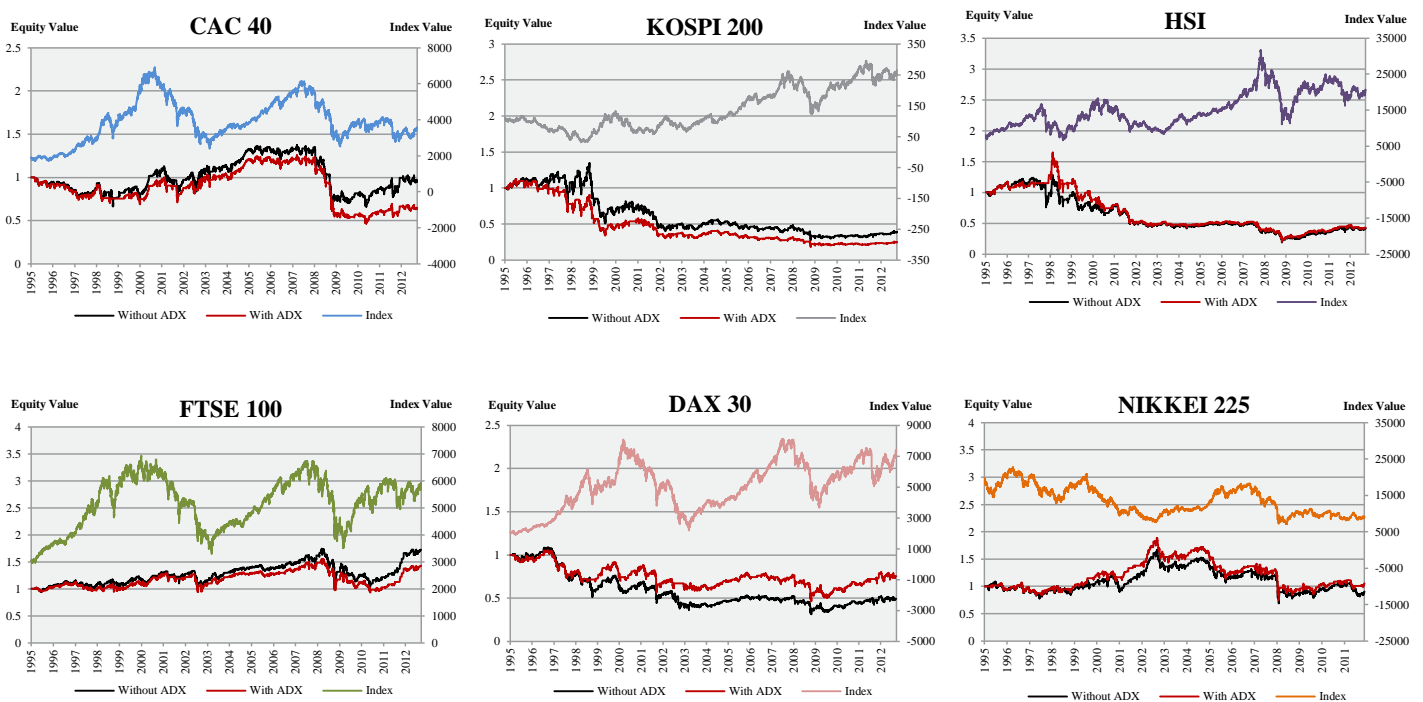
Figure 4 presents the performance of the strategy, with a correct trade defined as any trade that has a positive return. From the results we can see that the strategy generally resulted in trades that were profitable, with more than 60% of the trades being positive in most markets. The strategy augmented by the ADX does not consistently improve the results, with only three of the six markets showing improvements in the percentage of correct trades.

4.3 Equity Line

Figure 5 plots the value of \$1 invested in the various strategies at inception against the values of the market index. When compared with a buy-and-hold strategy, the trading strategies based on Bollinger bands tend to underperform the market. In addition, the augmented strategy only outperforms the strategy without the ADX in three of the six markets (DAX, HSI, NIKKEI). However, we contend that a buy-and-hold strategy is the wrong benchmark for comparison, as a strategy based on Bollinger bands would only exploit short-term market dislocations and thus not be invested for long periods of time. In particular, for stable and strongly trending markets, we would expect the Bollinger band to result in few profitable signals, and this has characterized the markets for a large part of the study period. Therefore, to evaluate the effectiveness of the strategy, we should look instead at whether the signals generated tend to result in profitable trades, which is what we explore in the next section of this article.

Table 1: Example of Calculation of Returns

	Open	Close	Moving Average	Upper Band	Lower Band	Signal
Day 1	105	98	123	142	104	
Day 2	100	97	120	140	100	Initial Crossing
Day 3	99	95	117	136	98	
Day 4	96	103	118	135	101	Confirmation
Day 5	100	108	115	130	100	Long Initiated
Day 6	115	120	117	140	94	Closing Signal
Day 7	120	130	120	135	105	Long Closed
Day 8	135	143	123	140	106	Initial Crossing
Day 9	140	145	124	141	107	
Day 10	135	134	127	139	115	Confirmation
Day 11	129	125	128	140	116	Closing Signal, Short Initiated
Day 12	120	121	126	138	114	Short Closed

Figure 3: Performance of the Six Equity Indices from January 1995 to September 2012**Figure 4: Performance of Both Strategies in Each Equity Market****Figure 5: Value of \$1 Invested in Both Strategies for the Six Equity Indices from January 1995 to September 2012**

4.4 Performance Breakdown

Table 2 shows the breakdown of performance for the different strategies. The results show that, on average, both strategies generated significantly more correct trades than wrong trades, a strong piece of evidence in support of the effectiveness of signals generated from Bollinger bands. However, the average return for all the strategies is very small and close to zero. If we look at the average returns, the reason for that becomes clear. Even though there tends to be more profitable than unprofitable trades, the average return for correct trades (~2% to 3%) tends to be a lot smaller than the average loss for wrong trades (~4% to 5%).

Next, trading strategies constructed based on Bollinger bands tend to be invested for less than 50% of the period under study. This tendency to remain out of the market, which originates from the strategy's predisposition to detect only extreme price movements, is also one of the key reasons for its underperformance relative to a buy-and-hold approach.

Finally, looking at the difference between the two strategies employed in this study, we see that the ADX indicator filtered out 11% of the trades on average. When we compare the returns between the augmented and normal strategy, we see very

limited improvement when we use the ADX as an initial filter. In particular, when we look at the left tail, none of the worst trades were prevented by the inclusion of the ADX as an initial filter.

4.5 Return Distribution

Figure 6 plots the distribution of the returns from trades based on the two different strategies. The return distribution, when compared with a normal distribution, exhibits a distinctive positive skew in all of the markets. However, there also tends to be a significant portion of the results concentrated in the left tail, which is a likely reason for the large drag on performance and average near-zero return for many of the markets. When comparing the results with the strategy augmented by the ADX, we see that the augmented strategy does a poor job in reducing the size of the left tail in most of the markets, with the exception of the Japanese market, where it performs fairly well.

4.6 Why Does the ADX Fail?

When we look at the price series closely, part of the reason why the ADX might fail as an effective initial screen becomes apparent. Figure 7 plots the return series of the worst trade in our data set that occurred in the KOSPI 200 and resulted in a

Table 2: Breakdown of Performance for the Six Equity Indices

	CAC 40		DAX 30		FTSE 100	
	BB	BB+ADX	BB	BB+ADX	BB	BB+ADX
Average Return (%)	0.08	-0.06	-0.30	-0.07	0.35	0.27
Correct Trades (%)	66.1	64.5	65.1	67.8	72.9	71.7
Wrong Trades (%)	33.9	35.5	34.9	32.2	27.1	28.3
Average Return for Correct Trades (%)	2.31	2.25	2.24	2.23	1.74	1.76
Average Return for Wrong Trades (%)	-4.27	-4.25	-5.03	-4.92	-3.39	-3.51
Best Trade (%)	11.63	11.63	9.02	9.02	8.34	8.34
Worst Trade (%)	-19.09	-19.09	-19.58	-19.58	-21.2	-21.2
Average Length of Trades (Days)	13	13	15	14	12	12
Time Invested (%)	49	44	55	46	50	46
Number of Trades	171	155	166	149	188	173
Trades filtered out (%)	9.4		10.2		8.0	
	NIKKEI 225		HSI		KOSPI 200	
	BB	BB+ADX	BB	BB+ADX	BB	BB+ADX
Average Return (%)	0.05	0.14	-0.33	-0.38	-0.40	-0.79
Correct Trades (%)	66.3	68.3	62.4	62.9	58.7	55.9
Wrong Trades (%)	33.7	31.7	37.6	37.1	41.3	44.1
Average Return for Correct Trades (%)	2.44	2.36	2.83	2.71	3.20	3.13
Average Return for Wrong Trades (%)	-4.66	-4.63	-5.58	-5.63	-5.50	-5.75
Best Trade (%)	7.10	7.10	17.72	17.72	14.43	13.84
Worst Trade (%)	-26.4	-26.4	-32.18	-32.18	-34.4	-34.4
Average Length of Trades (Days)	13	13	14	14	13	14
Time Invested (%)	49	42	53	46	47	45
Number of Trades	163	142	165	143	166	145
Trades filtered out (%)	12.9		13.3		12.7	

loss of 34.4%. When we look at the ADX at trade initiation we observe a low ADX level, which trends higher as the trade continues. This highlights a limitation of the use of the ADX as an initial signal filter: while signals generated in markets that have been trending for some time will be filtered out, signals generated in markets that are beginning to trend will not. To make things worse, these loss-making positions are likely to remain open for a significant duration as the price series remains above (for a short position) or below (for a long position) the moving average until the trend begins to correct. Incorporating information from Wilder's Directional Movement System to take into account both trend strength and direction might be a way to address this limitation of the ADX and improve its performance as an initial signal filter.

There are two additional ways to augment this strategy to incorporate information from the ADX and improve return performance. First, while the ADX proved ineffective as a systematic initial screen, it still contains useful information that could contribute to the implementation of a stop-loss strategy. The return distributions from the two trading strategies based on Bollinger bands exhibit a strong positive skew but a very large left tail that reduced the average returns significantly. Hence, an additional monitor to decide when to exit a trade and cut losses could be effective in improving the performance of these strategies. This could be implemented via a systematic approach where a trade is exited once the ADX crosses

Figure 6: Return Distribution of Both Strategies for the Six Equity Indices

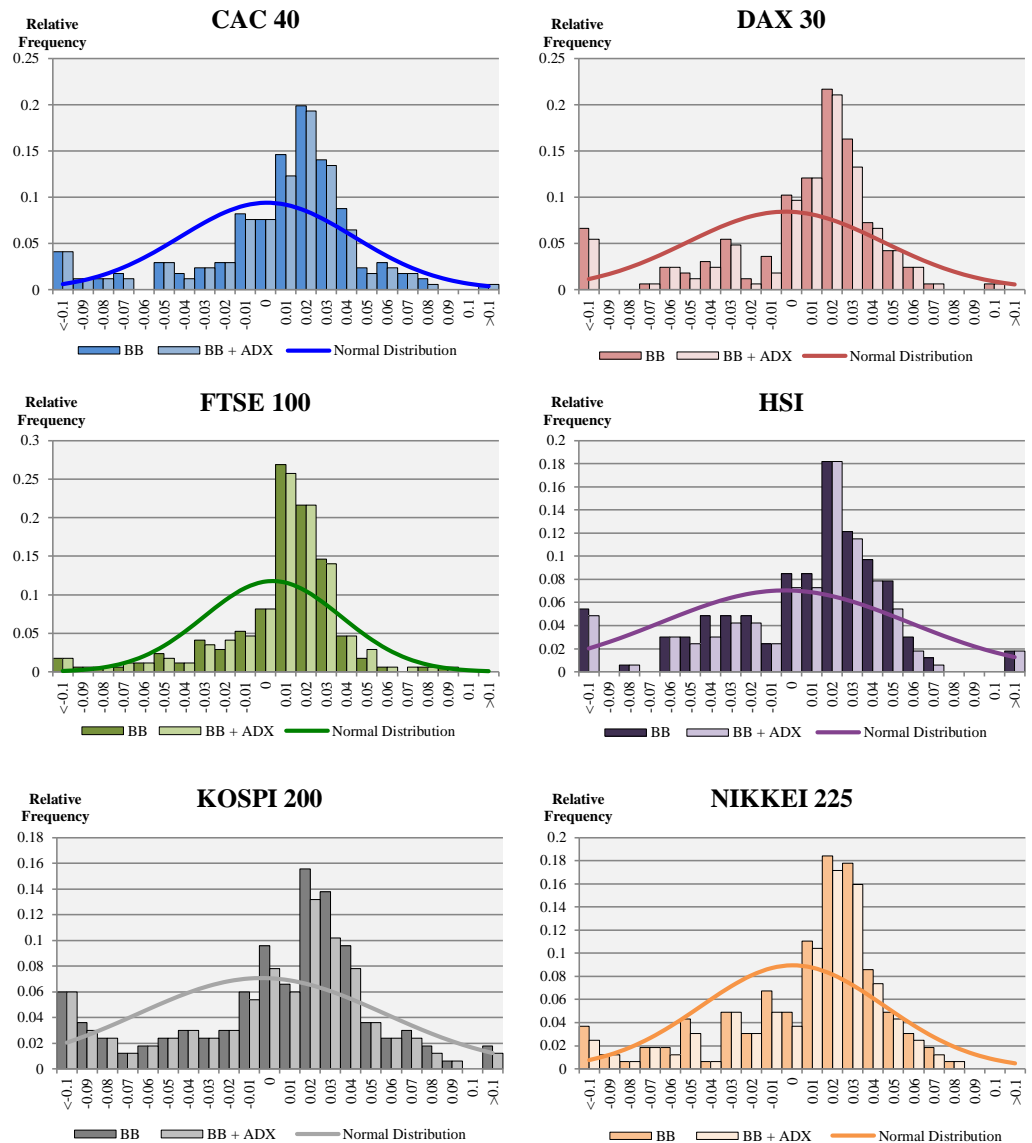
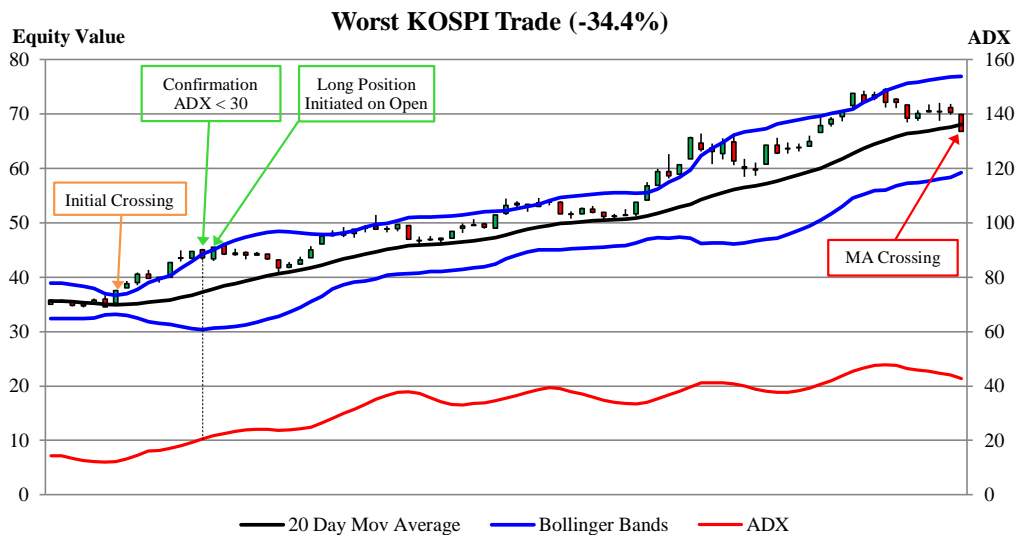


Figure 7: Price Series of the Worst Trade



30 or by using the ADX as a discretionary input in that decision-making process. Next, the ADX that we used for our study was for a similar timeframe as the moving average and Bollinger bands. A possible extension would be to calculate the indicator over a longer time period to detect markets that are in a strong intermediate trend, so as to exploit short-term fluctuations away from the trend that might be picked up with Bollinger bands.

5. Conclusion

While the performance of a trading strategy based solely on Bollinger bands tends to underperform a buy-and-hold strategy, the positive skew of the return distribution suggests that Bollinger bands still can play an effective role in implementing tactical trades to exploit short-term fluctuations. In particular, combining a trading strategy based on Bollinger bands with a stop-loss rule is likely to improve the performance of the overall strategy and limit the magnitude of the left tail, which places a large drag on overall performance. We investigated the use of the ADX as an initial systematic filter but found little evidence of improved performance. However, the ADX could still be effective if used as a discretionary input or combined to create a systematic stop-loss strategy, and further study is needed to evaluate its effectiveness in such a context.

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The Volume Divergence Indicator (VDI) for the Detection of Divergences Between Stock Prices and the On Balance Volume

by Christopher Krause, CFTe, MFTA

Abstract

Although divergences between stock prices and volumes are not primary trading signals, they are recognized as important warning signals for decreasing trend strength and possible trend changes.

This paper will introduce the Volume Divergence Indicator (VDI), a tool for the detection of divergences between the price development of a stock and the On Balance Volume (OBV). It is the aim to develop an algorithm that can be used as a warning signal and can be included in market scanner and trading systems.

The algorithm of the VDI is derived from the steps of a manual divergence analysis: the adaption of the scale of the OBV to the price scale, the determination of trendlines, and the rating of divergences by one single value.

Introduction

Divergence analyses in general are, until now, a manual, subjective, and laborious matter, as divergences can only be detected by comparing two chart developments. The weakness of this manual method is the fact that the result of this comparison cannot be quantified. An indicator, which is able to rate divergences automatically, would make a manual analysis more efficient or perhaps even redundant. Divergences could be indicated by the value of this single indicator, which also could be integrated in market scanner or automatic trading systems.

The concept of the Volume Divergence Indicator (VDI) is a first step in developing such an indicator for the rating of divergences. The following three major questions will be answered in the next chapters:

- How can two different scales be adapted to each other?
- How can necessary trendlines be determined automatically?
- How can divergences be rated mathematically?

Even if the introduced algorithm is applied to divergences between stocks and the On Balance Volume, it could be transmitted to the combination of other data series, too.

Basics

Divergences have always been important in modern technical analysis, especially in volume analysis, since divergences between the price development and the volume development are an early indicator for possible trend reversals or corrections.

In general, the volume should increase in the direction of the established trend. If this is not the case, it can be seen as an early warning signal for decreasing trend strength. One of the most well known and therefore most used volume indicators is

the On Balance Volume (OBV), which is an excellent indicator for the recognition of volume divergences.

If one price tops the price of the previous bar, the volume of the bar is assumed to be the value of OBV. Conversely, in the case of a price situated below the previous price, the value of the OBV is reduced by the volume. This calculation leads to a strong correlation between OBV and the stock prices. This makes the OBV a suitable indicator to detect divergences between the volume and price development, even with some weaknesses, which are discussed in detail in corresponding literature.

A divergence exists if two usually highly correlated data series develop a considerable difference. Divergences can be subdivided into two types: bullish and bearish.

Bullish divergences exist if the price cannot draw a higher high (or low) on the contrary to the indicator, which makes a higher high (or low). Bearish divergences exist if the price reaches a new local high (or low), but the indicator is not able to top the previous high (or low).

Identifying divergences has been a manual and subjective matter so far, because there has been no general accepted algorithm to rate divergences. This can be changed by the introduction of the VDI, which is able to detect divergences between the price development and the OBV.

A good example for a bearish divergence between the development of the volume, represented by the OBV, and the prices is the JPMorgan stock in spring 2013 (see Chart 1). This example is being used in all charts that follow.

Chart 1: The stock of JPMorgan and the On Balance Volume Indicator. This chart section is the basis for all the charts that follow.

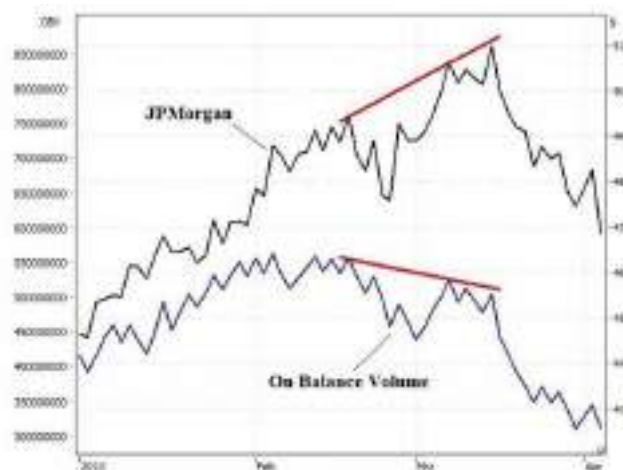


Chart 1 shows a good illustration of how divergences are detected manually. The scale of the OBV is adjusted to the price level of the stock to allow a comparison between both

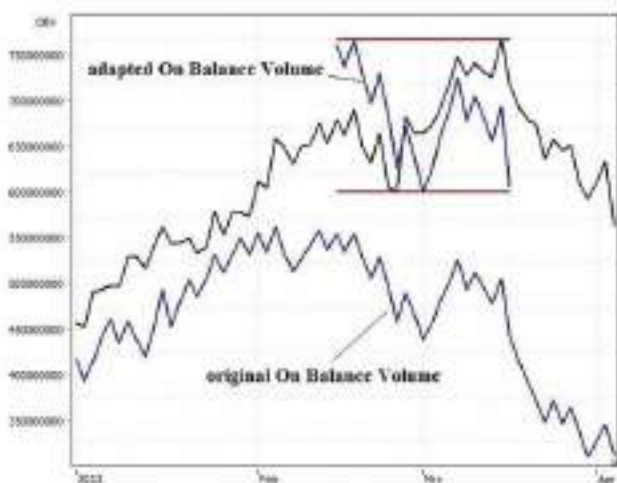
developments. The divergent developments of both graphs are usually visualized by trendlines (red); the different slopes of these trendlines are the crucial criterion for a divergence. The development and the algorithm of VDI are derived from this manual procedure and can be split into three major steps, which are described in the following chapters.

- Adjustment of the On Balance Volume scale
- Determination of trendlines
- Calculation of the Volume Divergence Indicator

Adjustment of the On Balance Volume Scale

The first step in facilitating an automatic determination of divergences is the adjustment of the scale. The stock prices usually move in a small positive range; the OBV can reach values of some million pieces, either positive or negative. To allow a comparison of the development of the stock and the OBV, the OBV has to be modified. Therefore, both extreme values over a defined period (called scaling period) of the OBV are equaled to the respective trading range of the stock. The necessary tool for this is a scaling function, which adjusts the OBV to the stock price level. For clarification, Chart 2 shows the same divergence of Chart 1 with an exemplary section of the adapted On Balance Volume (\widetilde{OBV}).

Chart 2: The adapted On Balance Volume over a period of 20 bars overlapping the stock prices. The same price level is a precondition for further calculations.



You see that the high and low within the chosen section of 20 bars of the OBV are adjusted to the highest and the lowest prices within this section. In normal use, the adapted OBV is not drawn separately, but is integrated in all further calculations. Also, the trendlines, which are considered in the next chapter, are drawn on the adapted OBV. The original values of the OBV are not used in any calculation.

Determination of Trendlines

As shown in Chart 1, trendlines in both chart developments are the preferred tool for the visualizing divergences. The calculation of the VDI is based on trendlines, too. Thus, the second step is the objective determination of trendlines.

The calculation refers to a certain analysis period consisting of several numbers of prices, which determine the drawing of the trendline. The chosen analysis period in the shown charts and examples is 20 daily bars.

A line, and with it a trendline, is the direct connection between two points. In this case, the points are the single closing prices. The key for the automatic determination of the trendlines lies in the consideration of all possible lines, which are determined by possible price combinations. An analysis period of 20 bars contains 190 price combinations and possibilities to draw a line through two prices within the chosen period. (The combinations refer to the combination of $n=20$ things taken $k=2$ at a time without repetitions).

Every chart has two trendlines for a chosen period—one above and one below the values. Both trendlines have to fulfill two compulsory conditions, which define them as a trendline.

Condition one: *The trendline is not crossed by any value.*

This means that all prices lie above or below the trendline, but of course at least two prices lie on the trendline—the two tangential prices—which determine the position of the trendline.

But condition one for itself does not define trendlines sufficiently, because there can be a few upper and lower trendlines that fulfill this criterion. Therefore, a second condition is necessary.

Condition two: *The trendline is the line fulfilling condition one with the lowest accumulated absolute deviation to the values.*

This additional criterion assures that the trendline is the most representative one. Chart 3 visualizes the determination of trendlines:

Chart 3: The visualization of all 190 possible lines, which are drawn through two prices within the period of 20 days. The two red lines are the trendlines.

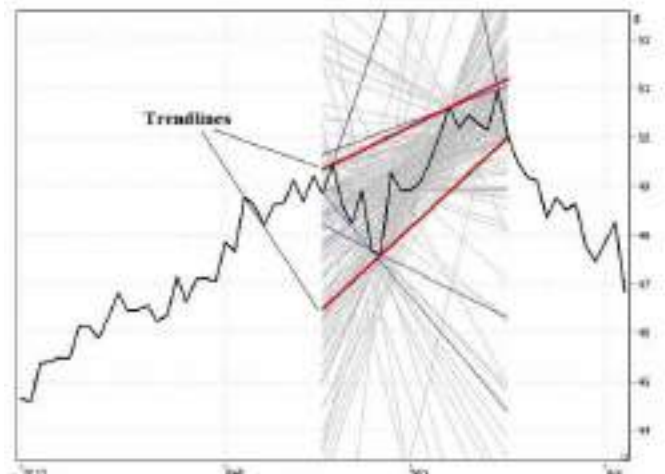


Chart 3 shows again the price development of the JPMorgan stock. The two red lines are the trendlines. The blue lines are the lines that fulfill the first criterion for a trendline but are less representative and therefore, are not a trendline. The other 183 grey lines represent one possible price combination, respectively. The high number of calculations, which are reasonably necessary, can be done very quickly by modern computer technology.

Calculation of the Volume Divergence Indicator

The two former steps allow the determination of both trendlines in price development and both trendlines of the adjusted OBV.

The next question is how divergences can be rated mathematically. The crucial factor for the calculations is the various trendlines. Divergences are characterized by different slopes of the trendlines. In general, there are two types of divergences: positive (bullish) and negative (bearish). Positive divergences are characterized by the fact that the trendline of the indicator—in this case the OBV—increases more strongly than the accompanying stock trendline, which could be interpreted as an early signal for increasing stock prices. The opponent case of a negative divergence is defined by a larger decrease of the indicator trendline compared with the stock trendline. This relation is valid for upper as well as lower trendlines. Thus, divergences can be quantified by the difference between the slope of the indicator trendlines and the slope of the stock trendlines. The equation for the VDI is as follows:

$$VDI = \frac{m_{OBV}^{ul} + m_{OBV}^{ld} - m_c^{ul} - m_c^{ld}}{2 * \bar{c}} * 100$$

m_c^{ul} : slope of the upper stock trendline.

m_c^{ld} : slope of the lower stock trendline.

m_{OBV}^{ul} : slope of the upper trendline of the adapted OBV.

m_{OBV}^{ld} : slope of the lower trendline of the adapted OBV.

\bar{c} : average stock price during the analysis period.

The value of the VDI oscillates in range around zero; bullish divergences are indicated by a positive value and bearish ones by a negative value. The higher the absolute value, the stronger the divergence. Unfortunately, there is no valid general value that has to be reached to indicate a divergence, since the amplitude of the VDI depends on the analysis period and the volatility. It is helpful to analyze the history to determine a range that divides divergences from the usual noise between both data series.

The difference of the slopes is divided by the average price to get a relation to the price level to allow a comparison of stocks with different price levels. The division by two is done to get the average divergence of the upper and lower trendlines. Chart 4 shows the application of VDI.

Chart 4: The application of the Volume Divergence Indicator, which indicates the bearish divergence in March. The subchart shows the 3-bar-average of the Volume Divergence Indicator with an analysis period of 20 bars.



The upper chart contains the price development of the stock (black) and the development of the modified OBV (blue)—this line is drawn below the stock for a better visibility. The lower subchart shows the 3-bar-average of the VDI with an analysis and scaling period of 20 bars. There is no standard period, but as divergences are short-term phenomena, the analysis period chosen should not be too long.

A value in the grey range close to zero indicates the range of values, which does not indicate a divergence because there are always small ones, as the stock and the OBV never move exact parallel. But in the middle of March, the value of the VDI drops below the defined tolerance area and indicates the bearish divergence correctly.

Discussion

The example has shown that the VDI is able to rate and indicate divergences between the stock and the OBV automatically, but there are also some weaknesses.

The VDI is, like other technical indicators, a very static tool, because divergences can only be detected if they spread over the selected analysis period. Divergences over shorter or longer periods could be ignored. Thus the VDI is only able to find divergences over the chosen period.

The ideal condition for divergences is trending markets, because the stock and, with it, the OBV move in one direction. An experienced analyst would notice situations in which it is reasonable to search for divergences. Thus, an analyst usually would not look for divergences in the course of a trend change or in a trendless market. He is also able to choose a suitable analysis period for the particular market situation.

The VDI itself cannot judge among suitable market situations, valid divergences, and false signals. A very typical false signal can be established in a situation of a single top. Sooner or later, the upper trendline will turn over the top by a strong change of the line's slope. If the overturning does not take place in both charts at the same bar, a divergence, which has no validation, is the result. One possibility for sustaining the

significance of the VDI is combining it with other indicators (e.g., trend indicators) to filter out false signals.

The introduced model of the VDI should not be understood as a finished concept. It is a basic model that contains a lot of possibilities for individual adjustments (e.g., the length of the analysis period, the application to average values). Every user should configure the VDI to his individual trading philosophy.

Conclusion

The detection of divergences is a complex matter. A manual divergence analysis has the advantage of having the market situation and different analysis periods considered. The VDI is, like other indicators, a static tool, which can detect divergences between the stock and the OBV over the chosen analysis period. But, as discussed, in a few cases, the algorithm can lead to false signals. This should be the starting point for future improvements.

The VDI is already a helpful tool that can be used as a warning signal or a filter, and also in scanner and trading systems. Nevertheless, the indicated divergences should be further validated by manual analysis. Therefore the aim of an indicator, which makes a manual analysis redundant, is not reached yet, but the VDI is the first big step as a basis for further developments and helps make divergence analyses more efficient.

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Software and Data

Charting software: Tradesignal Online Terminal
Data: TeleTrader Software GmbH



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Informative Smoothing of Financial Time Series

by Patrick Winter

Abstract

In this paper, we present the *Informative Smoothing (IS)*-algorithm for smoothing a financial time series by partitioning it into linear segments representing the current trend. It intrinsically determines the degree of smoothness optimal for trading purposes according to the *Criterion of Informative Breaking Points (CIBP)*, which we also introduce in this paper. We compare the IS-algorithm to the ZigZag procedure.

1. Introduction

For robustness and reliability of the results, time series data often have to be smoothed before analysis in order to filter out (some of its) random variation and to reduce the influence of outliers. Smoothing can also simplify the detection of patterns; this is particularly important in the domain of technical analysis, where these patterns are called *formations* and are used to predict price movements. Since most of the common formations are linear, *segmentation*-based smoothing procedures are widespread. They partition the time series into segments and approximate these segments by usually linear functions. A famous example of such a procedure is the ZigZag.

However, most common smoothing procedures require the user to specify a smoothing parameter defining the extent to which the details of the original time series should be kept – either explicitly, or implicitly through a surrogate parameter, such as the period of a moving average. Although the choice of those parameters can be critical, it often remains arbitrary due to the lack of objective criteria.

This paper introduces the *Criterion of Informative Breaking Points (CIBP)* as an approach to free linear segmentation-based smoothing procedures of their smoothing parameter in the context of financial time series by using the value best suited for trading purposes. Based on the advanced usage of this criterion, we develop the parameter-free *Informative Smoothing (IS)*-algorithm as the second contribution of this paper. It intrinsically distinguishes between long-time and short-time trends and creates segments that are idempotent.

The IS-algorithm is based on the Douglas-Peucker (DP)-algorithm (RAMER 1972, DOUGLAS/PEUCKER 1973), which has been used for smoothing time series before, despite its cartographic origin. The major part of this stream of research, however, has concentrated on reducing the space complexity for storing the series in a database (E. G. SHATKAY/ZDONIK 1996) or the time complexity for pattern mining (E. G. CAO ET AL. 2005). LAVRENKO ET AL. (2000) are some of the few authors who also deal with the smoothing parameter by replacing it with a statistical t-Test. They employ the resulting algorithm to identify trends in financial time series and relate them to contemporaneous news stories, building

an interesting bridge between technical and fundamental analysis.

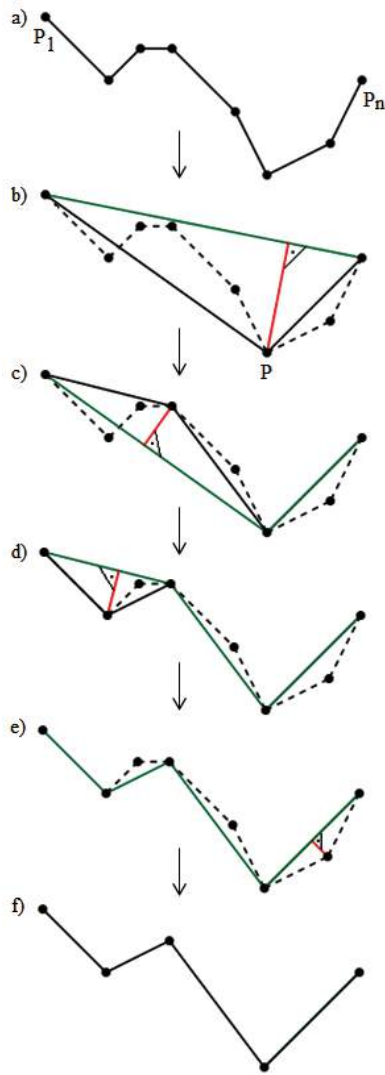
The remainder of this paper is structured as follows: Section 2 reviews and shortly discusses the DP-algorithm. Section 3 presents the IS-algorithm and the CIBP. Section 4 demonstrates a sample application of the IS-algorithm to data from the DAX (a major German stocks index) and compares it to the results of the ZigZag. Section 5 concludes this paper.

2. The DP-Algorithm

The DP-algorithm was developed by DOUGLAS/PEUCKER (1973) AND RAMER (1972) in the field of cartography for simplifying (smoothing) digitized lines such as river courses by the divide-and-conquer-principle. It expects a smoothing parameter ϵ and a sequence S of $n \geq 2$ points P_1, \dots, P_n (Figure 1a) as its inputs and proceeds as follows:

1. P_1 is connected with P_n by the line segment l (green line in Figure 1b).
2. The orthogonal distance d_i of each inner point P_i of S with $1 < i < n$ to l is calculated. Let d_{max} be the greatest of these distances (red line in Figure 1b) and P the corresponding point.
3. If $d_{max} > \epsilon$ (*divide*, Figure 1b, c, d), P is regarded as a new breaking point, the DP-algorithm is applied recursively to the subsequences P_1, \dots, P and P, \dots, P_n of S and the partial results are merged to the overall result s .
4. If $d_{max} \leq \epsilon$ (*conquer*, Figure 1e), all points P_i including P are regarded as negligible and the result s is just the current line segment l .
5. After all sub-problems are solved, s is returned as the final result (Figure 1f).

Obviously, the choice of ϵ is critical: If it is chosen too small, d_{max} often exceeds this threshold and too many segments are created. In the (hypothetical) extreme case of $\epsilon = 0$, s would always coincide with S . If ϵ is chosen too large, on the other hand, it is often greater than d_{max} and too few segments are created. For $\epsilon = \infty$, s would always remain the initial connection l between P_1 and P_n . However, while there have been attempts to improve the speed (HERSHBERGER/SNOEYINK 1992) or the distance measure (EBISCH 2002) of the DP-algorithm, little work has been done on the effects of ϵ – probably because there is no single “correct” value, but only values more appropriate and values less appropriate for the intended purpose.

Figure 1: The DP-algorithm

3. The IS-Algorithm

3.1 Input

Since the IS-algorithm is designed especially for smoothing a financial time series, it expects the n data points of the input sequence S to be vectors that consist of at least the four typical values: the opening, minimum, maximum, and closing prices $open_t$, low_t , $high_t$, and $close_t$ (resp.) of the period $t \in \{1; n\}$ they represent (e.g., days). Note that due to this requirement, the IS-algorithm cannot be used (without further ado about a different volatility measure) for high-frequency trading where these values do not exist.

From this input, the algorithm initially computes $y = (y_1 \dots y_n)'$ with

$$y_t = (close_t + (high_t + low_t)/2)/2$$

as the actual course to be smoothed. Note that we could also use another average like $y_t = (close_t + high_t + low_t)/3$ or even directly $y_t = close_t$ (the results would change

only slightly), but our formula emphasizes the important $close$ -value while cushioning the influence of outliers.

Furthermore, our algorithm calculates

$$v_t = (high_t - low_t)/2$$

and $v = (v_1 \dots v_n)'$ as a measure for the volatility that shall be tolerated in each period. Of course, we could employ again some other formulae, but since we will not use v directly (in contrast to the analogue ϵ of the DP-algorithm), the result does not critically depend on its exact formula, as long as the span between the extreme values of a period is accepted as a valid measure. Besides, our approach has the nice property of $v_t \geq 0$ with periods without trades ($v_t = 0$) being excluded by the IS-algorithm automatically.

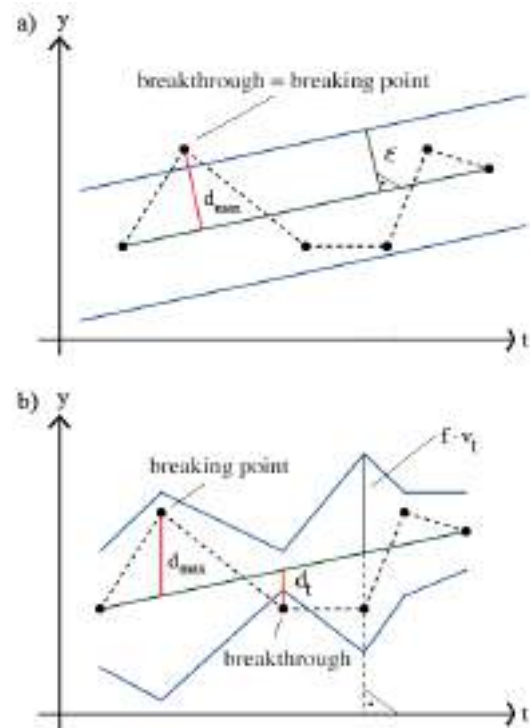
3.2 Step 1: The Modified DP-algorithm

The IS-algorithm consists of three steps, of which the first one is the application of a modified DP-algorithm to y . Figure 2 contrasts the modifications (part b) with their original counterparts (part a). They can be described as follows:

First, we measure the distance d_t of each point $P_i(t; y_i)$ to the approximating line segment vertically because the orthogonal

distance is meaningless for time series data. Note, however, that this is only semantically important and does not change the result of the DP-algorithm as long as all data points have the same horizontal distance Δt (since then $\sqrt{\Delta t^2 + \Delta y^2}$ is maximal if the vertical distance Δy is). This condition can be ensured by indexing each trading day (i.e., using $t \in \{1; n\}$ instead of real dates), what is done automatically by the IS-algorithm.

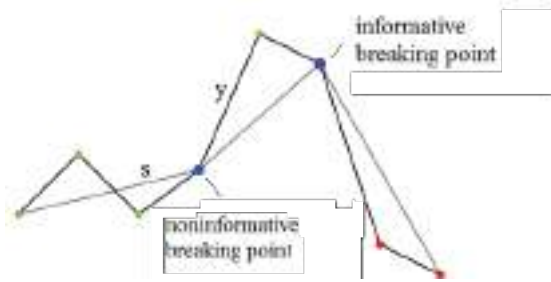
Second, instead of comparing only the greatest distance d_{max} with a user-specified smoothing parameter ϵ , we compare each distance d_t with the value $f \cdot v_t$, where f denotes an intrinsically determined parameter we will look at later. If $d_t \leq f \cdot v_t$ for all t , the current approximation (green lines in Figure 2) is completely enveloped by the channel $\{y - f \cdot v; y + f \cdot v\}$ (blue lines in Figure 2) and our algorithm terminates. Note that this channel is no longer parallel to y because v is no longer a constant value. Otherwise (orange line in Figure 2b), the point P with the distance d_{max} is regarded as the new breaking point as in the original algorithm. We do not regard the actual breakthrough point with $d_t > f \cdot v_t$ as the breaking point because P provides more information about the differences of the approximated and the real course.

Figure 2: The original (a) and the modified (b) DP-algorithm

3.3 Types of Breaking Points

Until now, the first step of the IS-algorithm is not specified completely because we did not state how to determine the parameter f . Let us assume for a moment that f would already be known. The modified DP-algorithm then could produce a result s like the one shown in Figure 3. We also depicted the course y to smooth with all of its points coloured green (red) if they belong to an ascending (descending) line segment of s or blue if they have been regarded as breaking points.

Figure 3: A possible result of the modified DP-algorithm for an arbitrary f



Breaking points that connect two ascending or two descending line segments of s (such as the first one in Figure 3) are irrelevant or *noninformative* for traders because they do not affect the trading decisions (buy or sell). Their existence, therefore, indicates an over-segmentation of y (i. e., f being too small). On the other hand, we want f to be as small as possible because the algorithm should find all relevant or *informative* breaking points that connect two line segments of different orientation (such as the second one in Figure 3) since they mean a trend reversal. From this trade-off we can derive the

Criterion of Informative Breaking Points (CIBP): The degree of smoothness $\epsilon \geq 0$ (with $\epsilon = 0$ meaning no smoothing at all) of linear, segmentation-based smoothing procedures optimal for trading purposes is the lowest positive number for which all resulting breaking points are informative.

We provide an efficient procedure for the determination of f according to the CIBP in the appendix of this paper.

3.4 Step 2: Localization

The first step of the IS-algorithm could now be employed without further ado for smoothing a financial time series. In fact, the result it produces is already meaningful globally (for the whole time series) and therefore can be used for a long-time analysis of the data. This is why we call it the *global* or *long-time* result. However, our current approach is less appropriate for a short-time analysis of the data because f was determined with respect to all data points instead of only the data points relevant for the current segment: For some segments s_i of s , a smaller local value f_i might have sufficed to fulfill the CIBP, leading to a locally higher level of detail.

To localize the result of our algorithm, we reapply its first step recursively to all segments of its initial result s . This is done until each segment becomes *idempotent* (i.e., it does not change anymore with further applications). Figure 4 shows an example of this procedure: Applied to the course y depicted in Figure 4a, our modified DP-algorithm produces a global result consisting of two differently oriented segments (Figure 4b). When reapplying it to these segments, we first observe that segment 2 remains the same and therefore already has become idempotent. Note here that this should be true for at least one of the initial segments due to the CIBP. Contrary, segment 1 gets split into two sub-segments (Figure 4c), indicating that $f_1 < f$. We again reapply the first step of the IS-algorithm to these sub-segments, and since we find that they also have become idempotent, its

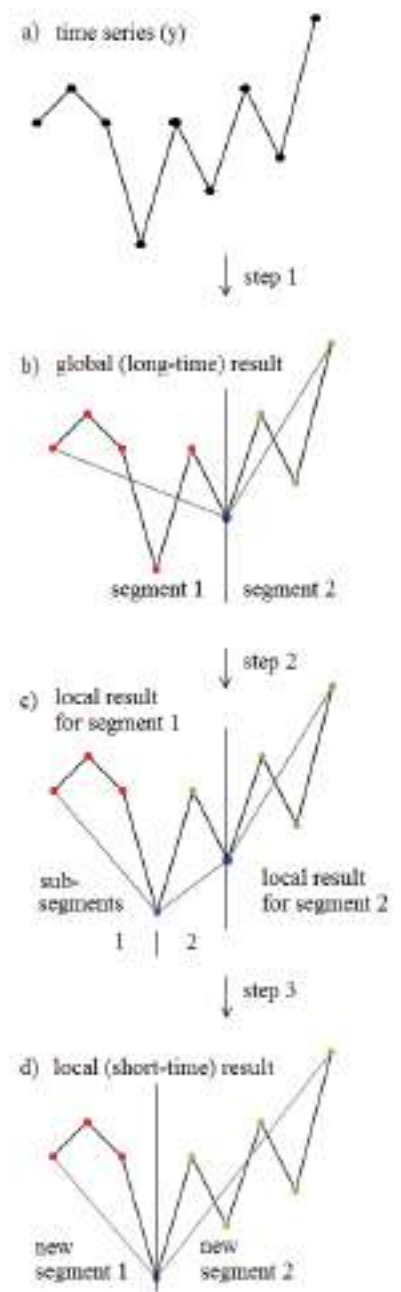
second step is completed. Note that the corresponding result has only a transitional character.

3.5 Step 3: Consolidation

As it is the case for the example depicted in Figure 4c, the application of the second step of the IS-algorithm can introduce new noninformative breaking points. Note, however, that this happens only rarely with real datasets. To regain a segmentation compliant with the CIBP, we merge the two colliding segments in the third and last step of our algorithm. In our example, the second sub-segment of segment 1 would be merged with segment 2. To reassure the idempotency of the new segments created this way, we again reapply the complete IS-algorithm recursively to them.

Since the segments that have not been merged are already idempotent by construction, the final *local* or *short-time* result of the IS-algorithm (Figure 4d) is as well.

Figure 4: The IS-algorithm



4. Application: An Alternative to the ZigZag

Concerning its construction and purpose, the IS-algorithm is similar to the *ZigZag*, which filters out all price movements that are below a user-specified threshold (the smoothing parameter) by connecting highs and lows seeming significant. Note that due to this construction, all breaking points found by the *ZigZag* are ex ante known to be informative; thus, the CIBP cannot be used to determine an optimal threshold.

Since the decision regarding whether an extreme is significant or not may depend on the generally unknown following data, the results of the *ZigZag* for a past period may change in the current one. Thus, it usually does not indicate anything and therefore is not an indicator (although this is what it is often referred to) but a smoothing method for a completely given time series like the IS-algorithm. Nevertheless, the *ZigZag* has drawn huge attention in technical analysis because the formations it produces

are closely related to the famous *Elliot Waves* (ELLIOT 1938) trading approach; we refer to MERRILL (1977) for a more detailed explanation of this relationship.

However, the ZigZag has got at least the following disadvantages:

First and most important, its output strongly depends on the user-specified smoothing parameter and therefore is quite subjective (e.g., for different values of this parameter, Elliot Waves might be found or not be found in the time series, leading to completely opposite interpretations).

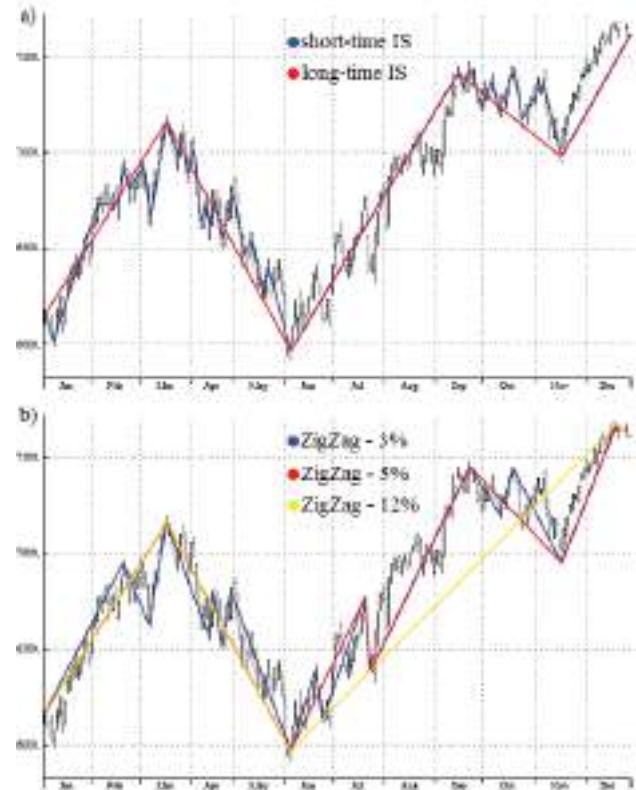
Second, due to the constancy of this smoothing parameter, all segments created by the ZigZag are smoothed to the same degree, while a higher (or lower) degree might be more appropriate for a segment with a high (or low) trading volatility.

Third, if using a relative smoothing parameter, the segments created by the ZigZag might not be idempotent and therefore change with further applications.

The IS-algorithm overcomes all of these shortages and, therefore, can be seen as an alternative to or a replacement for the ZigZag. Note that this is, of course, not the only purpose of its usage; other examples include finding the current trend's starting point for period-dependent indicators to avoid them relying on pre-trend data, or recognising sub-trends by contrasting the long-time and the short-time results.

However, due to space constraints we restrict this section to a comparison between the IS-algorithm and the ZigZag (with typical parameter values ignoring price movements below 3%, 5%, and 12% resp.). For this purpose, we first analyse the DAX development of the year 2012 with both procedures. The results shown in Figure 5 can be interpreted as follows: The global result of the IS-algorithm partitions the course into five segments (called *waves* in technical analysis). The first two of these waves are strongly detailed by the local result of the IS-algorithm, indicating the existence of many sub-waves between January and May. Contrarily, the third wave remains untouched, indicating the opposite for the period between June and roughly August. Note that this result would not have been possible using a ZigZag due to its second disadvantage described above. In fact, the 12%-ZigZag does not identify the third wave at all (and therefore seems a bit too coarse-grained for this date range), while the 3%- and the 5%-ZigZag even consider an additional detour. For the latter, this is the only difference to the global result of the IS-algorithm in this example. The fourth wave, taking place roughly between September and November, consists of a pattern similar to an Elliot-type wave that is identified by the local result of the IS-algorithm. While a 2.5%-ZigZag would also have found this pattern, the 3%-ZigZag doesn't, stressing the ZigZag's first disadvantage. The fifth wave, starting in November, is touched by neither the short-time result of the IS-algorithm nor the 3%-ZigZag. Its course is perfectly concave and therefore forms a so-called *inverse saucer*-formation when de-trended. Note here that de-trending can be another purpose of the IS-algorithm's two results. A non-de-trended inverse saucer-formation usually indicates a shift from a bullish to a bearish market; thus, its de-trended version indicates a slowdown of the current upturn. In fact, the rise of the DAX strongly decelerated at the beginning of 2013, confirming this prediction.

Figure 5: Candlestick chart of the DAX for the year 2012 and corresponding results of the IS-algorithm (a) and the ZigZag (b)



For a second, maybe more objective comparison between the IS-algorithm and the ZigZag, we now apply both procedures to the data of each of the 30 DAX members between 01-01-2013 and 30-04-2013 and measure how many segments are created (*smoothness*) and how well the smoothed series fits the original one (*accuracy*). We operationalize the latter through the Chi-Squared-distance $X^2 = \sum_{t=1}^n \frac{(y_t - \hat{y}_t)^2}{y_t}$ with y_t denoting the real course and \hat{y}_t its approximation at time t . Obviously, there is a tradeoff between those measures, because the more segments an algorithm produces, the lower X^2 should be. We therefore define $\tau = x^2 \cdot \#s$, with $\#s$ denoting the number of segments as a measure to compare different algorithms: The lower τ , the better the algorithm.

Table 1 presents the results of our analysis. We observe that the global result of the IS-algorithm performs best on this dataset since it achieves the lowest value of τ for more than half of the cases (53.3%). Its local counterpart with about 26.7% is better than each of the ZigZags (16.7%, 13.3%, and 16.7%). Considering the standard deviations of $\#s$, this can be explained as follows: While the ZigZag relies on a constant smoothing parameter that causes it to produce roughly the same number of segments for each time series, the IS-algorithm's choice of $\#s$ is data-driven and therefore more adaptive. On the other hand, this can lead to outliers of τ for degenerated cases such as the Allianz SE series (ALV), which exhibits a strongly alternating course, and worsen the average result. Indeed, when compared on the basis of the more robust median of τ , the local result of the IS-algorithm outperforms its global counterpart and each ZigZag (6.71 against 7.19, 7.46, 10.03, and 13.44).

Table 1: Comparison between the IS-algorithm and the ZigZag based on the data of the 30 DAX members between 01-01-2013 and 30-04-2013

IS-algorithm							ZigZag								
long-time			short-time			3% smoothing			5% smoothing			12% smoothing			
	#s	x ²	τ	#s	x ²	τ	#s	x ²	τ	#s	x ²	τ	#s	x ²	τ
ADS	8	1.04	8.29	13	0.87	11.34	8	1.39	11.13	6	2.84	17.05	2	17.51	35.03
ALV	5	13.32	66.58	11	10.82	118.97	7	3.02	21.16	5	3.57	17.87	2	21.01	42.02
BAS	5	2.57	12.85	8	2.39	19.15	10	1.21	12.11	8	1.94	15.48	3	3.53	10.59
BAYN	1	6.04	6.04	1	6.04	6.04	6	2.13	12.8	5	2.25	11.24	2	11.02	22.04
BEI	5	1.16	5.78	12	0.4	4.83	3	2.46	7.38	3	2.46	7.38	2	3.04	6.09
BMW	5	1.41	7.06	11	0.88	9.69	9	0.63	5.69	5	2.1	10.52	3	4.12	12.37
CBK	2	0.24	0.48	2	0.24	0.48	8	0.24	1.9	4	0.15	0.6	2	0.24	0.48
CON	4	4.81	19.25	16	0.74	11.9	7	3.85	26.92	5	10.97	54.87	3	24.1	72.3
DAI	3	1.38	4.14	5	1.05	5.27	7	0.91	6.4	5	1.05	5.27	3	1.15	3.46
DB1	5	6.32	31.58	19	4.5	85.55	7	0.87	6.07	5	0.94	4.7	3	2.41	7.22
DBK	9	0.81	7.29	19	0.39	7.44	11	0.69	7.54	5	1.91	9.53	3	2.78	8.33
DPW	5	0.36	1.8	12	0.16	1.86	6	0.28	1.71	4	1.18	4.71	2	1.69	3.37
DTE	9	0.05	0.47	18	0.03	0.52	6	0.25	1.53	4	0.37	1.48	4	0.37	1.48
EOAN	2	1.14	2.29	12	0.43	5.21	9	0.3	2.67	7	0.39	2.74	4	1.14	4.58
FME	1	3.54	3.54	1	3.54	3.54	6	1.4	8.42	4	2.89	11.54	2	7.1	14.2
FRE	7	0.73	5.11	11	0.54	5.92	6	1.62	9.74	4	3.25	13	2	5.43	10.86
HEI	7	1.53	10.73	13	1.25	16.27	9	0.86	7.75	3	10.12	30.35	3	10.12	30.35
HEN3	1	8.64	8.64	1	8.64	8.64	10	0.48	4.84	3	5.51	16.54	2	6.34	12.68
IFX	5	0.24	1.19	15	0.1	1.46	11	0.13	1.41	5	0.25	1.25	3	0.57	1.71
LHA	15	0.14	2.03	19	0.15	2.91	13	0.25	3.3	7	0.54	3.8	3	1.25	3.75
LIN	4	2.83	11.31	12	0.39	4.7	5	1.62	8.08	2	11.89	23.79	2	11.89	23.79
LXS	1	14.41	14.41	1	14.41	14.41	11	1.81	19.94	5	4.48	22.38	3	12.48	37.45
MRK	6	1.31	7.84	14	0.68	9.52	7	3.93	27.54	4	4.19	16.76	2	10.25	20.5
MUV2	9	1.38	12.39	9	1.38	12.39	8	3.36	26.87	2	22.79	45.58	2	22.79	45.58
RWE	13	0.6	7.74	21	0.3	6.2	11	0.64	7.09	5	1.02	5.08	5	1.02	5.08
SAP	3	2.84	8.51	9	1.32	11.89	7	1.04	7.29	5	1.88	9.41	2	8.5	17.01
SDF	10	0.37	3.69	12	0.38	4.53	9	0.56	5.06	5	1.28	6.38	3	6.93	20.8
SIE	5	1.42	7.09	16	0.45	7.21	6	1.59	9.56	5	1.68	8.38	3	12.06	36.19
TKA	7	0.74	5.19	8	0.7	5.63	8	0.77	6.18	6	0.97	5.8	3	6.67	20.02
VOW3	5	7.46	37.31	11	5.24	57.67	7	6.21	43.49	3	9.97	29.92	3	9.97	29.92
Avg.*	5.57	2.96	10.69	11.07	2.28	15.37	7.93	1.48	10.72	4.63	3.83	13.78	2.7	7.58	18.64
Med.*	5	1.38	7.19	12	0.72	6.71	7.5	0.98	7.46	5	2.02	10.03	3	6.51	13.44
Dev.*	3.43	3.74	13.4	5.79	3.51	26.11	2.18	1.39	9.74	1.38	4.87	12.76	0.75	6.8	16.6
Best**	16 (≙ 53,3%)			8 (≙ 26,7%)			5 (≙ 16,7%)			4 (≙ 13,3%)			5 (≙ 16,7%)		
	19 (≙ 63,3%)						12 (≙ 40%)								

* Avg., Med. and Dev. report the average, the median, and the standard deviation (resp.).

** Best counts how often the respective algorithm reached the minimal τ (coloured green) of each row.

5. Conclusion

In this paper, we proposed the IS-algorithm as a new procedure for smoothing financial time series ex post. It can be used for the same purposes as the ZigZag (e.g., formation analysis, recognition of trends and sub-trends, improvement of indicators) but has the following advantages:

- It intrinsically determines the degree of smoothness that is optimal for trading purposes according to the CIBP, an optimality criterion introduced in this paper, leading to more objective results.
- It automatically offers distinct results for a short-time or a long-time analysis.
- Its long-time result can be used to de-trend its short-time result, improving the identification of chart formations.
- The segments of its short-time result are idempotent and therefore more robust.

Analysing the DAX and its members, we demonstrated the effects of some of these advantages and found that the IS-algorithm outperforms the ZigZag on the usual trade-off between smoothness and accuracy.

Software

The IS-algorithm was implemented in the *InformativeSmoothing*-Package for the CAS *Mathematica* (Wolfram Research, www.wolfram.com). This Package is available for free upon request.

Acknowledgements

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Appendix

We will now give a procedure for the efficient determination of the smoothing parameter f of the IS-algorithm according to the CIBP presented in section 3.

First we observe that within a line segment $[\tau_{from}; \tau_{to}]$ a new breaking point can only arise if there exists an index t with the distance $d_t = |y_t - \hat{y}_t|$ between the real course y_t and its approximation \hat{y}_t being greater than $f \times v_t$. However, if

$$f > \max_{\tau \in [\tau_{from}; \tau_{to}]} \frac{|y_t - \hat{y}_t|}{v_t} =: C_{from; to}$$

holds, this can never be the case. We thus can state the following recursive algorithm *getCandidates* ($\tau_{from}; \tau_{to}$) for finding all critical values (potential candidates) for f :

1. Set $cs := \{C_{from; to}\}$.
2. Find the index $\tau^* \in [1; n]$ of the point P with the greatest distance d_{max} .
3. If $\tau_{from} < \tau^* < \tau_{to}$, set $cs := cs \cup \text{getCandidates}(\tau_{from}; \tau^*) \cup \text{getCandidates}(\tau^*; \tau_{to})$.
4. Sort cs in ascending order and return it.

With n denoting the length of y , the following algorithm finds f :

1. Set $cs := \text{getCandidates}(1; n)$.
2. Set $i := 1$.
3. Smooth y using $f := cs[i]$.
4. If the result s contains noninformative breaking points, set $i := i + 1$ and go to step 3.
5. Return f .

We consider this procedure as efficient because for a value $f' > f$ there might again be noninformative breaking points. Thus, each potential candidate for f must be tested, and the optimal order of these tests is the presented ascending one.

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How to Determine Trends Accurately

by Manfred G. Dürschner

Summary

A new type of Adaptive Moving Average (AMA) is used together with the Stochastic RSI Indicator (SRSI) and Heikin Ashi candlesticks to reveal the beginning and end of a trend regarding the performance of a basic value. The AMA is called UMAX (Universal Moving Average), with the X representing an MAS (simple MA), MAE (exponential MA) or MAW (weighted MA).

UMAX Approach

The approach of the new MA is described below with the following features:

- The MA is adaptive: It adapts very well to performance ascents.
- The MA excels by a good smoothing behavior.
- The time lag is minimized.

The UMAX adaptive behavior is achieved through a linear combination of three MAs, each with different periods. The idea is that small price movements are realized by the MA with the shortest period, while longer trends are better supported by the MA with the longest period than by both MAs with the shorter periods. Moreover, applying the least square method will supply a good smoothing behavior and minimize the time lag between price and UMAX.

The above-mentioned features can be realized using the following approach:

$$UMAX = \alpha_1 MAX_1 + \alpha_2 MAX_2 + \alpha_3 MAX_3,$$

$$MAX_1 = MAX[price[n_1],$$

$$MAX_2 = MAX[price[n_2],$$

$$MAX_3 = MAX[price[n_3],$$

$$\text{Price } K = \frac{(\text{High} + \text{Close} + \text{Low})/3}{3},$$

$$\alpha_1 + \alpha_2 + \alpha_3 = 1 \text{ or } \alpha_1 + \alpha_2 + \alpha_3 = 1 - \alpha_3 \text{ (Layer: UMAX Approach)}$$

Thus, the approach represents a linear combination of three MAs with different periods: n_1 , n_2 , and n_3 . The user must indicate his or her choice of the MA (MAS, MAE, or MAW) and the three different periods. In practice, the following values have proved to be convenient:

- $n_1=5$ or 8
- $n_2=13$ or 21
- $n_3=34$ or 55

Preferably, the user will choose MAW if the goal is a minimal time lag and MAE or MAS if the goal is a smoothing behavior. In particular, MAS will not be the first choice because of its greater time lag.

Coefficient Calculation

The two unknown coefficients, α_1 and α_2 are determined based on the method of least squares, where α is calculated from $\alpha = 1 - \alpha_1 - \alpha_2$. If the known default time series of the price is identified by K_i , and the unknown time series of UMAX is identified by $UMAX_i$ – index, i divides the time series: $t_i = i\Delta t$, $i = 1, 2, \dots, N$, where N identifies the number of time series data and Δt the time unit (e.g., hours, days, weeks), then the equation of condition according to the method of the least squares reads:

$$\sum_{i=1}^N (K_i - UMAX_i)^2 = \text{Minimum}$$

Inserting the above-mentioned formula in this equation of condition (i.e., for the UMAX; price K ; and the values of the MA chosen by the user, and/or its mathematic formulation and subsequent differentiation according to the two unknown coefficients α_1 and α_2) results in a system of linear equations for these two coefficients. The approach can be understood without considerable computing time, in particular, when it is possible to have recourse to the support of modern stock market software. Therefore, a more detailed explanation of the calculation is waived because the method of least squares is the common standard procedure and is often described in detail (i.e., not only on the Internet).

The following results and charts were compiled with the stock market software Investox 6. The corresponding UMAX code can be ordered from the author on request.

UMAX—A Comparison

Figures 1 and 2 compare the UMAX calculated according to the procedure outlined above with the MAW and/or MAE. The performance used is the Japanese Nikkei 225.

Figure 1 shows the UMAX—here X represents the MAW—with the periods $n_1 = 55$, $n_2 = 21$ and $n_3 = 8$ compared with the MAW[55], MAW[21], and MAW[8]. The UMAX follows the performance with the fewest delays. The difference to MAW[8] is the least marked and is much more marked to MAW[21] and MAW[55]. The UMAX follows the downward trend faster than the MAW[8], while the trend reversal occurs at the same Heikin-Ashi candlestick.

While a day setting was chosen for Figure 1, comparing the UMAX (with X representing the MAE) with the individual MAEs

Figure 1: UMAX[55, 21, 8] related to MAW[55], MAW[21] and MAW[8]

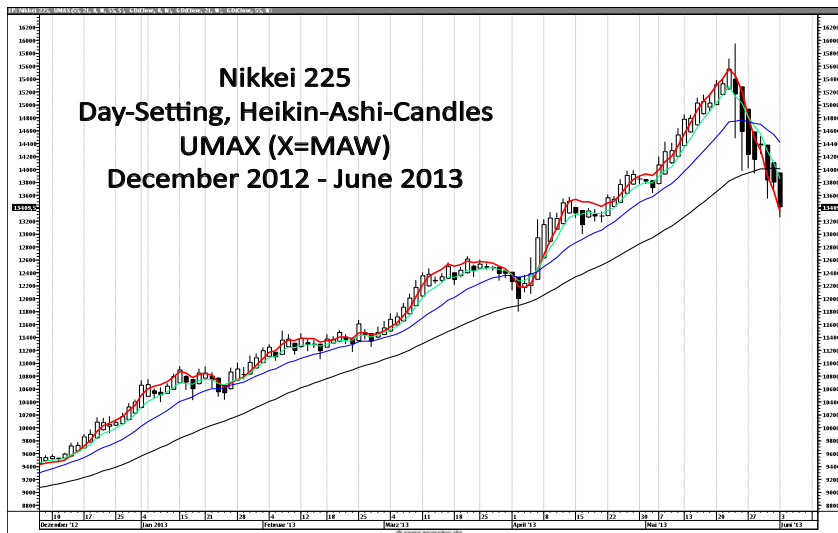


Figure 2: UMAX[34, 13, 5] related to MAE[34], MAE[13] and MAE[5]

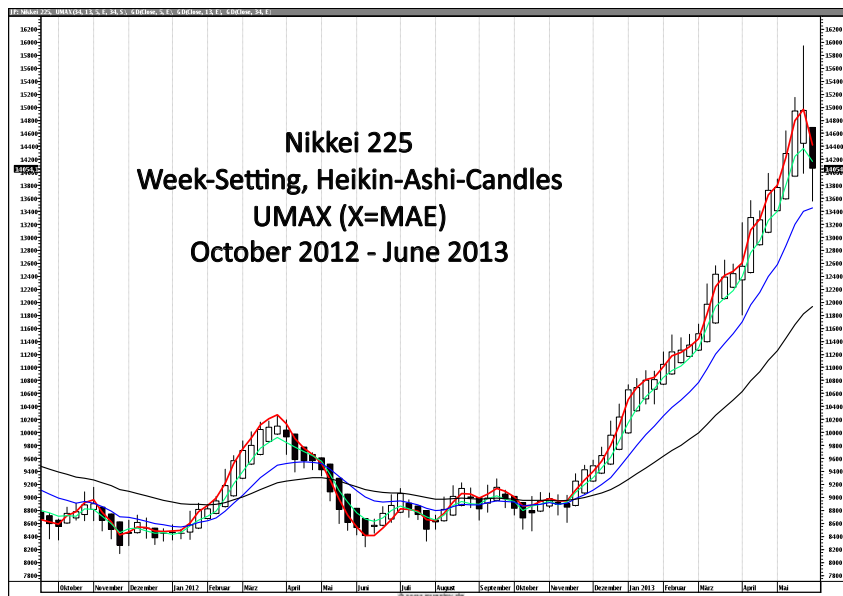
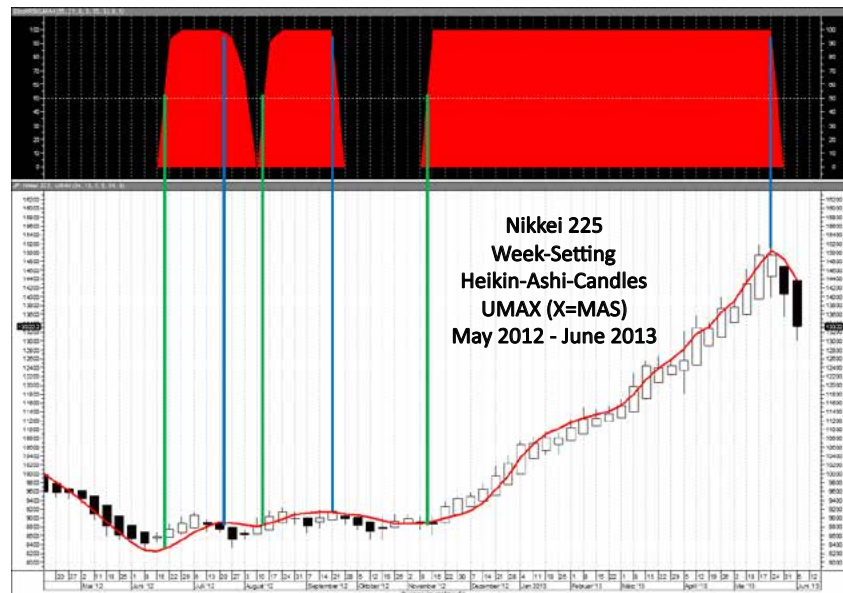


Figure 3: Trend-Evaluation: UMAX[34, 13, 5] and SRSI[8, 5]



was carried out in a week setting (period setting: $n_1 = 34$, $n_2 = 13$ and $n_3 = 5$). Compared with the three MAEs (MAE[34], MAE[13], and MAE[5]), the behavior of the UMAX is hardly different than that described in Figure 1. The two figures exemplify that the UMAX is adaptive, excels by a good smoothing behavior, and has a very low time lag with regard to performance.

Determining Trends

Trade signals are typically analyzed on a daily basis, while determining trends is mainly carried out on a weekly basis. Figure 3 shows the determination of a trend on a weekly basis with the help of the UMAX ($X = MAS$), where the trend is determined and made clear by the Heikin-Ashi candlesticks and the SRSI-Indicator (period 8 for the Relative Strength Indicator [RSI], period 5 for the Stochastic Indicator): Layer "Determining Trends." The important detail, however, is that the SRSI is applied to the UMAX in the specified period setting and not to the price. Once again, Nikkei 225 serves as an example of price. Further details are given in Figure 3.

Three upward trends are specified in Figure 3, with each trend marked by a green vertical starting line (signal: $SRSI[UMAX] > 50$) and a blue vertical end line (signal: $SRSI[UMAX] < 100$). The trends are recognized accurately; however, the left trend and the trend in the middle will hardly be profitable because they are not very pronounced. More precisely, both trends show only a slight ascent, which can be used to filter the trends. In contrast, the right trend has a very marked, long ascent. The $SRSI[UMAX]$ determines the upward trend reflected by the Heikin-Ashi candlesticks very well.

Points and Line Chart

by Mohamed Ashraf Mahfouz, MFTA, CFTe, CETA

1. Introduction

Price charting is a key and vital concept in Technical Analysis. It is the origin of the Technical Analysis idea that everything around us will be discounted by just looking at charts.¹

It is commonly known that price charting may be done using detail-oriented charts (or regular time-series charts) and demand and supply charts (or irregular time-series charts). Each type of charting technique has its advantages and drawbacks. Thus, while the Point and Figure chart (P&F thereafter) has the advantage of focusing on the demand and supply equation by filtering the price action by excluding noise, it always lacks the smoothed display of the detail-oriented charts, such as the Line chart. Furthermore, volume and time can not be displayed on a P&F chart.² In addition, it is often hard to benefit efficiently from applying indicators and oscillators on the P&F chart, specifically with regard to the 3 box reversal P&F charts (or greater) due to the condensation of the chart where the Technical Analysis indicator calculations are based on the center price of every column and not on the last price.

Thus, the purpose of this paper is to attempt to create what will be referred to henceforth as “*Points and Line chart*.” The chart’s purpose is to maximize P&F and line charting benefits by merging them while eliminating their drawbacks. From its name, Points and Line chart uses only points on the chart and a line that connects those points. It uses the same P&F chart principles including price filtration, scaling, box size, box reversal, the buy/sell triggers, and target projections. At the same time, it benefits from the Line chart advantages, including the use of closing price, volume, smoothed trend display, price patterns, target projections, and trend lines. Points and Line chart also adds to both charts two new concepts: the total volume and time (or number of days). And last but not least, it allows for much more efficient Technical Analysis indicator application compared with the P&F and the Line charts.

The paper will be divided into six sections. The following section of the paper will review the Line and the P&F charting methods, pointing out their benefits and drawbacks in comparative points in order to highlight the importance of the new charting method: the Points and Line chart. Section 3 will be devoted to illustrating the Points and Line charting’s main idea and its calculation methodology with clear examples. For more understanding of the chart filtering purpose, the concept of filtering prices from noise versus price smoothing will be clarified. Two types of volume display (total and average volume) will be added to the Points and Line chart, allowing it to be more informative. In order to add time, a new concept will be introduced: the number of days. The advantages and similarities of the Points and Line chart versus the Line chart and the P&F chart will be discussed in terms of price chart analysis, trend

lines, price patterns, and target projections. The possibility of converting the Points and Line chart into a weekly chart will also be discussed under what can be referred to as a 5 Points chart. The difference between the Points and Line chart and the monthly Line chart will be clarified. Finally, this part will end with the recommended box size and box reversal that should be used with the Points and Line chart and the possibility of adjusting those parameters. Section 4 will explain the advantages of this charting technique over the Line and the P&F charts in terms of applying the Technical Analysis indicators and oscillators. Section 5 will demonstrate the advantage of the Points and Line chart over the P&F chart with the aid of a practical example. Section 6 concludes the paper. At the end of this paper, two appendixes are available; the first one illustrates extra examples for the Points and Line chart and the second makes a quick review of other filtering ideas that could be applied on the Line chart.

Keywords: Line Chart, Point and Figure Chart, Closing Price, Trend, Volume, Time, Price Patterns, Trend Lines, Total Volume, Average Volume, Number of Days, Noise Filtration, Vertical Count, Horizontal Count, Box Size, Box Reversal, Peak/Bottom, Support/Resistance, Breakouts, Simple Buy/Sell Signal.

2. Price Charting Techniques: A Background

2.1 Detail-oriented charts (regular time-series charts): Line charts

The Line chart is one of the oldest and most important charting methods in Technical Analysis. It is a simple charting method that plots only successive closing prices. Yet, its importance and validity in measuring price activity is highlighted by Charles Dow, who relied exclusively on closing prices, as he did not consider intraday penetrations valid.³ Also, as Murphy argues, “Many chartists believe that because the closing price is the most critical price of the trading day, a line (or close only) chart is more valid measure of price activity.”⁴

2.2 Demand and supply oriented charts (irregular time-series charts): Point and Figure charts

P&F chart is also one of the oldest charts. It focuses on the significant moves rather than plotting all the data. “On the Point and Figure chart, only the price changes are recorded. If no price change occurs, the chart is left untouched. During active market periods, a considerable amount of plotting may be required. During quiet market conditions, little or no plotting will be needed.”⁵ P&F chart excludes prices that are not significant by focusing on the trend demand and supply by plotting simple consecutive Xs that represent the demand and consecutive

Os that represent the supply. This plotting is based on specific criteria: the “Box Size” and the “Box Reversal.”

2.3 Line charts versus Point and Figure charts: Advantages and limitations

This section will offer a detailed overview of the advantages and the limitations of the Line chart versus the P&F chart by comparing them from eight different perspectives. This comparison will facilitate highlighting the importance of the new chart concept that will be introduced later in the paper.

2.3.1 The smooth ascending and descending display versus the vertical display

The Line chart has a smoothed ascending and descending display that shows the price movements in a more informative way than the P&F chart, especially if it is viewed at the price action from the momentum point of view. The vertical display of the P&F chart will not differentiate between a rise (or a decline) on a higher or a lower momentum, as in both cases it will be displayed as a column of Xs (or a column of Os). On the contrary, the Line chart will show the change in momentum clearly as the line slope will differ if the price momentum changed. For example, by using the P&F chart, if the closing prices of a stock moved directly from 25 to 27 it will be displayed exactly the same as if the prices moved from 25 to 26 then from 26 to 27; in both cases it will be displayed by drawing three consecutive Xs (Box size 1). However, the Line chart will show a steeper slope in case of the direct rise from 25 to 27 than the rise from 25 to 26 then from 26 to 27.

2.3.2 The filtration characteristic versus the normal chart display

The P&F chart focuses on the demand and supply of the trend by filtering the price chart from insignificant price movements or noise, while the Line chart records every single day even if the price remained the same. This advantage is highlighted in buy/sell signals that are triggered from the violation of resistance and support levels. Using those signals in the Line chart could cause a lot of whipsaws and false breaks, as there will always be a lot of insignificant support and resistance levels that are created from the short-term fluctuations. On the other hand, using those signals in the P&F chart is much more significant, as the short-term fluctuations are already filtered, and only significant support and resistance levels are shown.

2.3.3 Data plotting

The Line chart plots the actual price data; on the other hand, due to its filtration concept, the P&F chart does not plot the actual data, but it plots the box size where prices are trading within.

2.3.4 Volume display

The Line chart has the advantage of displaying volume as a separate entity. The P&F chart does not display volume as a separate entity with a claim that volume is reflected in the amount of price changes recorded in the chart. The volume display is very important for the following reasons:

1. It increases the significance of support and resistance levels.
2. It is a leading indicator for the price action, “Volume should

increase or expand in the direction of the existing trend.”⁶ This information is always important in confirming the price movement or in warning of a trend reversal or at least in indicating that the current movement can or can not be trusted.

3. It confirms the price patterns.
4. It can identify important reversal peaks and bottoms, what is known as blow off and selling climax situations.⁷
5. There are various indicators that were created to analyze the volume structure to trigger buy/sell signals (e.g., On Balance Volume, Weighted-On Balance Volume, Volume Zone Oscillator).

2.3.5 Price patterns and their projected targets

The P&F chart can provide the same information that is displayed by the Line chart, as it shows price patterns that can be seen by the Line chart (e.g., Triangles, Head and Shoulders). The P&F chart also has its own set of chart-patterns that have important indications (e.g., Catapult, Fulcrum, Compound Fulcrum, saucer). However, the construction and psychology behind the significance of these patterns is nearly the same compared to the Line chart patterns, but with minor variations. What is unique in the P&F chart is that it not only allows the normal target measuring and projections of the Line chart patterns (vertical measurement), but it also allows horizontal measurement of the price target, which “is based on the premise that there is a direct relationship between the width of a congestion area and the subsequent move once a breakout occurs.”⁸

2.3.6 Trend lines

Trend lines can be drawn on both Line charts and P&F charts. In P&F charts there are two types of trend lines; the subjective trend line (which is similar to the Line chart trend lines) and the objective trend line (what is known as the 45 degree trend line). Murphy advised to apply the 45 degree trend lines when using the P&F chart because of the severe condensation on these charts.⁹ Thus, when using the 3 box reversal P&F chart, due to the chart condensation, it is not desirable to draw subjective trend lines that connect rally tops or reaction lows like the Line chart. The trend lines of both the Line chart and the P&F charts will trigger buy/sell signals, but the trend line on the Line chart has the advantage of adjusting to monitor the trend slope or the change in the rate of speed over time. It has also the advantage of anticipating potential support/resistance levels in the future.

2.3.7 Time display

Unlike the Line chart, the P&F chart does not plot time as Murphy pointed out, “it is the study of pure price movement. That is, it does not take time into consideration while plotting the price action.”¹⁰ The P&F chart substitutes volume and time by recording the number of price reversals; thus, time is substituted by the number of changes in direction or the number of columns.¹¹ Time is an important indicator in identifying support and resistance levels. Using the P&F chart, during major market bottoms (or tops) it is often difficult to identify the time duration before the reversal takes place, even if we identify a catapult or fulcrum pattern, the increase in the number of columns in this area could be on account of the high volatility

fluctuations (number of price reversals), not because prices have been traded for a long time during this period. Thus, we could identify two similar catapult formations: one that took months to construct and the other took weeks. Also, in the case of the support and resistance levels that are constructed within the trend, it will always be seen that those that have not been tested have the same importance regardless of time differentials.

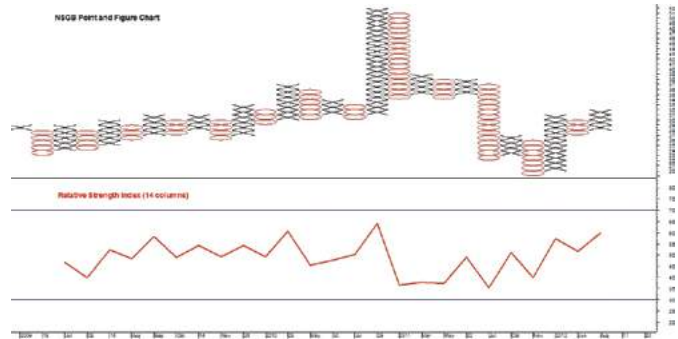
2.3.8 Technical Analysis indicators

Unlike the Line chart, Technical Analysis indicators cannot be applied on the P&F chart unless they are based on the number of columns instead of time. As David Keller pointed out, "One of the traditional disadvantages of point and figure charts is that they can't be used with indicators such as MACD, stochastic, or OBV, and the like, because they don't have a time scale and consequently won't match up with the indicator. If, however, the indicator is calculated based on columns rather than time, any indicator can be used with a Point and Figure chart. The difference is that the indicator "period" (length) is measured in columns rather than days or weeks."¹²

Although the change in indicator calculation has solved the problem of drawing, this calculation method still means that every column in the P&F chart will be represented as one point in the calculated indicator (usually the midpoint of each column). For example, if we have a column of 10 Xs, it will be represented by only one point in the calculation of any indicator. This calculation will decrease the indicator's efficiency relative to the Line chart, especially for the oscillators, in showing divergences, leading moves, failure swings, and trend identification. That is why a lot of Technical Analysis indicators will not be that informative when applied on the P&F chart compared to the Line chart, because there is a small number of columns in the P&F chart relative to the large number of prices shown by the Line chart from where the Technical Analysis indicators are calculated. Furthermore, David Keller states that "indicators do not work well on arithmetic Point and Figure charts because of the sensitivity and hence the number of columns is not consistent throughout the chart."¹³

Charts 1 and 2 show the Relative Strength Index (RSI) application for the same stock and in the same period on the Line chart and the P&F chart.

Chart 2: National Societe Generale Bank (NSGB.CA) Point and Figure chart (1 box size X 3 Box reversal) with the Relative Strength Index (14 columns)

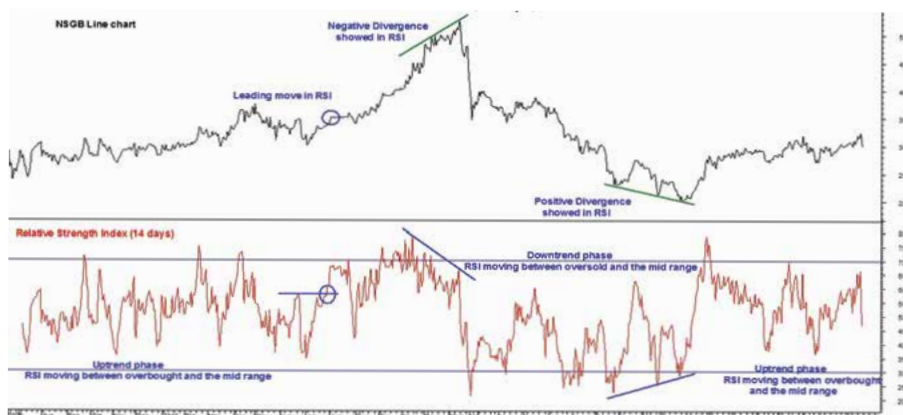


As observed from the charts, the P&F chart has plotted the Relative Strength Index (14 columns) successfully and, of course, filtered relative to the Line chart, but the indicator is of little value when it is applied here, as it is calculated from the number of columns. On the other hand, the RSI is much more informative when applied on the Line chart. The only way to solve this problem is to use the P&F chart with 1 box reversal, but this will eliminate the filtration advantage of the P&F chart.

To the P&F practitioners, this is not considered a problem, as it is believed that indicators are not made to give buy/sell signals when they are used on the P&F chart but are only made to confirm the unambiguous signals generated from the P&F chart. "Adding moving averages to the chart helps to confirm or reject a Point and Figure signal that is already there."¹⁴ That is why Jeremy Du Plessis has only applied in his book three indicators that will work efficiently when they are drawn on the P&F chart (i.e., the moving averages, the Bollinger bands, and the parabolic stop and reverse [SAR]).¹⁵ Yet their default parameters must be decreased to work with the small number of columns in the P&F chart.

Although his recommendation is to apply the moving average indicator, he advised that it is better to use two moving averages instead of one; one is short term and the other is longer term, as he pointed out that "you cannot use the same length (measure in columns) moving average across different box sizes, different reversals and different construction methods. So, the choice of moving average length is much more complex for Point and Figure then it is when using line charts."¹⁶

Chart 1: National Societe Generale Bank (NSGB.CA) Line chart with the Relative Strength Index (14 days)



3. The Points and Line Chart

After this brief background comparing the Line and P&F charts, the following sections will be dedicated to explaining in detail how the Points and Line chart is drawn and the advantage of the Points and Line chart over the P&F and the Line charts.

3.1 Main idea

The Points and Line chart has the same display as the normal Line chart, but it filters the trend from noise by using the same filtering criteria as the P&F

chart, where it uses the standard box size¹⁷ and 3 box reversals.¹⁸ It differs, however, in the following six important aspects:

1. It plots prices in points connected with a line, not Xs or Os.
2. It does not move in columns, but in an ascending and descending manner.
3. If prices move directly from 20 to 24, it will not plot 21, 22, and 23; a point will be plotted at 20 and the next point will be at 24.
4. It plots the actual prices, not the box size. If the prices reach 20.25, the point will be plotted at 20.25, not at 20 (box size scale), unlike P&F.
5. Volume is included: total volume or average volume.
6. A new concept is included: the number of days, which represents the time that prices stay in a support or resistance.

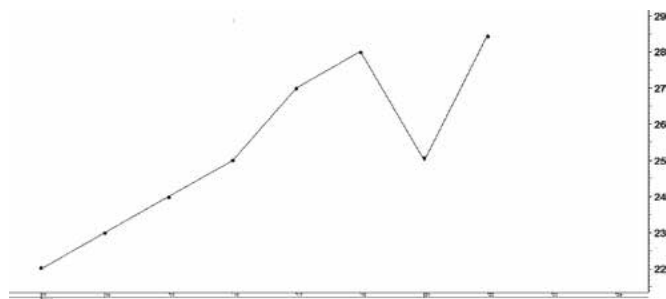
3.1.1 Numerical example

The example below shows how the Points and Line chart is drawn. As can be seen in Chart 3, the Points and Line chart is plotted as the usual Line chart; however, it does not plot insignificant price actions.

Table 1: Daily closing prices for a hypothetical stock for 10 consecutive day

Day	Closing Price
1	22
2	23
3	24
4	25
5	27
6	27.5
7	28.01
8	25
9	24.8
10	28.50

Chart 3: Points and Line chart of the hypothetical stock



The following charts will illustrate step by step how Chart 3 is drawn, pointing out the differences between the Points and Line chart and the Line and the P&F charts. The default box size according to this data is 1 and box reversal used is 3.

As can be seen in Chart 4, Day 1 was plotted as a point at price 22, and then when prices rose to 23 in Day 2, instead of plotting an X above 22 (like the P&F chart), another point was plotted above and to the right of 22 at 23. Then, the two points were connected with a line.

Chart 4: Points and Line chart for Day 1 and Day 2

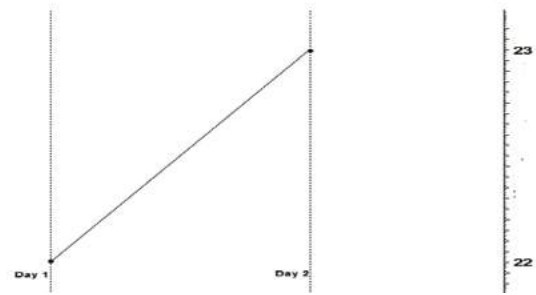
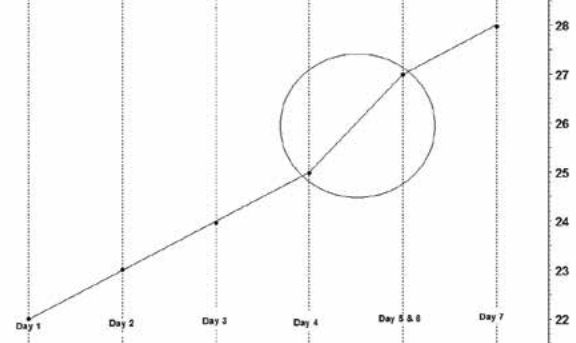


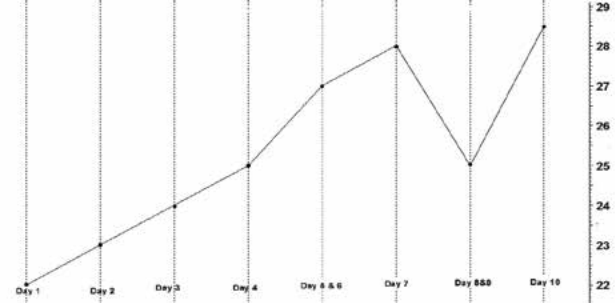
Chart 5: Points and Line chart for Day 1 to Day 7



As can be seen in Chart 5, Day 3 and Day 4 were plotted normally, similar to Day 1 and Day 2. At Day 5, prices jumped directly from 25 to 27; unlike the P&F, the Points and Line chart did not plot a point at 26 and showed a steeper slope from 25 to 27, indicating the increase in the rate of change of prices, as shown in the circle.

Also, it can be noticed that Day 6 was not plotted on the chart since 27.50 was included in the box size of Day 5 at 27; thus, it was not plotted because it was not a significant move.

Chart 6: Points and Line chart adding Day 8 to Day 10



As can be seen in Chart 6, at Day 8 when prices declined to 25, a point was drawn at 25; unlike the P&F chart, Day 7 and Day 8 were connected directly from 28 to 25. Day 9 was included in Day 8, as 24.50 was still in the box size of 25.

At Day 10, prices rose to 28.50, making another 3 box reversal, and a point is plotted at 28.50. Unlike the P&F chart, the Points and Line chart has plotted a point exactly at 28.50, not at box 28, making a new high relative to the previous peak at Day 7.

Before moving on to the Volume and Time plotting of the Points and Line chart, it is very important to clarify the noise filtration concept that is applied by the Points and Line chart and the difference between the noise filtration and the price smoothing that the moving average indicator applies.

3.1.2 Noise filtration

The Points and Line chart has the advantage of filtering trend from noise; thus, an important question is in place: what price movement is considered noise?

One of the important Technical Analysis premises is that prices move in trends that represent the market direction; all Technical Analysis charts and tools are used for the purpose of participating in those trends. But as Murphy states, "Market moves are characterized by a series of zigzags. These zigzags resemble a series of successive waves with fairly obvious peaks and troughs. It is the direction of those peaks and troughs that constitutes market trend."¹⁹ Looking closely at the trend and its zigzag structure, there are an almost infinite number of trends interacting with one another to construct it from the very short-term trends to the very long-term trends. Very short-term trends that constitute the larger term movements are considered noise relative to the overall trend, whether these movements are counter-trend movements (corrections) or along with trend direction. Thus, the less amplitude a wave or a movement has, the noisier it becomes relative to the overall trend.

In the following example, Chart 7 displays a normal Line chart of a hypothetical stock that is in an uptrend without making any noise filtration.

Chart 7: Line chart of a hypothetical stock in an uptrend

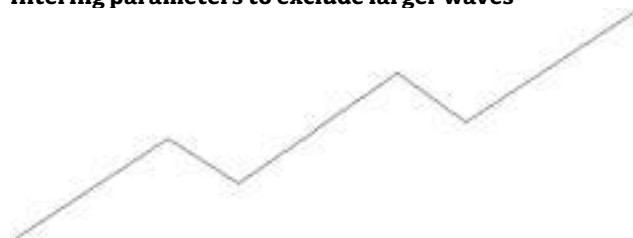


As observed in Chart 7, the very short-term trend zigzags and the longer term trends zigzags are interacting together to construct this uptrend. Thus, the more the waves of small amplitudes are excluded, the clearer this uptrend will be. (See Charts 8 and 9)

Chart 8: Same Line chart of Chart 7 after excluding small waves or noise



Chart 9: Same Line chart of Chart 7 by increasing the filtering parameters to exclude larger waves

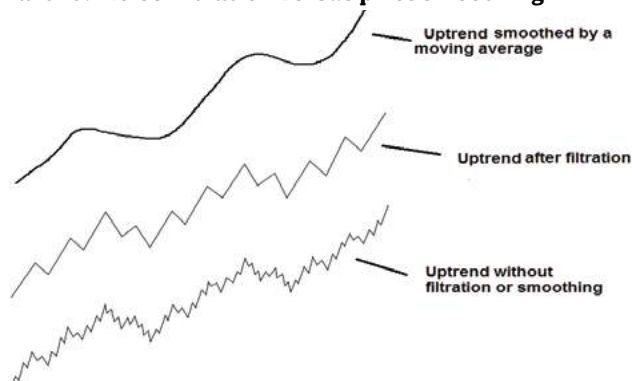


That is what the Points and Line chart does; it filters the price trend from noise to focus on the main market direction. (See also Charts 11 and 12 to compare the Points and Line chart with the Line chart from the filtration perspective). Of course, the larger the box size and box reversal used, the more filtration that will be applied on prices.

3.1.3 Noise filtration versus price smoothing

The noise filtration excludes the price waves of small amplitude to focus on price waves of larger amplitude. On the other hand, the price smoothing converts the trend zigzag display in a smoothed line that does not include any zigzags to focus only on the market direction, whether it is going up or down. (See Chart 10)

Chart 10: Noise filtration versus price smoothing



3.2 Plotting volume to the "Points and Line chart"

There are two types of volume plotting in the Points and Line chart; the first type is the total volume and the second type is the average volume.

3.2.1 Total volume

The normal definition of volume applies to total volume—it "represents the total amount of trading activity in that market for that day."²⁰ The total volume is calculated by adding the volume of all sessions that are included in the same point.

3.2.1.1 Numerical example

Table 2 shows how the Points and Line volume can be calculated. The first column shows the number of sessions, the second one shows the daily closing prices, the third one shows the daily normal volume, and the fourth one shows the Points and Line total volume.

Table 2: Daily closing prices and volume for a hypothetical stock for 10 consecutive days and the Points and Line volume

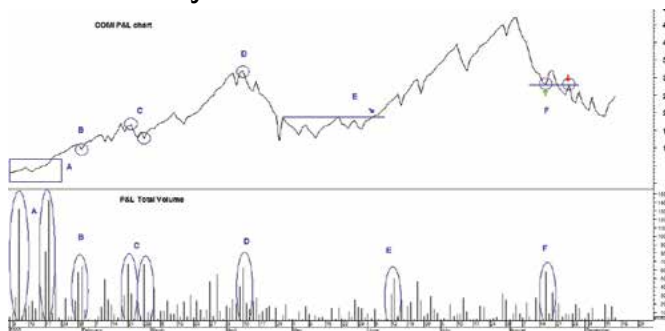
Day	Closing Price	Volume	Points and Line Volume
1	22	100,000	100,000
2	23	120,000	120,000
3	24	130,000	130,000
4	25	150,000	150,000
5	27	125,000	255,000
6	27.5	130,000	
7	28.01	145,000	145,000
8	25	90,000	240,000
9	24.8	150,000	
10	28.50	180,000	180,000

As can be seen in Table 2, the Points and Line total volume adds the volume of the days that are included in the same box size. In Day 5, the price has reached 27 (a new upside point) and its volume is plotted normally 125,000; in Day 6, the price rose to 27.50, which is an insignificant move that is not plotted, but its volume is added to the previous day. Thus, the volume of Day 5 is then equal to Day 5 volume + Day 6 volume (125,000+130,000) = 255,000. The same goes for Days 8 and 9, where the volume of Day 9 is added to the volume of Day 8 (90,000+150,000 = 240,000)

Thus, the Points and Line total volume rule is to add the volume of the ignored insignificant days to the previous plotted day.

The Points and Line total volume is important in determining critical support and resistance levels since "The more trading that takes place in support area, the more significant it becomes because more participants have a vested interest in that area."²¹ Thus, it shows the extreme volume that appears in peaks and bottoms. (See Chart 11)

Chart 11: Commercial International Bank (COMI.CA) Points and Line chart with total volume from February 2002 to February 2012.



As observed in Chart 11, there are six extreme volume cases that show significant important support and resistance levels. Unlike the simple Line chart (Chart 12 below), these extreme cases appear very clear using a Points and Line presentation because the stock has witnessed a lot of insignificant price fluctuations.

Chart 12: Commercial International Bank (COMI.CA) Line chart with normal volume from year 2002 to February 2012



At point A: This was the beginning of the strong uptrend of COMI, and the stock witnessed extremely high total volume.

At point B: The stock bottom at point B was so significant that the market did not reach it again.

At point C: The stock has witnessed a resistance area that was accompanied by extreme volume, and was violated again by another significant volume.

At point D: The stock witnessed extreme volume at an important market peak at that time and changed its trend to the downside.

At point E: After changing its trend to the downside, the Points and Line volume was normal until the stock violated an important resistance that shifted the trend to the upside with extreme high volume.

At point F: The stock was in a downtrend, and that was the first support that halted the stock decline, which is why it was accompanied by an extremely high volume. According to the support-resistance reversing rule,²² when the stock violated the support level at point F to the downside it turned to become a strong resistance level, and its significance comes from its extremely high volume.

Unlike the Points and Line chart, the Line chart showed a lot of noise in the price action, as it does not ignore the insignificant moves. Also, the volume of the Line chart did not show the extreme cases that were shown clearly in the Points and Line chart. At the same time, the P&F charts do not display volume at all; thus, all price levels will have the same importance despite the volume structure.

3.2.2 Average volume

Though plotting total volume in the manner explained earlier has the advantage of highlighting extreme support and resistance levels, it tends to show relatively small total volumes for points corresponding to single days. This could be misleading in some cases because single days with large trading volumes could be hard to trace in a large-scale chart. One method to account for this problem is to plot average trading volume for each point rather than total volume.

For example if the closing price stays at 27 for 10 successive sessions with total volume 1,000,000 shares, this means that each session has an average of 100,000 shares. If the closing price reaches 28 the next day and the volume of this session is 200,000 shares, and the stock stays at 28 for only one session and rises to 29 the next day, the total volume of the Points and Line chart will show that at price 28 there is low volume. This low volume is shown in the total volume, although day 28 witnessed high volume (200,000) relative to the previous 10 sessions (100,000).

3.2.2.1 Numerical example

Table 3 shows how the Points and Line average volume is calculated. The first column shows the number of sessions, the second one shows the daily closing prices, the third one shows the per-point total volume, the fourth one shows the number of days per point and the fifth column shows the Points and Line average volume, which is the total volume divided by the number of days in each point.

Table 3: Average volume calculation for a hypothetical stock for 10 consecutive days

Day	Closing Price	Points and Line Total Volume	Number of Days at Each Point	Points and Line Average Volume Total V/No. of Days
1	22	100,000	1	100,000
2	23	120,000	1	120,000
3	24	130,000	1	130,000
4	25	150,000	1	150,000
5	27	255,000	2	127,500
6	27.5			
7	28.01	145,000	1	145,000
8	25	240,000	2	120,000
9	24.8			
10	28.50	180,000	1	180,000

As observed in Table 3, after calculating the average volume there will not be any extreme volume that is affected by the number of days. (See Chart 13).

As can be seen in Chart 13, the volume picture is similar to the normal Line chart in Chart 12.

Chart 13: Commercial International Bank (COMI.CA) Points and Line chart with Average volume from year 2002 to February 2012

3.3 Plotting time or the number of days to the “Points and Line chart”

Murphy argued that “The longer the period of time that prices trade in a support or resistance area, the more significant that area becomes. For example, if prices trade sideways for three weeks in a congestion area before moving higher, that support area would be more important than if only three days of trading had occurred.”²³

According to his argument, as previously stated, the Points and Line chart can add more information to the chart by showing the number of days, which is the time that prices stay at every point in the chart; it will thus show the total number of days that prices congest in specific areas.

3.3.1 Numerical example

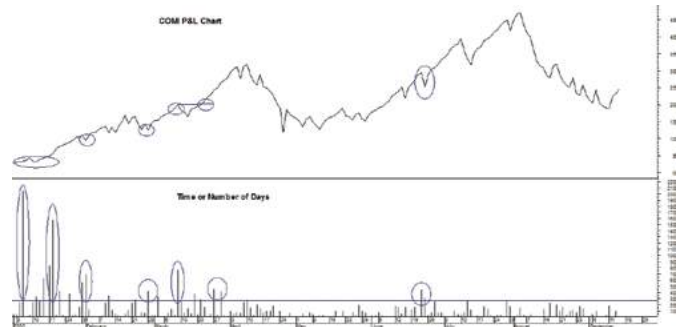
Table 4 shows how the Points and Line number of days is calculated. The first column shows the days, the second one shows the daily closing prices and the third one shows the number of days at each point.

Table 4: Daily closing prices and the number of days for a hypothetical stock for 10 consecutive days

Day	Closing Price	Number of Days at Each Point
1	22	1
2	23	1
3	24	1
4	25	1
5	27	2
6	27.5	
7	28.01	1
8	25	2
9	24.8	
10	28.50	1

Thus, by looking at Table 4 we will find that prices have stayed at levels 27 and 25 more than the other level.

As can be seen in Chart 14, the number of days is plotted below the price chart like volume plotting. The number of days can be used to highlight support and resistance levels in a similar manner to the total volume, as can be seen in the chart below.

Chart 14: Commercial International Bank (COMI.CA) Points and Line chart with number of days from year 2002 to February 2012

3.4 Points and Line chart analysis versus Line chart and P&F chart

Since the Points and Line chart display is similar to the Line chart display, except that it filters significant price movements from insignificant ones, the Points and Line chart is analyzed exactly like the Line chart. Meanwhile, at the same time, it will trigger the same buy/sell signals that are found in the P&F chart in addition to the advantage stated in the previous sections of adding the total volume and the number of days. (See Chart 15)

Chart 15: Commercial International Bank (COMI.CA) Points and Line chart with classic price analysis

As can be seen in Chart 15, the Points and Line chart can be analyzed similar to the Line chart. The following can be observed:

At Point A: There was a confirmed positive trend line that can be drawn, and its violation has signaled the stock decline and a target can be measured to the downside. Also, the adjustment of the same trend line has given an earlier sell signal.

At point B: A double top formation can be seen, which reversed the stock trend at that time.

At point C: A bottoming higher lows formation can be seen, and the violation of the resistance level to the upside triggered the stock trend reversal to the upside.

At point D: Another positive trend line is confirmed until it was violated, triggering the stock decline. Also, the adjustment of the same trend line has given an earlier sell signal.

At point E: A downward channel that can be used for trading can be clearly seen, as well as the significance of its violation to the upside where a channel target can be measured.

Also, like the P&F chart, because of the price filtration method, as can be seen in Chart 15, a violation of a previous peak or bottom is considered very significant relative to other price charts, indicating significant declines or rises. Thus, the Points and Line chart will trigger the same significant buy/sell signals that are triggered by the P&F chart. (See Chart 16)

Chart 16: Commercial International Bank (COMI.CA) P&F chart (1 box size and 3 box reversal)



The Points and Line chart has extra information above the P&F chart in the volume and number of days display that confirm those signals.

As can be seen in Chart 16, the two positive trend lines and their adjustments that were drawn in the Points and Line chart (See Chart 15) cannot be drawn in the P&F chart due to its condensed display. Finally, unlike in the Points and Line chart, due to the vertical display, the change in momentum in any rise or decline is not shown.

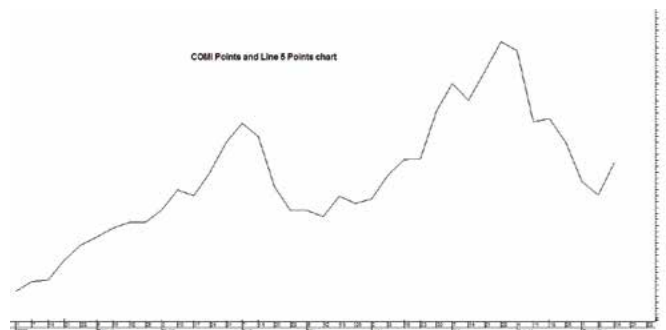
On the other hand, of course there will be other situations where a subjective trend line is drawn on both the Points and Line chart and the P&F chart (negative channel on the right in Charts 15 and 16).

The Points and Line chart has the advantage of applying the same target projections of the Line chart and the P&F chart. Although, it is easier to make the count on boxes than on Points, the Points and Line chart can still apply the Vertical and the Horizontal counts that are applied on the P&F chart. However, when it comes to the calculation of the horizontal count in the Points and Line chart, the number of upward and downward movements will be counted instead of the number of columns in the P&F chart. (See Charts A.10 and A.11 in Appendix A).

3.5 Points and Line weekly or "5 points" chart

The Points and Line chart can also show the very long-term trends by converting them to a weekly chart or what can be referred to as "5 Points chart". This will be done by plotting the fifth point of every 5 points, which is similar to the idea of the weekly normal Line chart (See Chart 17).

Chart 17: Commercial International Bank (COMI.CA) 5 Points chart



3.6 The filtration advantage of the Points and Line chart versus the monthly Line chart

It is very important to distinguish between the filtration that is explained in the Points and Line chart and the filtration that is obtained using the normal monthly Line chart. The monthly Line chart displays the closing price of the last day of every month. This data is displayed whether it is significant or not. Also, if there is any shorter term significant moves that happened during the month, they will not be shown in the monthly chart, as it displays only the last day.

The Points and Line chart is a mix of the daily, weekly and monthly data; a day can be plotted at a point, and the next point can represent a week and another point can represent a month. The following two examples (Charts 18 and 19) show the monthly Line chart and the Points and Line chart for the Commercial International Bank (COMI.CA).

Chart 18: Commercial International Bank (COMI.CA) monthly Line chart from February 2002 to February 2012

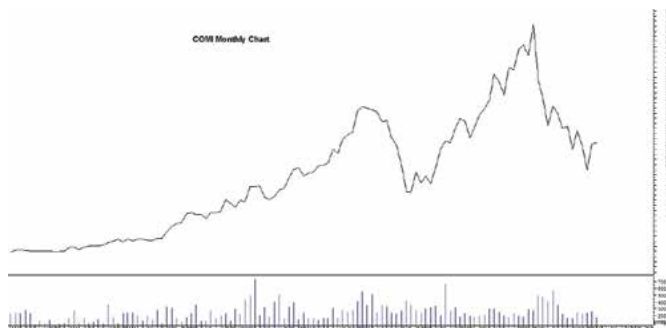


Chart 19: Commercial International Bank (COMI.CA) Points and Line chart from February 2002 to February 2012



As can be seen in Charts 18 and 19, unlike the Line chart, the Points and Line chart displays prices based on the significance of the move, whether this move is made in a day, week, month or even more than one month. Thus, it can be clearly seen that both charts are different in structure, although both charts filter the price action but based on different criteria.

3.7 Changing Points and Line box size and box criteria

The box size used in the Points and Line chart is the standard box size and the 3 box reversals on the closing price. The 3 box reversals are recommended so as not to increase the filtration process in a way that decreases the number of trades. On the other hand, it does not decrease the box reversal to the extent that it loses the filtration advantage.

However, box size and box criteria can be changed according to user preferences, taking into consideration that the larger the box size and criteria, the more the filtration in prices. On the other hand, the smaller the box size and box criteria, the more noise and false breakouts will be in the chart.

4. The Points and Line Chart and Technical Analysis Indicators and Oscillators

Technical Analysis indicators and oscillators applied on the Points and Line chart will be filtered from noise, owing to the filtration advantage of the chart. Thus, the Points and Line chart indicators will provide clearer buy and sell signals compared to the Line chart.

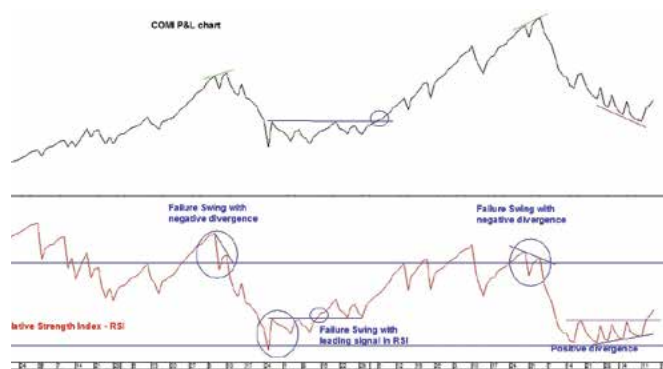
It is worth mentioning here that the Points and Line chart has an advantage over the P&F chart in that the Technical Analysis indicators will be calculated based on the number of points not on the number of columns. Thus, despite the same

filtration criteria applied on both charts, as a result of the descending/ascending display of the Points and Line chart, indicators that are calculated from the Points and Line chart will show details that may not be visible on the indicators that are calculated from the P&F chart; this is because the indicators that are calculated from the P&F chart will use only one point from the center of each column. Thus, the Technical Analysis indicators with their default settings will be much smoother and informative on the Points and Line chart relative to the P&F chart. For example, in the P&F chart, a movement that consists of 16 Xs will be represented by only one point in the calculation of an indicator, whereas in the Points and Line chart, the 16 Points will be used in the calculation of an indicator.

The following sections will clarify in more detail the advantages of applying the Technical Analysis indicators on the Points and Line chart over the Line chart and the P&F chart.

4.1 The Points and Line chart with the relative strength index – RSI

Chart 20: Commercial International Bank (COMI.CA) Points and Line chart with the relative strength index (14 Points)



As can be seen in Chart 20, the RSI, which is a fast and volatile indicator, becomes more filtered from noise by calculating it from the Points and Line chart, providing clearer buy and sell signals. In addition, the divergences, failure swings, leading moves and trend identification are very clear, unlike the case with the Line chart. (See Charts 21 and 22).

Chart 21: Commercial International Bank (COMI.CA) Line Daily chart with the relative strength index (14 days)



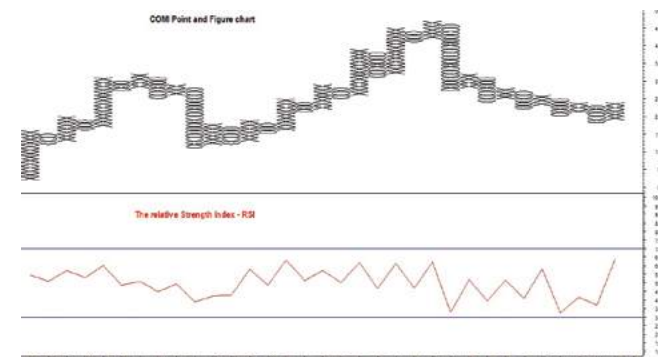
Chart 21 shows how volatile the RSI is when calculated from the Line chart. In Chart 22, the RSI is calculated using weekly data, yet a lot of insignificant noise is still present.

Chart 22: Commercial International Bank (COMI.CA) Line Weekly chart with the relative strength index (14 weeks)



As can be seen in Chart 23, the RSI signals from the P&F chart are insignificant relative to the Points and Line chart and the Line chart, as the RSI is calculated based on the number of columns, which is too small to make it informative.

Chart 23: Commercial International Bank (COMI.CA) Point and Figure chart (Box size 1 and box reversal 3) with the relative strength index (14 columns)



4.2 The Points and Line chart with the moving average convergence divergence (MACD) and MACD histogram

Chart 24: Commercial International Bank (COMI.CA) Points and Line chart with MACD and MACD histogram

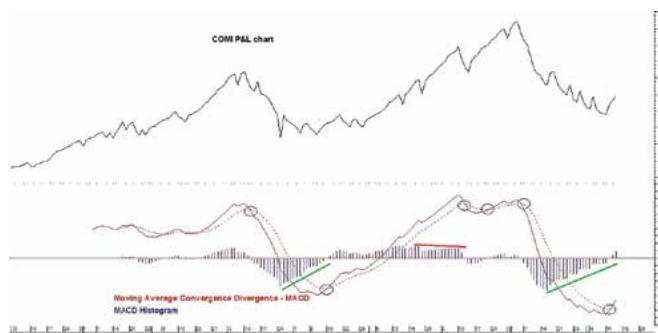


Chart 25: Commercial International Bank (COMI.CA) Line chart with MACD and MACD histogram

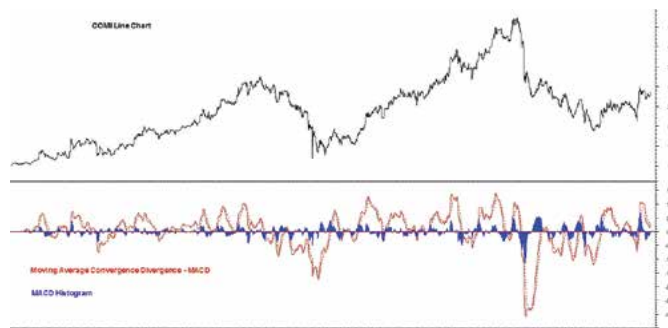
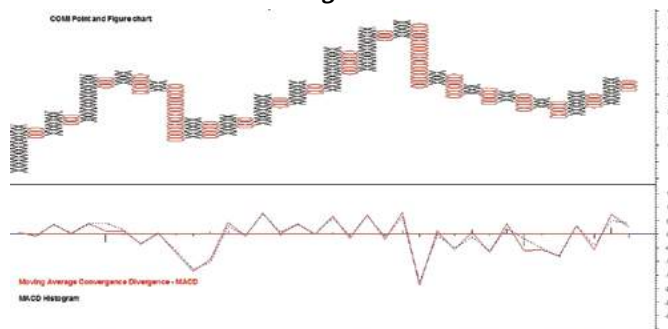


Chart 26: Commercial International Bank (COMI.CA) Point and Figure chart (box size 1 and box reversal 3) with MACD and MACD histogram



As can be seen in Charts 24 through 26, unlike the Line chart, the Points and Line chart provided significant clearer buy/sell signals. On the other hand, the P&F chart filtration and vertical display compressed the MACD and MACD histogram, which makes it difficult to provide any significant signals.

4.3 The Points and Line chart with the slow stochastic oscillator and the commodity channel index (CCI)

Concerning the indicators or oscillators that use the high and low values in their calculations, the open, high and low values could be available in the database of the Points and Line chart. This could be done by entering in the database the open, high and low values of the significant plotted closing price of the Points and Line chart.

The same advantage scenario of the Points and Line chart over the Line chart and The P&F chart explained in the RSI and the MACD indicators applies to the slow stochastic oscillator and the commodity channel index. (See Charts 27 through 29)

Chart 27: Commercial International Bank (COMI.CA) Points and Line chart with the stochastic oscillator (9,5,3)



Chart 28: Commercial International Bank (COMI.CA) Points and Line chart with the commodity channel index—CCI (14)

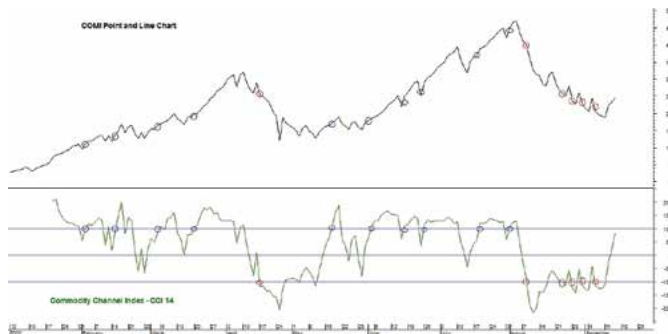
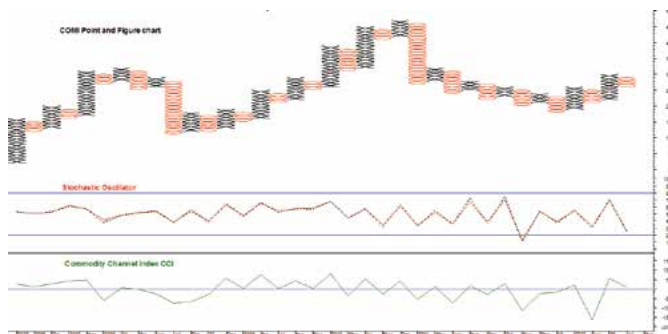


Chart 29: Commercial International Bank (COMI.CA) Point and Figure chart (box size 1 and box reversal 3) with the stochastic oscillator (9,5,3) and the commodity channel index – CCI (14)



4.4 Moving averages, Bollinger bands, and the parabolic stop and reverse (SAR) with the Points and Line chart

As previously explained in Section 2.3.8, the moving averages, the Bollinger bands, and the parabolic stop and reverse (SAR) are well applied on the P&F chart, so in the Points and Line chart, the only difference will be the length of the indicators. The P&F chart will use smaller parameters relative to the Points and Line chart because the number of columns in the P&F chart is smaller relative to the number of points in the Points and Line chart.

The following two charts compare the Points and Line chart to the P&F chart when applying the moving average indicator.

Chart 30: Commercial International Bank (COMI.CA) Points and Line chart with simple moving average (20)

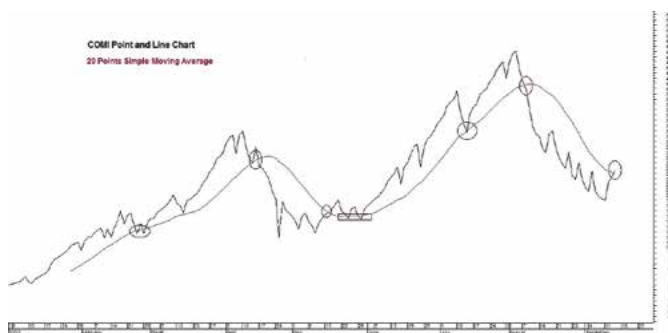
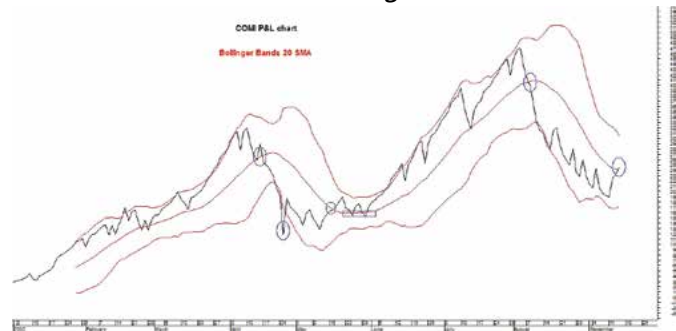


Chart 31: Commercial International Bank (COMI.CA) Point and Figure chart with simple moving average (5)



As can be seen in Charts 30 and 31, the Points and Line chart will give nearly the same results as the P&F chart when the moving average indicator is applied, but the length of the moving average will be smaller in the P&F chart (5 standard moving average) than the Points and Line chart (20 points simple moving average).

Chart 32: Commercial International Bank (COMI.CA) Points and Line chart with Bollinger bands



Bollinger bands used a 20-day simple moving average with two standard deviation bands. These settings will normally be used when applied on the Points and Line chart, as shown in Chart 32, but will be calculated using 20 points instead of 20 days.

On the other hand, when applied on the P&F chart, the Bollinger bands settings must be changed, as Du Plessis pointed out, "In column terms, you will find that around half the suggested moving average length is better for Point and Figure charts, although it is dependent on the make-up of the Point and Figure chart itself. 1 box reversal, and charts constructed with high/low data have wider congestion areas and, therefore, fewer long columns, requiring you to lengthen the moving average."²⁴ It is important here to understand that when the

1 box reversal is used in the P&F chart, the chart will lose its filtration advantage and will show a lot of insignificant short-term movements.

5. The Points and Line Chart Versus the Point and Figure Chart (Practical Example)

After illustrating the Points and Line chart, the following example will focus on the Points and Line chart advantage over the P&F chart in a practical example. (See Charts 33 and 34)

Chart 33: Facebook Inc. (FB.O) Points and Line chart with Total Volume, Number of Days and one point momentum, May to August 2012

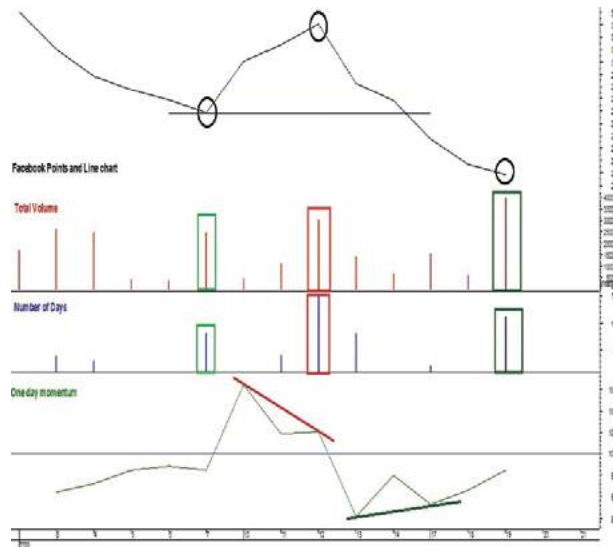
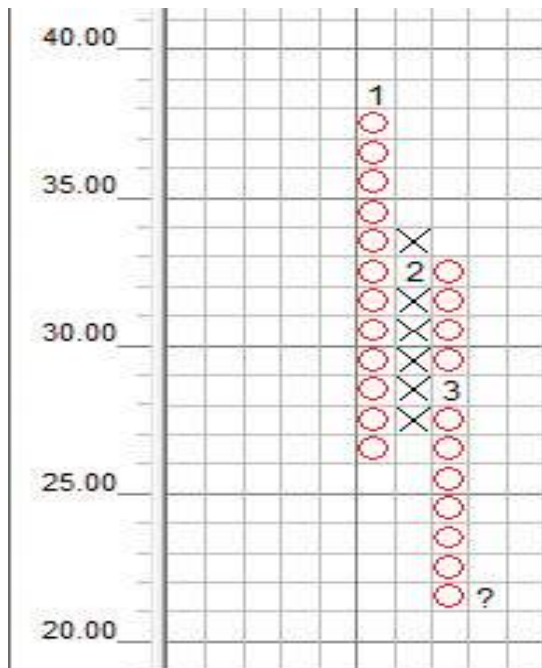


Chart 34: Facebook Inc. (FB.O) P&F chart, May to August 2012



The Facebook stock was selected to focus on the benefits of the Points and Line chart over the P&F chart in each move, as it includes only two significant declines and one rise. As can be observed, the Points and Line chart recorded the same data as the P&F chart, and the same simple sell signal is triggered on both charts. But the Points and Line chart showed the weakness in the stock rise from 25.50 level to 33 level, where the rise slope decreased; the one-point momentum confirmed this weakness. Also, during the decline from 33 to 22, it is clearly shown from the Points and Line chart that this fall is getting weaker, and the momentum indicator is showing the change in the rate of speed of this decline. The number of days and the total volume confirms the significance of the support level at 25.50 as well as the resistance level at 33. Also, both the number of days and the total volume have risen significantly in the last point.

On the other hand, the P&F chart did not show any strength or weakness in the rise or the fall because it has only recorded the rise as a vertical column of Xs and the fall as a vertical column of Os. Furthermore, due to its condensed display, a one-column momentum will not be informative. Finally, volume and number of days are not displayed and thus, all price levels have the same importance.

Conclusion

The paper attempts to introduce a new type of charting technique: the Points and Line chart. This chart can be created by applying the P&F chart calculations on the normal Line chart with specific adjustments. By doing so, the Points and Line chart has the benefit of filtering the price action like the P&F chart to provide clear buy/sell signals while benefiting from the smooth display of the Line chart. Plotting the Points and Line chart in a similar fashion as the Line chart solved the problem of the P&F chart in showing the change in price momentum and trend slope. New concepts have been introduced (the total volume and the number of days), which help in figuring out the significant price levels. The Points and Line chart can be analyzed normally and much more easily than the Line chart because it excludes noise. Target projections applied by the Line chart and the P&F chart can also be applied on the Points and Line chart. It can also be converted to what can be referred to as a 5 points chart. Though the paper has used the standard box size and the 3 box reversal in the calculation of the Points and Line chart, those criteria can be changed according to user preferences. Technical Analysis indicators and oscillators applied on Points and Line chart were found to be filtered from noise owing to the filtration advantage of the chart. Thus, indicators provide clearer buy and sell signals relative to the Line chart and are more easily applicable and efficient compared with the P&F charts. Also, it has been recommended to plot the open, high and low values of the Points and Line closing prices in the database for using them in the indicators or oscillators that use those values in their calculation, like the stochastic oscillator.

Appendix A: Points and Line Chart Examples

This appendix provides additional examples for the Points and Line chart and its applicability on different markets.

The Dow Jones Industrial Average – (.DJI)

Chart A.1 DJIA Points and Line chart with Number of Days from January 1977 to March 2012

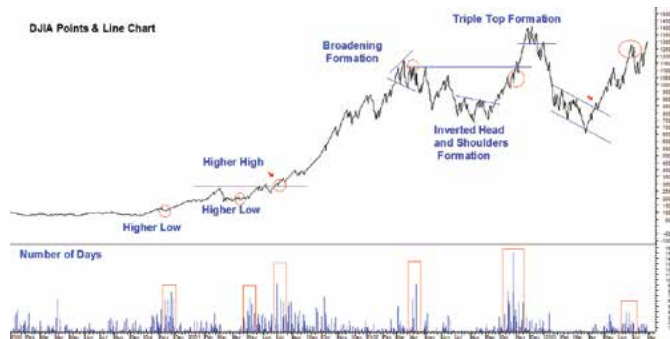
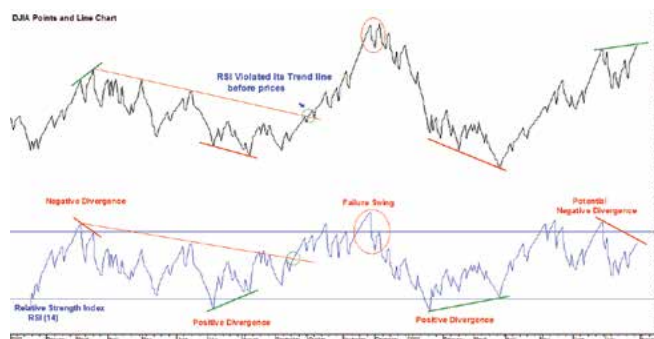


Chart A.2 DJIA Points and Line chart with the relative strength index – RSI (14 Points) from June 1998 to March 2012



Gold – (XAU=D)

Chart A.3 Gold Points and Line chart with Number of Days from August 2003 to March 2012

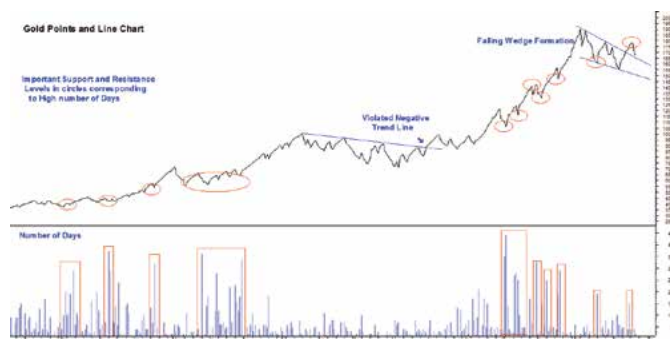
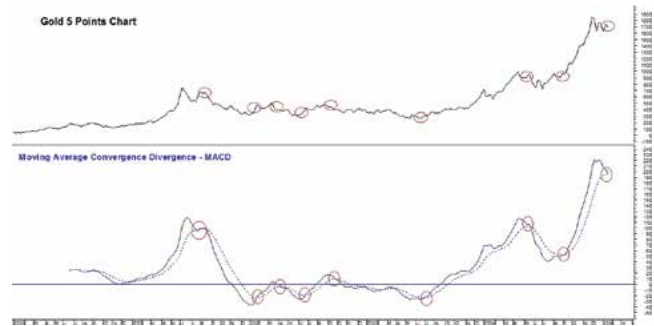


Chart A.4 Gold 5 point chart with moving average convergence divergence (MACD) from March 1968 to March 2012

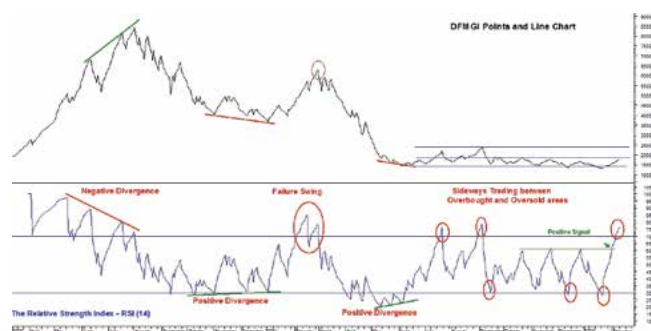


The Dubai Financial Market General Index – (.DFMGI)

Chart A.5 Dubai Financial Market General Index (DFMGI) Points and Line chart analysis with 10 and 20 Points exponential moving averages from January 2004 to October 2010



Chart A.6 Dubai Financial Market General Index (DFMGI) Points and Line chart with the relative strength index – RSI (14 Points) from January 2004 to March 2012



The Egyptian Stock Market Index – (.EGX30)

Chart A.7 EGX 30 Points and Line chart with Total Volume from January 2005 to March 2012

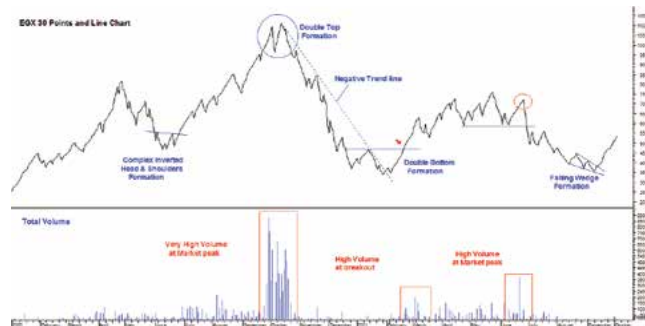
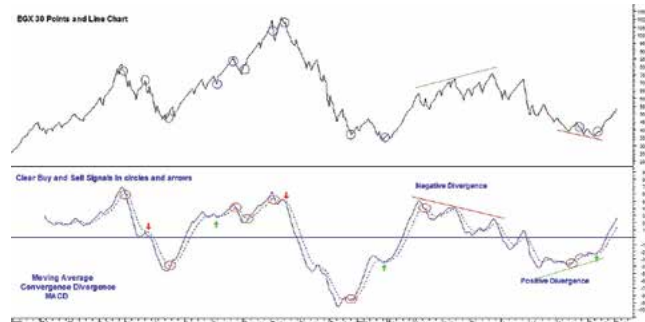


Chart A.8 EGX 30 Points and Line chart with the relative strength index – RSI (14 Points) from January 2005 to March 2012



Chart A.9 EGX 30 Points and Line chart with the moving average convergence divergence (MACD) from January 2005 to March 2012



Commercial International Bank (COMI.CA) – Vertical and Horizontal counts

Chart A.10 Commercial International Bank (COMI.CA) Points and Line chart Vertical Count

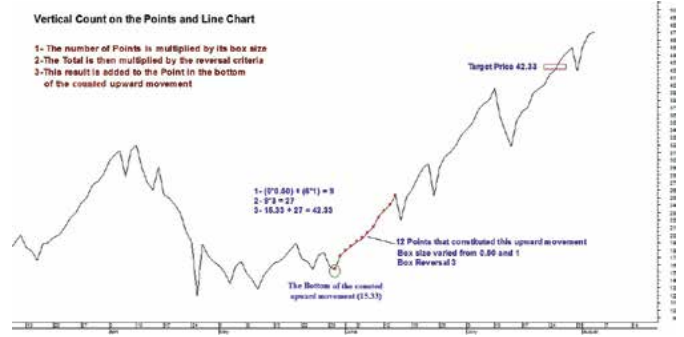


Chart A.11 Commercial International Bank (COMI.CA) Points and Line chart Horizontal Count



Appendix B: Other Filtration Concepts

As explained previously, the aim of this paper is to apply the P&F filtration criteria on the Line chart to benefit from the Line chart smooth display while filtering its noise. This appendix attempts to review other charting techniques that filter the price movements like the P&F chart but with different concepts or criteria. For further studies, those concepts, including its volume and number of days, can be applied on the Points and Line chart.

The 3-day chart moves

The 3-day chart filtration concept depends on the market action itself, not on a specific box size and box reversal like the P&F chart. It filters the market action depending on the number of positive days and negative days; thus, all the moves depend only on calendar days, not on the percentage of rise or decline. The only exception is when there is a significant movement that exceeded the high or the low of the positive or negative days, as W.D. Gann explains, "When a market is advancing and starts up from a low point and makes higher Bottoms and higher tops for 3 consecutive days, the chart is moved up to the top of the third day. Should the market then react for 2 days, you would not record this movement on the chart, but when it moved up above the First Top, continue to move the line up to the top of each day until there were 3 days lower Bottoms. Then you would move the line down to the low of the third day and continue to follow up it down as long as prices went lower. If 2-day rallies occurred,

you would ignore them, except when the market is near extreme high or extreme low prices. In cases of this kind you would record the 2-day moves, especially if the fluctuations were very wide. After a market has been advancing for a considerable time and makes a Double or Triple Top and breaks the last low on the 3-Day chart, you consider that the minor trends, at least, have turned down. When a market is declining and crosses the last Top on the 3-Day chart, you would consider that the trend had turned up at least temporarily.”²⁵ The 3-day criteria can be adjusted, and that is why Gann calls it “the 3-day chart or more” in his book.

The 9-point chart swings

W.D. Gann has also introduced another kind of chart that includes an idea similar to the box reversal of the P&F chart, which is the 9-Points criteria. This kind of chart does not introduce the box size concept of the P&F chart, and thus, it plots the actual prices. It helps in studying how often the market moves from 9 to 10 points. He based it on the stock market averages, which is why it is measured in points.

“When the market is advancing the chart continues to move up until there is a reaction of 9 points or more. When the market is declining, the chart moves down on the line until there is a rally of at least 9 points or more, which is a reversal on the 9-Point chart.”²⁶

The Kagi chart

There are similarities between the Kagi charts and the 3-day Moves and the 9-Point chart swings, in that their line displays are similar and also dependent on the market direction. To draw a Kagi chart, a reversal amount must be chosen similar to the 9-Point and the P&F chart ideas.

“The Kagi charts are most commonly based on closing prices. Before starting the Kagi chart, a turnaround (i.e., or reversal) amount must be chosen. This is the minimum price movement that is needed before a new reversal line can be drawn in the next column.”²⁷

For example, if prices were rising and the reversal amount was 3\$, when prices fall, the chart will not record this decline or change direction until the prices fall below this predetermined amount. On the other hand, if prices continue in the same direction as the prior line, the line will be extended in the same direction, no matter how small the move.

What makes the Kagi chart different compared to the 9-Point chart is that when prices penetrate a prior low or high, the thickness of the of the Kagi lines changes, where the thick Kagi line is called “yang” line and the thin Kagi Line is called a “yin” line.

The three-line break chart

The three-line break chart has the same filtration concept similar to the past reviewed charts, where it depends on the market action itself. However, it differs in its appearance, as the three-line breaks apply the same candlestick appearance concept of white and black blocks.

“The three-line break chart looks like a series of white and black blocks of varying heights. A new block is in a separate column. Each of these blocks is called a line. Using the closing

price, a new white line is added if the previous high is exceeded and a new black line is drawn if the market reaches a new low for the move. If there is neither a new high nor a low, nothing is drawn.”²⁸

To shift from a column to another, the market has to break above (or below) the prior three lines, from where the three-line break name is derived. Volume and time are also not included as in the P&F chart.

The Renko chart

The Renko chart is similar to the three-line breaks in its display, as it is also formed of white and black blocks (referred to as bricks). At the same time, the Renko chart is similar to the P&F chart, as it filters the price action by a predetermined amount but unlike the P&F chart this amount is fixed all the time.

The Renko chart fixed amount filtration criteria is used in moving the previous brick higher (or lower), and it is also used as the reversal criteria that shifts the market in the opposite direction, which is why its bricks are all the same size. Volume and time are also not included as in the P&F chart.

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Technical Software and data

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MS Office, 2003 Microsoft office.

Data provided by Reuters.

Analysis of Up/Down Price Difference in Near Closing Time Range

by Takashi Nakamura, MFTA, MBA, CIIA, CMA, CFP, MRICS, SMECA

Summary

This research focuses on stochastics, a proven and theoretically supported oscillator-type technical analysis tool, and aims to analyze the possibility of its utilization as a new technical analysis tool to detect a change in the trend, to judge whether a stock is overvalued or undervalued, and to judge the right time to sell or buy by applying it to the up/down price difference index in near closing time ranges (a technical index the author originated, hereinafter called the “up/down price difference index”). It reflects an original viewpoint of “stock price movements in particular time ranges near the closing of the day” based on the daily accumulation of rise/fall data before the closing from the viewpoint of buy/sell signs. It also aims to complement the deficiency of oscillator-type technical tools and improve their performance in the actual stock market by changing how to use the technical analysis tool (i.e., how to read the sell/buy sign) considering the characteristics of each country’s stock market. In this research, the objects of analysis are Nikkei Stock Average and Hang Seng Index, the representative indexes of the Japanese and Hong Kong stock markets, two internationally open markets with different momentum effect characteristics. The indexes were measured and compared during the hour before closing in four 15-minute time ranges. As a result of the analysis, a possibility was shown as a tool to detect a change in the trend when the up/down price difference index shows a downward (upward) trend despite the rising (falling) trend of the stock price. Also, it became clear that by indicating the position of the present up/down price difference index in the range between the peak and the bottom of the index in a certain period in the past (a technical index the author originated, hereinafter called the “up/down price difference oscillator”), it can be judged whether the present stock price is overheated or undervalued. It was shown that by changing how to read the buy/sell sign considering the characteristics of the Japanese and Hong Kong stock markets, a more accurate buy/sell sign can be read from the cross of two up/down price difference oscillators calculated for different periods, which leads to an improvement of performance in the actual stock market.

As a result, this research showed a possibility of contributing to improvement of management performance by using, in accordance with the characteristics of the actual stock market, the up/down price difference index and the up/down price difference oscillator as new technical analysis tools to detect a change in the stock price trend, to judge whether a stock is overvalued or undervalued, and to judge the right time to sell or buy.

This research paper is structured as follows.

Introduction: Inference and theoretical background of stochastics

Chapter 1 (Objective)	Objective of research and outline of objects
Chapter 2 (Method)	Research method and implemented tests
Chapter 3 (Supporting material)	Supporting material and test results
Chapter 4 (Conclusion)	Conclusion derived from the supporting material

Notes, list of references cited, bibliography, reference data

Introduction: Inference and theoretical background of stochastics

1. Inference

A variety of chart analysis tools are used in technical analysis, and they are broadly classified into trend-oriented tools, oscillator-type tools and trading volume tools. Trend-oriented chart analysis tools aimed at judging the current trend include: (1) Point and Figure, (2) Parabolic System, (3) Ichimoku Chart, (4) ShinNeAshi, and (5) Renko Ashi. Oscillator-type chart analysis tools, supposedly suitable for judging the market’s fluctuation speed and undervalued/overheated feeling, include (1) RSI, (2) Williams’ R, (3) stochastics, (4) MACD, (5) bullish consensus, and (6) Bollinger bands. Trading volume tools, thought to be suitable for judging the trend and undervalued/overheated feeling, include (1) volume ratio, (2) Wako volume ratio and (3) on-balance volume. Among these analysis tools, this research focuses on stochastics, a proven and theoretically supported technical analysis tool of the oscillator type, as a preceding research, and starts from the inference that a technically effective investment strategy can be developed by applying the viewpoint of sell/buy signs based on trend changes and overheated/undervalued feeling to the up/down price difference index. Many papers have been written using stochastics. For example, Kimura (2009) applied stochastics to analysis of major indexes (such as NY Dow Index, Nikkei Stock Average and crude oil price) and individual stocks, and by changing parameters such as daily and monthly candlesticks, commented on the difference in the degree of applicability of the strategy. Ng (2007) introduced a method to increase the accuracy of sell/buy signs of stochastics by combining it with GMMA (Guppy Multiple Moving Average) and the trend line. Other analyses tested the application of sell/buy signs of stochastics to other fields. The fund and

securities division of the Bank of Tokyo-Mitsubishi (2004) applied sell/buy signs of stochastics to the composite index of the economy and showed a possibility of its use as a means to quantify and visualize momentum of the economy and detect a turnaround of the interest rate. These are examples of many analyses using stochastics. But analysis of this research is based on daily closing prices of “up/down price difference index”, which is an accumulation of market price ranges of increase/decrease toward the closing. So far, no research paper has used such analysis to examine the possibility of using the technical analysis tool. Therefore, analysis of this research also incorporates the viewpoint of contributing to the practical as well as academic side through such analysis.

2. Theoretical background of stochastics

Stochastics is a technical analysis tool, a kind of oscillator analysis tool, devised by George Lane (1984), an American chart analyst. It is often called “fast stochastics” when %K and %D are used, and “slow stochastics” when %D and Slow%D are used. In any case, basically a combination of two lines is used. Stochastics gives a sign that a stock is being oversold or overbought, a feature of oscillator-type index, and uses two lines, whose crossing is regarded as a sell/buy sign. Also, selling/buying based on divergence or convergence with the stock price is regarded as effective. In stochastics, a line approaching zero on the graph indicates that the stock is being oversold, whereas a line approaching 100 indicates that the stock is being overbought. Generally, a stock is deemed as being overbought when %K is 70% to 80% or more and oversold when it is 20% to 25% or less. Also, a buy sign in stochastics is when %K passes %D or %D passes Slow%D from below, and a sell sign is when they pass from above. A convergence, or a rise in stochastics when the stock price is falling, is considered a buy sign. Conversely, a divergence, or a fall in stochastics when the stock price is rising, is considered a sell sign. Stochastics is calculated as follows:

$\%K = 100 \times \frac{\text{the current closing price} - \text{the lowest closing price over the last } n \text{ days}}{\text{the highest closing price over the last } n \text{ days} - \text{the lowest closing price over the last } n \text{ days}}$

$\%D = 100 \times \frac{\{3\text{-day sum of (the current closing price} - \text{the lowest closing price over the last } n \text{ days}) \div (\text{the highest closing price over the last } n \text{ days} - \text{the lowest closing price over the last } n \text{ days})\}}$

Slow%D=3-day moving average of %D

On the other hand, a weakness of a stochastics oscillator is that it is not so effective in a very bullish or very bearish phase of the market. For example, when it is used in a stock market with a strong momentum effect, the market tends to turn very bullish or very bearish, which makes the figure remain at the maximum or minimum level and unable to function as a technical analysis tool.

The author has looked at the concept, equation, preceding research, etc. of stochastics in detail because it is an important technical analysis tool that can be applied to the concept and equator of the up/down price difference oscillator to be analyzed below.

Chapter 1 (Objective): Objective of research and outline of objects

This research aims to analyze the possibility of its utilization as a new technical analysis tool to detect a change in the trend, to judge whether a stock is overvalued or undervalued, and to judge the right time to sell or buy by using the up/down price difference index and up/down price difference oscillator. It also aims to improve the performance in the actual stock market by changing how to use the technical analysis tool (i.e., how to read the sell/buy sign) considering the characteristics of the Japanese and Hong Kong stock markets. This research tests the following hypotheses through analysis of the representative indexes of the Japanese and Hong Kong markets, two internationally open markets with different momentum effect characteristics.

1. Hypotheses

Hypothesis 1: When the up/down price difference index shows a downward (upward) trend despite the rising (falling) trend of the stock price, this may suggest a change in the trend. (A sign of divergence or convergence appears.)

Hypothesis 2: By indicating the position of the present up/down price difference index in the range between the peak and the bottom of the index in a certain period in the past (this is called the up/down price difference oscillator), it may be judged whether the present stock price is overheated or undervalued.

Hypothesis 3: Based on the characteristics of the Japanese and Hong Kong stock markets, a more accurate buy/sell sign can be read from a crossing of two up/down price difference oscillators calculated for different periods and performance in the actual stock market can be improved.

2. Outline of objects of analysis

“Nikkei Stock Average is a stock average index comprising 225 representative stocks among those listed on the First Section of the Tokyo Stock Exchange. It is based on the arithmetic stock price average of ¥176.21 (divisor: 225) on May 16, 1949.”¹ Nikkei Stock Average is calculated as follows:²

Adjusted stock price = stock price x 50(yen)/presumed par value (yen)

Nikkei Stock Average = sum of Adjusted stock price/Divisor

Overseas investors account for over 50% to 60% of trading on TSE in recent years, so it is an internationally open market.

“Hang Seng Index is a market capitalization-weighted index based on floating stocks on the Hong Kong stock market. The constituent companies are categorized into four industry sub-indexes: Hang Seng Commerce & Industry Sub-index, Hang Seng Finance Sub-index, Hang Seng Utilities Sub-index and Hang Seng Properties Sub-index. The index is calculated against the market capitalization on the base date of July 31, 1964, which is set at 100”.³

Hang Seng Index is calculated as follows:⁴

$$\text{Current Index} = \frac{\sum [P(t) \times IS \times FAF \times CF]}{\sum [P(t-1) \times IS \times FAF \times CF]} \times \text{Yesterday's Closing Index}$$

P(t): Current Price at Day t

P(t-1): Closing Price at Day (t-1)

IS: Issued Shares

FAF: Freefloat-adjusted Factor, which is between 0 and 1

CF: Cap Factor, which is between 0 and 1

Overseas investors account for over 40% to 50% of trading on the Hong Kong stock market in recent years, so it is an internationally open market.

Chapter 2 (Method): Research method and implemented tests

The objects of the analysis now having been outlined, the next step is to clarify the difference of characteristics of the Japanese and Hong Kong stock markets from the viewpoint of a stock market's momentum effect on the basis of preceding research.

1. The difference of characteristics regarding momentum effect

From the viewpoint of technical analysis tools, when a momentum effect is working, a stock tends to be bought further (its price tends to rise) even if oscillator indexes and other technical tools indicate that the stock is overvalued. Likewise, the stock tends to be sold (sending down the price) even if indexes show the stock is undervalued. Preceding research of momentum effect of individual markets by Chui (2000), Kato (2003), Tokunaga (2004), and Shiroshita and Moriyasu (2009) conclude that no significant momentum effect was observed in the Japanese stock market. On the other hand, in the Hong Kong stock market, Hameed and Kusnadi (2002), Yasumura (2010), and Cheng and Joseph W (2010) reported they had observed momentum effects. From these observations, it can be concluded that Japanese and Hong Kong stock markets have different characteristics in terms of momentum effect.

2. Period of analysis

As for the period of analysis, the five years from January 2004 to the end of December 2008 were selected to cover periods of rising, declining and leveling-off trends, and as a period for which Nikkei Stock Average and Hang Seng index data could be obtained from a third-party organization to ensure reproducibility and objectivity (Nikkei Stock Average from January 5, 2004, to December 30, 2008; Hang Seng Index from January 2, 2004, to December 31, 2008). As near-closing time ranges, the hour before closing was divided into four segments (15 minutes, 30 minutes, 45 minutes and 1 hour before closing) for the purpose of analysis.

3. Data for analysis

To ensure reproducibility and objectivity, third-party data—Nikkei Stock Average of Nikkei Media Marketing, and Hang Seng Index of Hang Seng Indexes Company Limited—were used.

4. Background information for correct understanding of the analysis system

UDI (Up/Down price difference Index): An index reflecting stock price movements in particular time ranges near the closing of the day based on daily accumulation of data of rise/fall before the closing. UDI is calculated as follows:

$$UDI = n\text{-day sum of (the current closing price} - \text{the price } m \text{ minutes before the closing of the day)}$$

When the stock price rises from a certain time range toward closing, the UDI increases. When the stock price falls from a certain time period toward closing, the UDI drops.

UDO (Up/Down price difference Oscillator): A technical index indicating the position of the present up/down price difference index in the range between the peak and the bottom of the index in a certain period in the past. UDO is calculated as follows:

$$UDO = 100 \times \{(\text{the current closing value of up/down price difference index} - \text{the lowest closing value of up/down price difference index over the last } n \text{ days}) \div (\text{the highest closing value of up/down price difference index over the last } n \text{ days} - \text{the lowest closing value of up/down price difference index over the last } n \text{ days})\}$$

The maximum value of UDO is 100% and the minimum value is 0%. When using UDO, usually the 75% to 80% or higher range is regarded as an indication that the stock price is overheated, and the 20% to 25% or lower range is considered to indicate that the stock is undervalued. In a stock market with a momentum effect, the 75% to 80% or higher range means the stock price has momentum, and the 20% to 25% or lower range means the stock price has no momentum. Also, by using different periods of n days, two UDOs can be calculated:

UDO (Short) <calculated for a shorter period of n days>

and UDO (Long) <calculated for a longer period of n days>.

Usually, when UDO (Short) passes UDO (Long) from below, it is considered a buy sign, and when it passes UDO (Long) from above, it is considered a sell sign. On the other hand, in a stock market with a momentum effect, a sell sign is when UDO (Short) passes UDO (Long) from below, and a buy sign is when UDO (Short) passes UDO (Long) from above.

5. Verification of hypothesis

To verify Hypothesis 1, this paper focused on the Nikkei Stock Average and the Hang Seng Index and calculated the up/down price difference index reflecting stock price movements in particular time ranges near the closing of the day (1 hour, 45 minutes, 30 minutes and 15 minutes before closing) based on daily accumulation of data of rise/fall before the closing. Then the indexes were compared with the stock indexes. If the market closed after the morning session, the values 15 minutes, 30 minutes, 45 minutes and 1 hour before the closing of the session were used. On August 10, 2007, trading on the Hong Kong market was closed in the middle of the session due to a typhoon, so the closing value was used instead of the values 30 minutes, 45 minutes and 1 hour before closing.

To Verify Hypothesis 2, the Nikkei Stock Average and the Hang Seng Index were used, and the up/down price difference oscillator, which indicates the position of the present up/down price difference index within the range between the peak and the bottom of the up/down price difference index in a certain

period in the past, was calculated for 1 hour, 45 minutes, 30 minutes and 15 minutes before closing on the basis of the peak and bottom values in the past 52 weeks (260 days: “n” in the equation). Then the values were compared with the stock price index.

To verify Hypothesis 3, the up/down price difference oscillator was calculated for 1 hour, 45 minutes, 30 minutes and 15 minutes before closing on the basis of the peak and bottom values in the past 26 weeks (130 days) <UDO (Short)> and in the past 52 weeks (260 days) <UDO (Long)>. The stock was sold or bought when <UDO (Short)> and <UDO (Long)> crossed, and performance on the stock market was measured. Considering the country characteristics, it was regarded as a buy sign in the Japanese stock market when UDO (Short) passed UDO (Long) from below and a sell sign when it passed UDO (Long) from above. On the other hand, in the Hong Kong market with momentum effect, it was considered a sell sign when UDO (Short) passed UDO (Long) from below and a buy sign when it passed UDO (Long) from above. The sign changes to sell or buy only when UDO (Short) passes UDO (Long) clearly from above or below. The sign does not change when UDO (Short) and UDO (Long) are the same value. When the sign changed, the performance was measured with the changed position from the next business day onward. To calculate both UDO (Short) and UDO (Long) and measure the performance with the judgment of crossing, up/down ratio data of Nikkei Stock Average from January 24, 2005, to December 30, 2008, and that of Hang Seng Index from January 17, 2005, to December 31, 2008, were used. UDO (Short) and UDO (Long) of Hang Seng Index 1 hour before closing were the same value from January 17, 2005, to January 20, 2005, so performance was measured from the next business day following January 20, 2005, when the lines crossed. Also, UDO (Short) and UDO (Long) of Hang Seng Index 45 minutes before closing were the same value from January 17, 2005, to January 26, 2005, so performance was measured from the next business day following January 27, 2005, when the lines crossed. When there was a sell/buy sign at the beginning of the period, performance was measured from the day's up/down ratio on the basis of the sell/buy sign.

Chapter 3 (Supporting material): Conclusion drawn from the supporting material

1. Analysis of Hypothesis 1

The charts of Nikkei Stock Average, Hang Seng Index and up/down price difference index (UDI) show divergence and convergence (see Figures 1 through 8). In Figure 1, for instance, a convergence is marked with ①, and following stock price movements are marked with ①' (oval). These show an upward trend of UDI despite a downward trend of Nikkei Stock Average, and later the Nikkei Stock Average went up. A divergence is marked with “a” and following stock price movements are marked with “a'” (oval). These show a downward trend of UDI

despite an upward trend of Nikkei Stock Average, and later Nikkei Stock Average went down. Convergence ② shows that the up/down price difference index is showing an upward trend despite the falling stock price, suggesting a possibility that the stock price may begin to rise. But, later stock price movements are not covered in this measurement period, so there is no ②' or oval in this chart. During the measurement period, Nikkei Stock Average went up for a longer period by convergence rather than by divergence. The duration totals more than one year. In the case of the Hang Seng index, only convergence appears, and the duration is notably longer compared with the Nikkei Stock Average.

** In the following graphs, “Nikkei index” means Nikkei Stock Average and “Hong Kong Hang Seng index” means Hang Seng index.*

Figure 1: Nikkei Stock Average and up/down price difference index 1 hour before closing

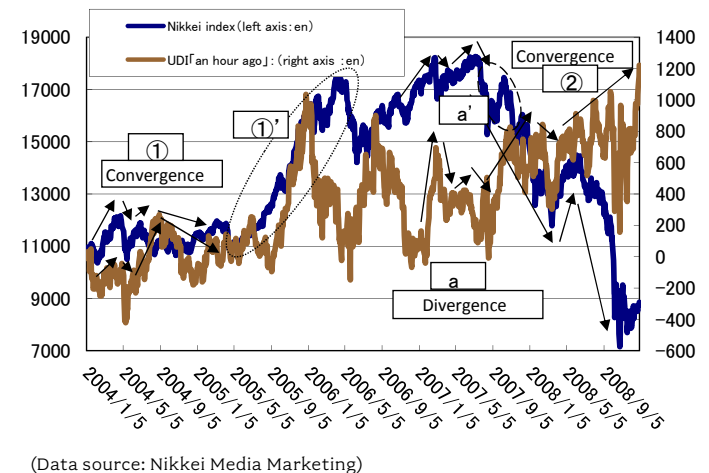


Figure 2: Nikkei Stock Average and up/down price difference index 45 minutes before closing

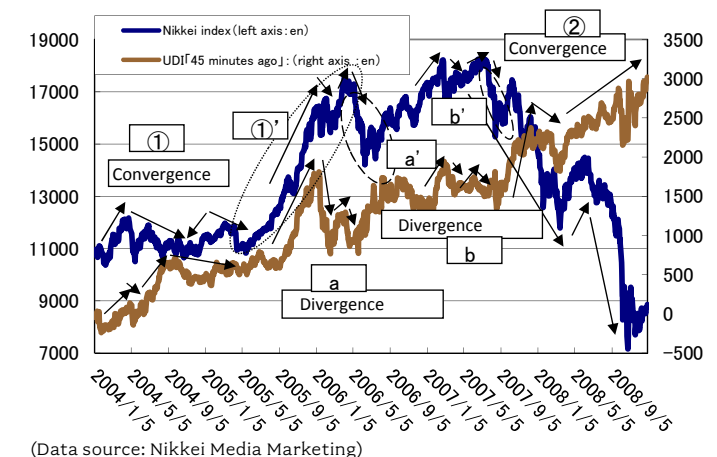
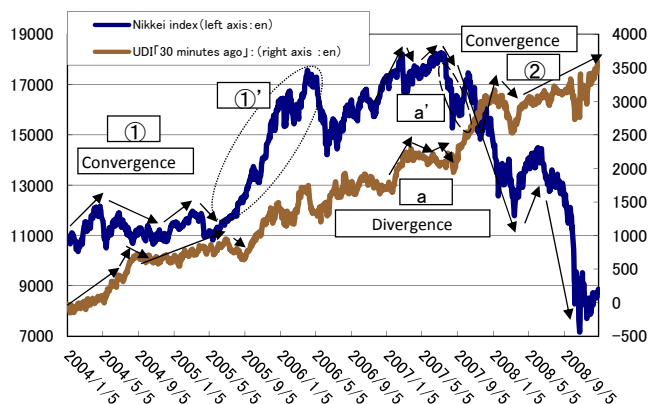
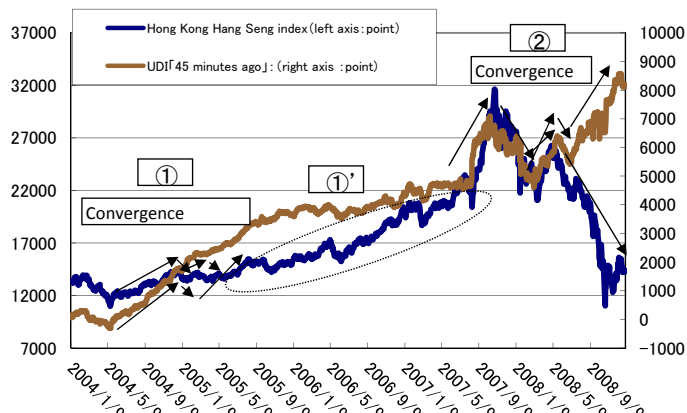


Figure 3: Nikkei Stock Average and up/down price difference index 30 minutes before closing



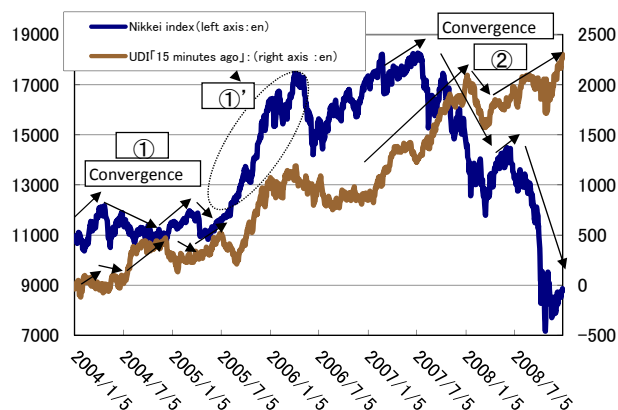
(Data source: Nikkei Media Marketing)

Figure 6: Hang Seng Index and up/down price difference index 45 minutes before closing



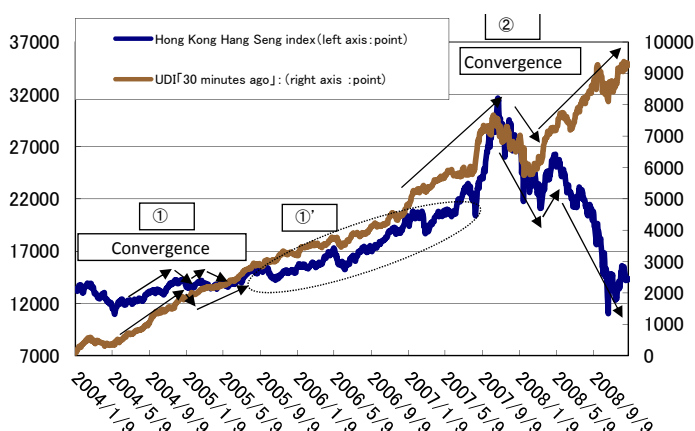
(Data source: Hang Seng Indexes Company Limited)

Figure 4: Nikkei Stock Average and up/down price difference index 15 minutes before closing



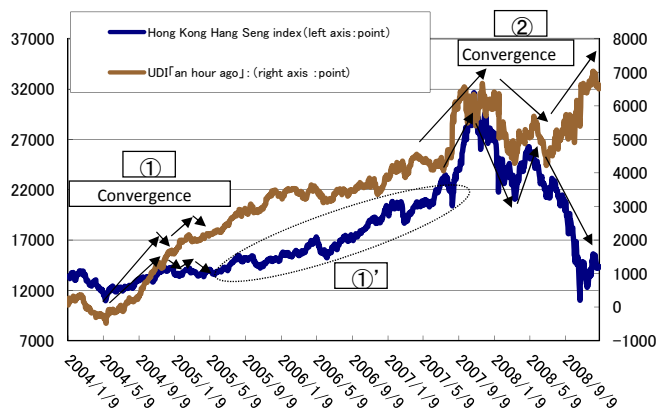
(Data source: Nikkei Media Marketing)

Figure 7: Hang Seng Index and up/down price difference index 30 minutes before closing



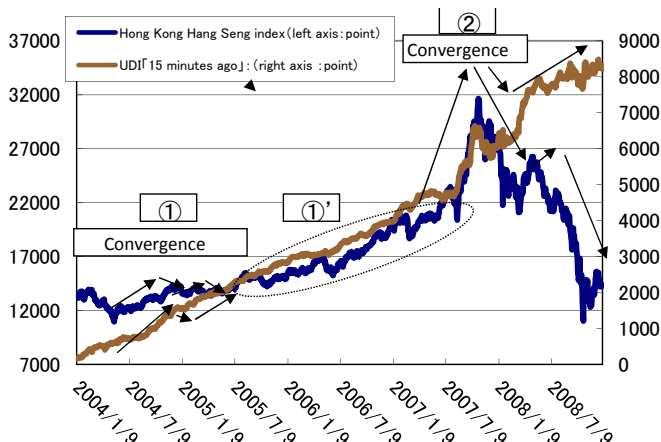
(Data source: Hang Seng Indexes Company Limited)

Figure 5: Hang Seng Index and up/down price difference index 1 hour before closing



(Data source: Hang Seng Indexes Company Limited)

Figure 8: Hang Seng Index and up/down price difference index 15 minutes before closing



(Data source: Hang Seng Indexes Company Limited)

2. Analysis of Hypothesis 2

The graphs of Nikkei Stock Average and UDO show that generally, there is a sense of being undervalued in the range under 25% and of being overheated in the range above 85%. In other words, after UDO enters the undervalued range, Nikkei Stock Average generally tends to rebound, whereas after UDO enters the overheated range, Nikkei Stock Average generally tends to decline. Both ranges are marked in the graphs (see Figures 9 through 12). On the other hand, the graphs of the Hang Seng index and UDO show that generally, in the Hong Kong market with momentum effect, the stock price has momentum in the range above 85% and no momentum in the range below 25%. In other words, after UDO enters a range with momentum, generally the Hang Seng index tends to go up, whereas after UDO enters a range without momentum, the Hang Seng index tends to go down. Both ranges are marked in the graphs (see Figures 13 through 16).

Figure 9: Nikkei Stock Average and UDO 1 hour before closing

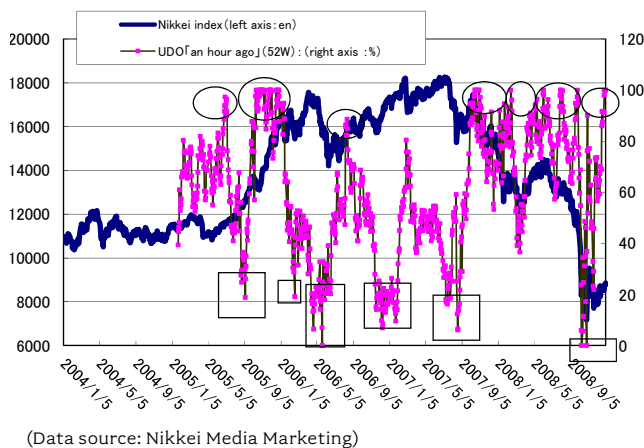


Figure 10: Nikkei Stock Average and UDO 45 minutes before closing

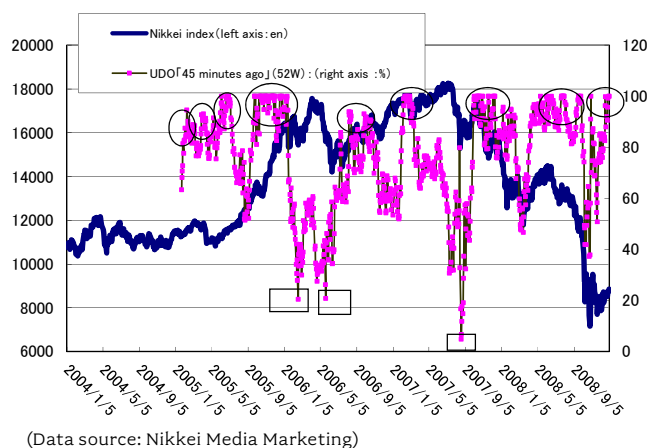


Figure 11: Nikkei Stock Average and UDO 30 minutes before closing

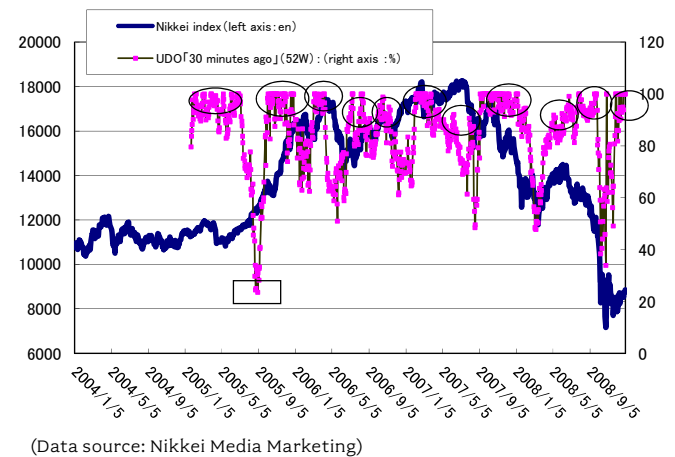


Figure 12: Nikkei Stock Average and UDO 15 minutes before closing

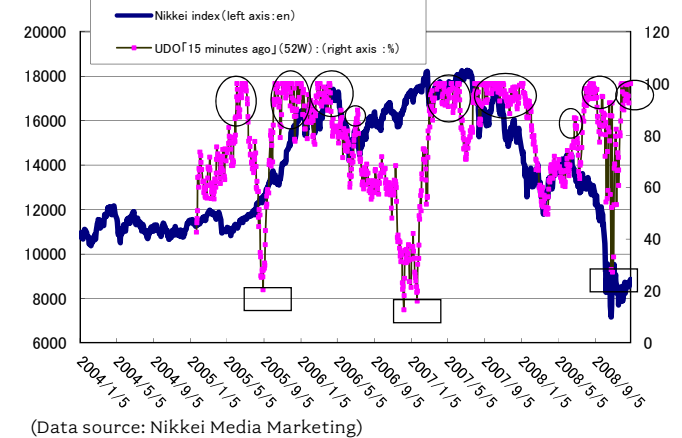


Figure 13: Hang Seng Index and UDO 1 hour before closing

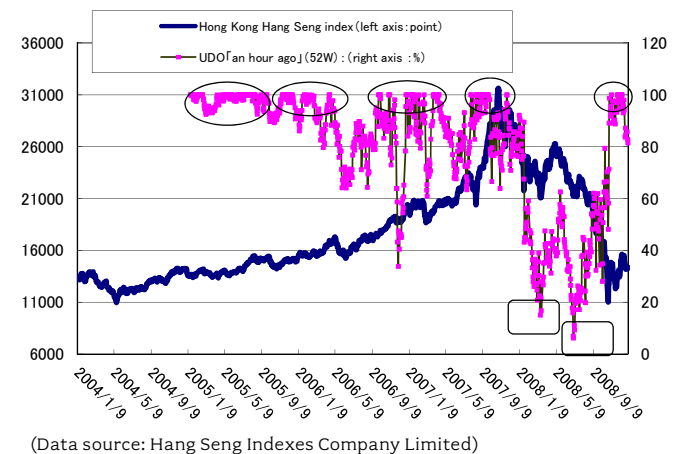
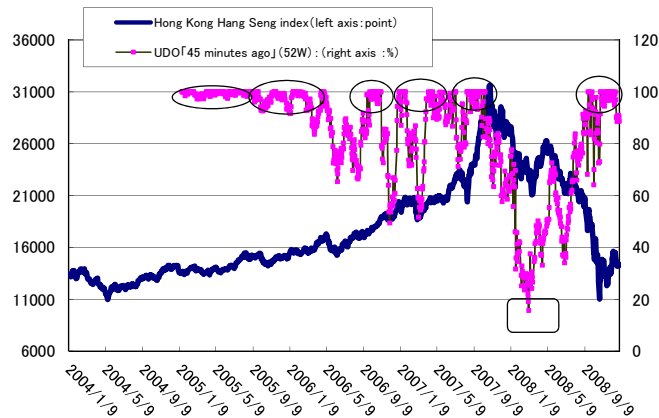
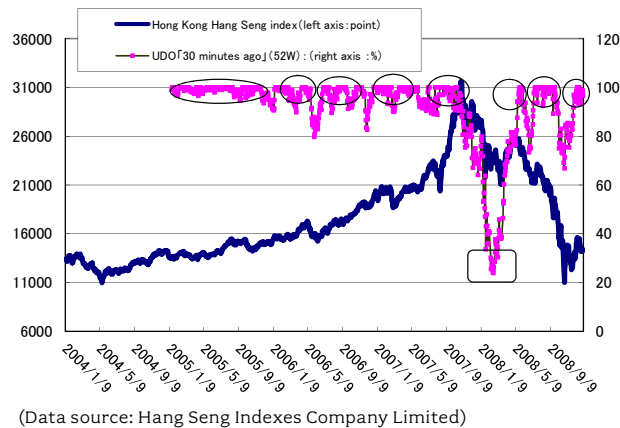
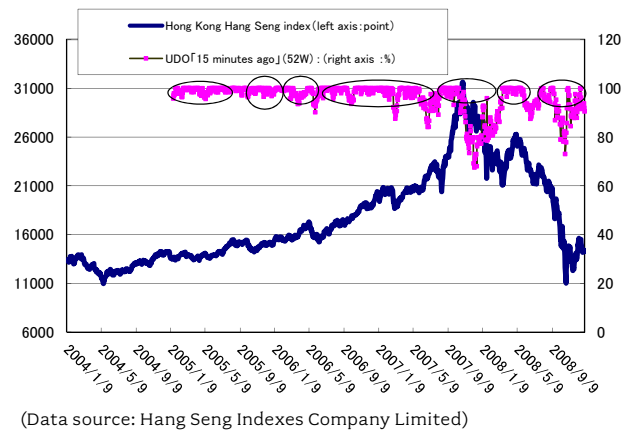


Figure 14: Hang Seng Index and UDO 45 minutes before closing**Figure 15: Hang Seng Index and UDO 30 minutes before closing****Figure 16: Hang Seng Index and UDO 15 minutes before closing**

3. Analysis of Hypothesis 3

Performance of trading using the crossing of UDO (26 weeks) and UDO (52 weeks) of Nikkei Stock Average and sell/buy signs based on their crossing are shown in Tables 1 and 2.

The difference(α): the cumulative return (UDO strategy) – the cumulative return (buy and hold) was positive except for 1 hour before closing. The cumulative return of Figures 17 through 20 shows the return based on the UDO strategy (Table 1).

Table 1: Cumulative return based on crossing of UDO (26 weeks) and UDO (52 weeks) of Nikkei Stock Average by time range: [UDO strategy] and cumulative return based on [buy and hold]

	(UDO strategy)	(buy and hold)	
Nikkei	cumulative return	cumulative return	difference(α)
「an hour ago」	-13.3%	-8.8%	-4.5%
「45 minutes ago」	35.5%	-8.8%	44.3%
「30 minutes ago」	8.8%	-8.8%	17.6%
「15 minutes ago」	18.0%	-8.8%	26.8%

(Data source: Nikkei Media Marketing)

Table 2: Sell/buy signs based on crossing of UDO (26 weeks) and UDO (52 weeks) of Nikkei Stock Average by time range: [UDO strategy]

Nikkei	「an hour ago」	Nikkei	「45 minutes ago」	Nikkei	「30 minutes ago」	Nikkei	「15 minutes ago」
sign	date	sign	date	sign	date	sign	date
buy①	2005/4/8	sell①	2005/1/24	sell①	2005/1/24	sell①	2005/1/24
sell①	2005/4/11	buy①	2005/5/11			buy①	2006/11/22
buy②	2005/4/15	sell②	2005/5/12			sell②	2007/4/16
sell②	2005/4/18	buy②	2005/6/3			buy②	2008/7/24
buy③	2005/4/28	sell③	2005/6/8			sell③	2008/8/5
sell③	2005/5/17	buy③	2006/7/24			buy③	2008/8/7
buy④	2005/5/27	sell④	2006/11/28			sell④	2008/8/8
sell④	2005/7/21	buy④	2007/9/7			buy④	2008/8/13
buy⑤	2006/7/7	sell⑤	2007/10/10			sell⑤	2008/8/20
sell⑤	2006/11/28						
buy⑥	2007/2/27						
sell⑥	2007/8/17						
buy⑦	2007/8/29						
sell⑦	2007/9/5						
buy⑧	2007/9/7						
sell⑧	2007/9/12						
buy⑨	2007/9/13						
sell⑨	2007/10/24						

In the UDO strategy for Nikkei Stock Average, the number of signal occurrences was the largest one hour before closing compared with the other three time ranges, but the difference(α) was negative. On the other hand, the number of signal occurrences 45 minutes and 15 minutes before closing were about half that of one hour before, and the signal occurred only once 30 minutes before closing, but the difference(α) was positive. This means that frequent occurrence of signals does not mean effectiveness of strategy, while the effectiveness of the UDO strategy for the Nikkei index tended to increase when the signal occurrences were small in number.

The statistical significance was not particularly high (Table 3), but the UDO strategy generally indicated predictability of stock price.

Performance of trading using the crossing of UDO (26 weeks) and UDO (52 weeks) of the Hang Seng Index and sell/buy signs

based on their crossing are shown in Tables 4 and 5.

The difference(α): the cumulative return (UDO strategy) – the cumulative return (buy and hold) was positive except for 15 minutes before closing (Table 4). The cumulative return of Figures 21 through 24 shows the return based on the UDO strategy. In the analysis of 15 minutes before closing, a buy sign occurred at the beginning of the period, but no buy or sell sign occurred after that. Therefore, the difference (α) is zero, as the (UDO strategy) cumulative return and the (buy and hold) cumulative return are the same. In the UDO strategy for the Hang Seng Index, the number of signal occurrences was one to three in each of the four time ranges, but the difference (α) was positive except for 15 minutes before closing. This means that effectiveness of the UDO strategy tended to increase when the signal occurrences were small in number, as in the case of the UDO strategy for the Nikkei Stock Average.

Table 3: Basic statistical data (UDO strategy and buy and hold of Nikkei Stock Average)

Nikkei		monthly basis			
an hour ago		coefficient	standard error	t	P
sample n	intercept(UDO strategy)	-0.00641435	0.005659024	-1.1334721	0.2628891
48	(buy and hold)	-0.7827688	0.094065732	-8.3215087	9.975E-11
45 minutes ago		coefficient	standard error	t	P
sample n	intercept(UDO strategy)	0.003322089	0.003801295	0.87393602	0.3866929
48	(buy and hold)	-0.89412607	0.063186084	-14.15068	2.255E-18
30 minutes ago		coefficient	standard error	t	P
sample n	intercept(UDO strategy)	-0.00253263	0.001142973	-2.2158262	** 0.0316912
48	(buy and hold)	-0.93041484	0.018998788	-48.972327	2.444E-41
15 minutes ago		coefficient	standard error	t	P
sample n	intercept(UDO strategy)	-0.00034614	0.003694577	-0.0936899	0.9257624
48	(buy and hold)	-0.87151533	0.061412185	-14.191245	2.025E-18
monthly basis, sample number 48					
**significant (5 percent level of significance), *significant (10 percent level of significance)					

(Data source: Nikkei Media Marketing)

Table 4: Cumulative return based on crossing of UDO (26 weeks) and UDO (52 weeks) of Hang Seng Index by time range: [UDO strategy] and cumulative return based on [buy and hold]

	(UDO strategy)	(buy and hold)	
Hong Kong	cumulative return	cumulative return	difference(α)
「an hour ago」	96.2%	23.9%	72.3%
「45 minutes ago」	79.4%	23.3%	56.1%
「30 minutes ago」	33.9%	24.3%	9.6%
「15 minutes ago」	24.3%	24.3%	0.0%

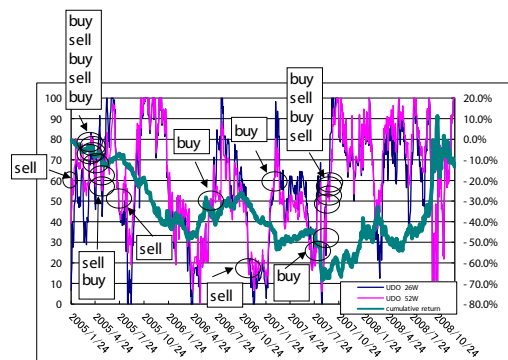
(Data source: Hang Seng Indexes Company Limited)

Table 5: Sell/buy signs based on crossing of UDO (26 weeks) and UDO (52 weeks) of Hang Seng Index by time range: [UDO strategy]

Hong Kong	「an hour ago」	Hong Kong	「45 minutes ago」	Hong Kong	「30 minutes ago」	Hong Kong	「15 minutes ago」
sign	date	sign	date	sign	date	sign	date
buy①	2005/1/20	buy①	2005/1/27	buy①	2005/1/17	buy①	2005/1/17
sell①	2008/8/4	sell①	2008/4/25	sell①	2008/4/25		
		buy②	2008/9/23	buy②	2008/5/27		

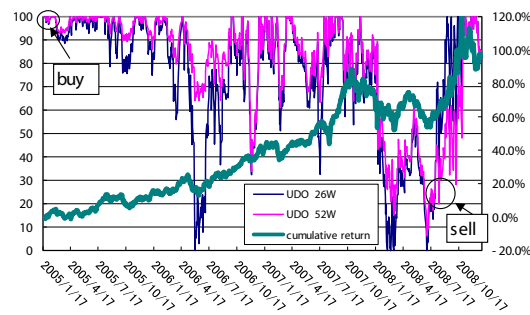
(Data source: Hang Seng Indexes Company Limited)

Figure 17: UDO (26 weeks) and UDO (52 weeks) of Nikkei Stock Average 1 hour before closing and cumulative performance



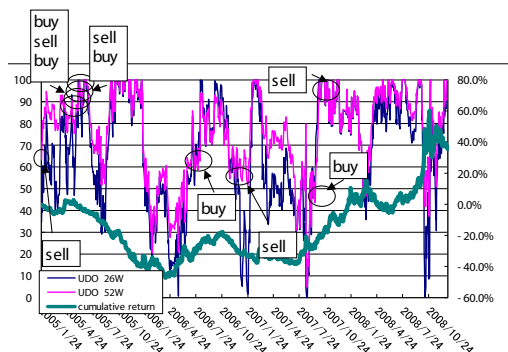
(Data source: Nikkei Media Marketing)

Figure 21: UDO (26 weeks) and UDO (52 weeks) of Hang Seng Index 1 hour before closing and cumulative performance



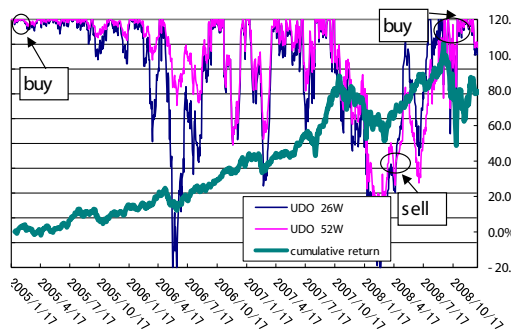
(Data source: Hang Seng Indexes Company Limited)

Figure 18: UDO (26 weeks) and UDO (52 weeks) of Nikkei Stock Average 45 minutes before closing and cumulative performance



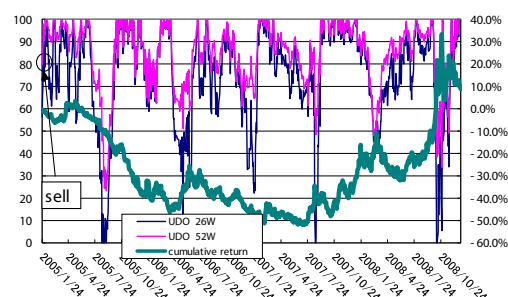
(Data source: Nikkei Media Marketing)

Figure 22: UDO (26 weeks) and UDO (52 weeks) of Hang Seng Index 45 minutes before closing and cumulative performance



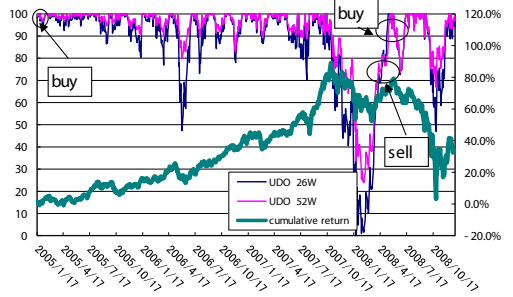
(Data source: Hang Seng Indexes Company Limited)

Figure 19: UDO (26 weeks) and UDO (52 weeks) of Nikkei Stock Average 30 minutes before closing and cumulative performance



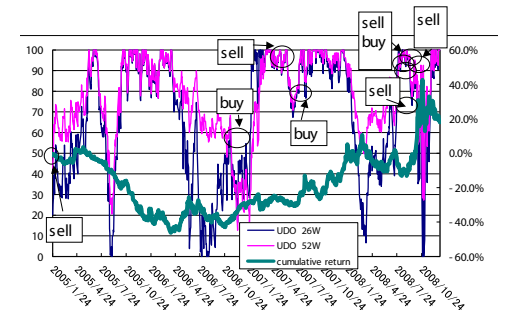
(Data source: Nikkei Media Marketing)

Figure 23: UDO (26 weeks) and UDO (52 weeks) of Hang Seng Index 30 minutes before closing and cumulative performance



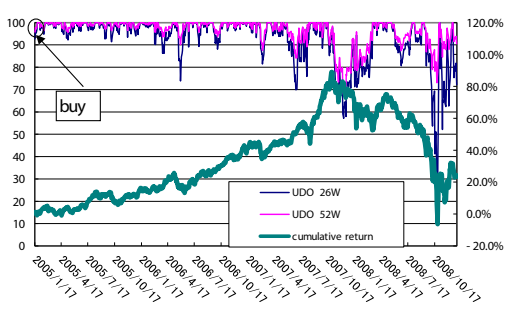
(Data source: Hang Seng Indexes Company Limited)

Figure 20: UDO (26 weeks) and UDO (52 weeks) of Nikkei Stock Average 15 minutes before closing and cumulative performance



(Data source: Nikkei Media Marketing)

Figure 24: UDO (26 weeks) and UDO (52 weeks) of Hang Seng Index 15 minutes before closing and cumulative performance



(Data source: Hang Seng Indexes Company Limited)

The statistical significance was not particularly high (Table 6), but the UDO strategy generally indicated predictability of stock price.

Chapter 4 (Conclusion): Conclusion derived from the supporting material

Verification of Hypotheses 1, 2 and 3 showed the possibility to detect a change in the trend when the up/down price difference index shows a downward (upward) trend despite the rising (falling) trend of the stock price. Also, it became clear that by indicating the position of the present up/down price difference index in the range between the peak and the bottom of the index in a certain period in the past (hereinafter called the “up/down price difference oscillator”), it can be judged whether the present stock price is overheated or undervalued. It was shown that by changing how to read the buy/sell sign, considering the characteristics of the Japanese and Hong Kong stock markets, a more accurate buy/sell sign can be read from the cross of two up/down price difference oscillators using different moving averages, which leads to an improvement of performance. As

Table 6: Basic statistical data (UDO strategy and buy and hold of Hang Seng Index)

Hong Kong		monthly basis				
an hour ago			coefficient	standard error	t	P
sample n		intercept(UDO strategy)	0.01700773	0.00854406	1.99059113 *	0.0524865
	48	(buy and hold)	0.36087698	0.123308951	2.92660815	0.0053095
45 minutes ago			coefficient	standard error	t	P
sample n		intercept(UDO strategy)	0.012519414	0.006241483	2.0058396 *	0.0507753
	48	(buy and hold)	0.691210551	0.090102622	7.67137001	9.061E-10
30 minutes ago			coefficient	standard error	t	P
sample n		intercept(UDO strategy)	0.002112127	0.002456305	0.85987955	0.3943148
	48	(buy and hold)	0.962966198	0.035441263	27.1707645	5.646E-30
15 minutes ago			coefficient	standard error	t	P
sample n		intercept(UDO strategy)	-8.6736E-19	2.20266E-18	-0.3937801	0.6955628
	48	(buy and hold)	1.0	3.17814E-17	3.1465E+16	0
monthly basis, sample number 48						
**significant (5 percent level of significance), *significant (10 percent level of significance)						

(Data source: Hang Seng Indexes Company Limited)

a result, this research showed a possibility of contributing to improvement of performance by using, in accordance with the characteristics of the actual stock market, the up/down price difference index and the up/down price difference oscillator as new technical analysis tools to detect a change in the stock price trend, to judge whether a stock is overvalued or undervalued, and to judge the right time to sell or buy.

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Reference data: Nikkei Media Marketing, Hang Seng Indexes Company Limited

Notes

1. Bloomberg
2. Nikkei Inc.
3. Bloomberg
4. Hang Seng Indexes Company Limited

Application of Internal Patterns of Fibonacci Retracement on the Currency Exchange Market

by Viktor Pershikov, MFTA

Abstract

This paper describes internal patterns of Fibonacci retracement, a new way of trading based on the Fibonacci retracement tool.

The main objective of this theoretical study is to add to the existing body of knowledge on this technical analysis tool with new methods and ways of trading on the foreign exchange market.

The five major currency pairs in Forex trading and their historical changes on the H1 timeframe over the period from 2005 to 2012 have been selected as the material for the study. The Fibonacci retracements given in the paper have been constructed using the Dynamic Trader application.

Identification and testing of internal patterns have been accomplished manually, since Fibonacci retracement must always be constructed based on the trend's extremes, which are essentially dynamic, and it is impossible to develop a single model-finding heuristic that would work in every market situation. The paper describes the specific methods of retracement construction that simplify the process of internal patterns identification.

The research presented in the paper results in the establishment of new technical analysis models, namely, the internal patterns of Fibonacci retracement, the statistics of which make this analysis tool one of the most precise Fibonacci trading methods in the Forex market. Over the time span that the five currency pairs have been observed, 927 models have been formed. During the period from 2005 to 2012, no pattern has demonstrated negative dynamics, in which the number of the losing cases would have been greater than the number of the profitable ones.

The internal patterns of retracement are a simple trading method, since all that is required is to construct the retracement for a particular segment of the trend movement in order to determine the correction, and to identify the Fibonacci levels involved in the model. Each model contains information on the levels at which the stop-loss and take-profit orders are placed.

The point of this paper is to present a non-traditional approach to using the retracement as a support and resistance levels tool. The paper describes systemic trading methods based on repeated price models identifiable using Fibonacci retracement.

This paper is a result of many years of using the technical models described below in real-life trading.

1. Introduction

Fibonacci retracement, also known as Fibonacci lines, is one of the most popular instruments of technical analysis, with a multitude of possible ways of application. This instrument

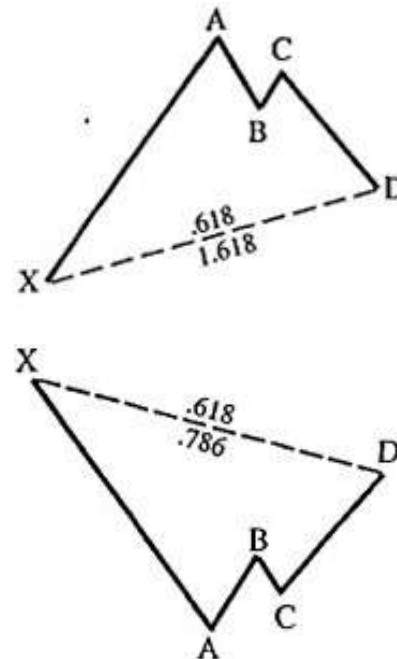
has been applied with success on the stock and commodity exchange markets as well as on the foreign exchange market Forex.

Widely known and popular, this tool has gained recognition among traders and analysts, and during the last few decades many books and research papers have been published on the subject of its application in trading and technical analysis of exchange markets.

The first researcher who has laid the foundation of trading based on the patterns of Fibonacci ratios was H.M. Gartley. In his book *Profits In the Stock Market*, he described a pattern consisting of five base points.¹

Later, this pattern had been further developed and enhanced by Larry Pessavento and presented in his book *Fibonacci Ratios with Pattern Recognition*. The pattern Gartley 222² as well as other patterns based on the Fibonacci ratios is one of the most successful trading models that can be applied to trading on exchange markets with positive results (Figure 1).

Figure 1. The pattern "Gartley 222"



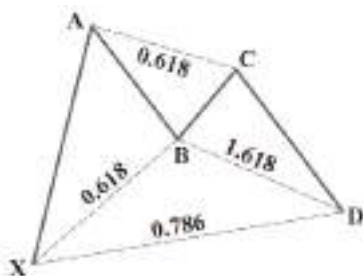
Source: Pessavento Larry, *Fibonacci ratios with pattern recognition*. Traders Press, 1997, p. 56, 64

To apply this pattern correctly in trading, the parameters and ratios of the waves comprising the model must be verified using the Fibonacci retracement.

One of the best descriptions of the wave ratios within this pattern is the one offered by Scot Carney, so-called "Ideal Gartley"³ where each point of the pattern corresponds to a level

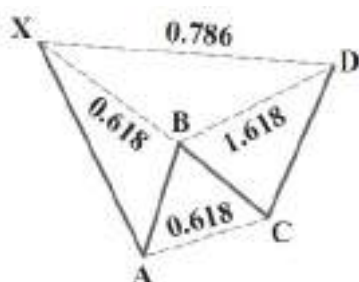
within the Fibonacci retracement. In his book *The Harmonic Trading*, Scot Carney offered bullish and bearish models of the Ideal Gartley pattern (Figures 2 and 3).

Figure 2. Ideal bullish Gartley



Source: Carney S. *Harmonic Trading: Volume One*. FT press, 2010, p.115

Figure 3. Ideal bearish Gartley



Source: Carney S. *Harmonic Trading: Volume One*. FT press, 2010, p.118

The research presented in this paper is based on the aforementioned patterns (Figures 1 through 3). They are essentially complete correctional models, whilst the internal patterns of Fibonacci retracement enable the trader to make decisions within the correction as it develops, without having to wait for its completion.

The internal patterns of retracement are price movements within the correction, which occur between two key levels of the retracement (designated as Level 1 and Level 2). Each pattern has its own target level, at which a take-profit order should be placed, and the model termination level where a stop-loss order is called for. The internal patterns of retracement are models that can be used as the base for one's trading strategy in the Forex market.

The idea to use the internal patterns of Fibonacci retracement has come to the author after reading the book *Fibonacci For The Active Trader*, by Derrick S. Hobbs, who cites a number of excellent trading strategies based on Fibonacci tools (e.g., the Heisenberg 200, the Shark Attack, the Air Pockets).⁴ These strategies take advantage of sets of conjectures created using Fibonacci tools as well as certain additional tools of analysis (SMA, ADX). The question that arises upon considering the book's ideas on the practical applications of retracement, is this: is it possible to develop profitable methods of trading based only on Fibonacci retracement, without turning to additional analysis tools? The objective of this study is to demonstrate that one can make money on the currency market using the retracement only, and that additional analysis methods are not necessary. All that is needed is to identify the type of the retracement pattern being formed and make trades according to a corresponding model.

Another concept that has become a cornerstone of this paper has to do with evaluating the length of correction. This concept has been developed by Robert Fischer and presented in his book *The New Fibonacci Trader. Tools & Strategies for Trading Success*:

'Forecasting the exact size of a correction is an empirical problem; investing after a correction of just 38.2% might be too early, whereas waiting for a correction of 61.8% might result in missing strong trends completely.'⁵

This statement would be difficult to argue with. But the problem can be approached from another direction: if there are methods that enable trading from within a developing correction, the task of determining its length becomes secondary. The main objective in this case would be to identify the correctional movement's target, which can also become the level of correction's termination. This problem is easily solved by using the internal patterns of retracement, since each pattern contains information about its target level (the profit take-profit level).

2. Presenting the Hypotheses

This paper aims to confirm the following hypotheses developed in the process of studying the behavior of price correction in the currency market:

1. In the process of moving between the levels of Fibonacci retracement, the price forms certain typical models, which can be designated technical analysis patterns.
2. There exist additional levels of Fibonacci retracement, based on which it is possible to identify more patterns.
3. Using the internal patterns of retracement that are formed as the correction develops, it is possible to determine the target of the correctional movement.

The first hypothesis is central to this paper, most of which is dedicated to examining it. To confirm this hypothesis, examples of the patterns forming on the major currency pairs of the Forex market will be given, along with the statistical data on the developing patterns, which is necessary to determine the number and forecasting performance of the patterns forming on the assets of the Forex market.

To confirm the second hypothesis, two additional Fibonacci levels will be presented and described in the third chapter of this paper. The sample currency pair diagrams will demonstrate how these auxiliary Fibonacci retracement levels can assist in describing a greater number of internal correctional models.

The third hypothesis provides a perspective on the internal patterns of retracement as a currency market trading tool. If a particular internal pattern of retracement performs well during historical price model testing, then the market entry and target level information contained in that pattern can be used for trading in the Forex market. The statistics of trading based on the internal patterns is presented in Chapter 5.

3. The Study Methodology and Identification of the Internal Patterns of Retracement

The study presented in this paper is based on the actual historical price changes of the major Forex market currency pairs. Five such pairs have been selected for observation:

- EUR/USD
- GBP/USD
- USD/CHF
- USD/CAD
- USD/JPY

These currency pairs are chosen as the main objects of this study since they are the most popular assets among traders in the Forex market. The history of price fluctuations for these currency pairs is long enough to make examining them worthwhile.

The H1 timeframe has been chosen for studying and testing the internal patterns of retracement, as this is a popular trading timeframe with enough internal patterns in it to draw definite conclusions regarding the forecasting value of the models.

The 7-year time interval from January 2005 to December 2012 has been selected for testing the patterns. This period of time provides a sufficient sample of price fluctuations in the currency market and is also historically close to the present.

3.1 Fibonacci retracement settings

In addition to the basic Fibonacci levels of 23.6%, 38.2%, 50% and 61.8%, this study makes use of two additional levels of Fibonacci retracement, which have no widespread application in technical analysis. These levels are 9% and 14.6%.¹

They have been identified based on the 23.6% level:

$$23.6\% = 61.8\% - 38.2\%$$

$$14.6\% = 38.2\% - 23.6\%$$

$$9\% = 23.6\% - 14.6\%$$

1. The use of the levels 14.6% and 9% in trading, from the perspective of EWA (Elliot Wave Analysis), has been described in the book *Harmonic Elliott Wave: The Case for Modification of R. N. Elliott's Impulsive Wave Structure*, by Ian Copsey.⁶ However, these levels are less significant as compared to the key levels of retracement (38.2%, 50% and 61.8%).
2. Also, possible use of the 14.6% level is mentioned in George MacLean's book *Fibonacci and Gann Applications in Financial Markets*.⁷
3. Despite the fact that these levels are easily calculated and applicable in the analysis of price fluctuations, they have not been given due attention in technical analysis. The study presented in this paper attempts to reveal the properties of the 14.6% and 9% levels in terms of using them in trading based on Fibonacci retracement.

Using the 14.6% and 9% levels allows for the description of more models occurring in the currency market correction. The examples of using these additional levels will be presented in Chapter 4 of this paper.

3.2 Manual testing methodology of the internal patterns of Fibonacci retracement

To introduce the research procedures common across multiple models, the Dynamic Traderⁱⁱ software has been selected as one that enables automatic measurement of distances between price movement extremes. This is necessary

for constructing a Fibonacci retracement. This software application makes the task of constructing a retracement and identifying its internal patterns significantly easier.

Figure 4 shows the chart of the EUR/USD pair with automatically drawn (in the Auto Swings - Major-term Primary mode) lines constructed on the price fluctuations. Based on this automatic markup, a Fibonacci retracement is then constructed.

Figure 4. A Fibonacci retracement constructed on the downswing (in the Major-term Primary mode), using Dynamic Trader. EUR/USD, H1



The research and testing of the internal patterns of retracement have been conducted using the Dynamic Trader software over the period from 2005 to 2012, manually. A Fibonacci retracement was constructed for each swing formed on the graph in the Dynamic Trader program. Then the presence or absence of a pattern was identified, as well as the outcome of its development (success or failure of the model).

Manual testing and examination of patterns allowed the most comprehensive and precise statistical data to be obtained on the interactions between price and the internal patterns of retracement as they developed. Studying manually the five major Forex market pairs throughout the 7-year period is a testing method just as precise as automatic testing, and therefore, the result of the painstaking search for patterns on the H1 timeframe has become the foundation of this paper.

To identify the internal patterns of retracement using the Dynamic Trader application, the following procedure has been used:

1. Auto swings were drawn on the currency pair graph in the Major-term Primary mode (so as to describe the main short-term trend of the pair).
2. A Fibonacci retracement was constructed based on the swings formed by the software, from min to max in the upward trend or from max to min in the downward trend.
3. In the price correction process, a price movement between two key retracement levels was identified as an internal pattern.

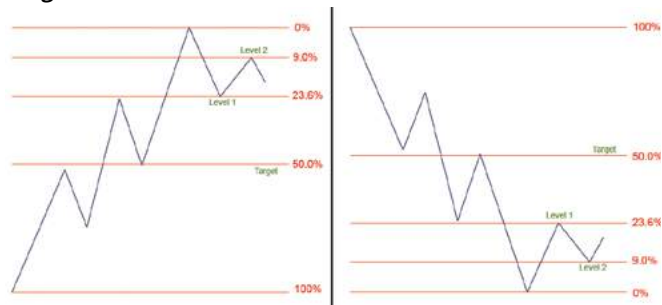
4. Types of Internal Patterns of Fibonacci Retracement

Currently, four internal patterns of Fibonacci retracement are recognized and used in trading and analysis in the Forex market.

4.1 The IP1 pattern

The first internal pattern of the retracement is formed in the process of price movement between the 23.6% and 9% levels. The diagram of the pattern's development is shown in Figure 5.

Figure 5. The IP1 (23.6%-9%) pattern, bearish and bullish diagrams



The key levels of the IP1 pattern:

L1 = 23.6%

L2 = 9% (market-entry level)

Stop = 0% (a stop-loss order should be entered at this level, because if the price does not break the 0%, the pattern becomes false).

Target = 50% (a take-profit order should be placed at this target level).

The pattern's P/L ratio equals 4.6:1

This pattern has been discovered in the process of examining typical price behavior models at the first stage of correction. Quite often the price, without having penetrated the 23.6% level, comes back down close to the level of 0%, and after that, the correction continues to develop to the key levels of 50% and 61.8%. Figure 6 shows such an example with the EUR/USD pair, with the classic Fibonacci levels drawn on its downward trend.

Figure 6 demonstrates that the price did not hold for long above the 23.6% level, fell slightly and then kept on going up to the 50% level. Such a turnaround of the price should provide an opportunity for entering the market, but entering the market also requires a support level that the price can bounce off. This situation is shown in Figure 7, with the presence of the additional retracement level of 9%.

Figure 6. Correction on EUR/USD, H1

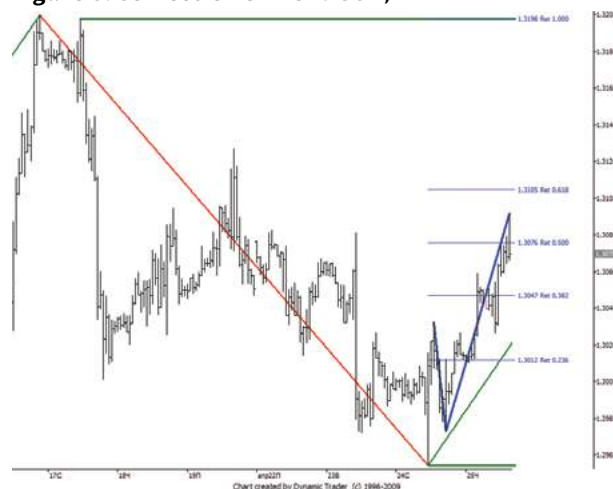


Figure 7. Correction on EUR/USD, H1

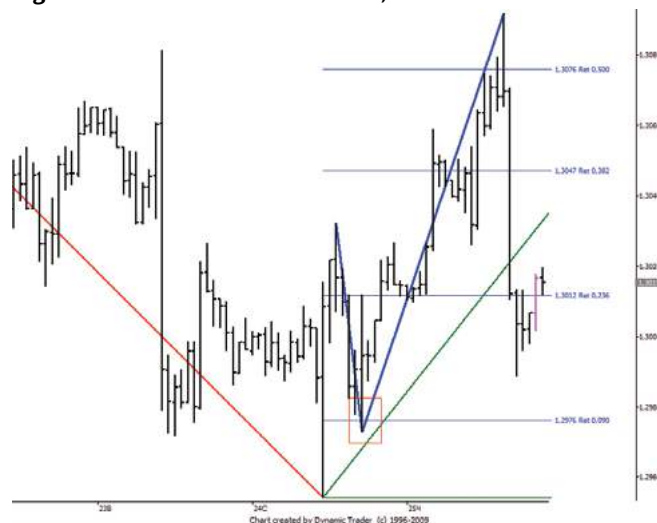


Figure 7 shows that the price, having dropped from the 23.6% level, tested 9% and turned around, beginning an upward correction movement reaching the level of 50%.

Similar situations, with the price going back from the 23.6% level to the 9%, may be observed in a multitude of examples on major currency pairs of the Forex market (see Figures 8 through 11).

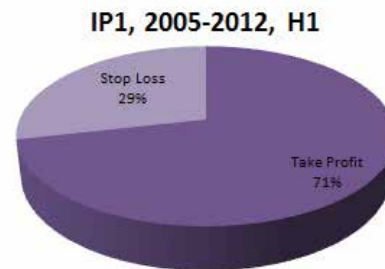
Figures 8 and 9 show the 23.6%-9% price movement and the result of its development on the GBP/USD pair. The price reaches the 23.6% level but soon enters a downward trend again and touches the 9% level. According to the concept of the IP1 pattern, one should expect the correction development to go on to reach deeper correction levels, which is exactly what happens with the GBP/USD pair example (Figure 9).

Figures 10 and 11 show the IP1 (23.6%-9%) pattern and the aftermath of its formation on the USD/CAD pair example. The price often penetrates the 23.6% and 9% levels before beginning correction development, but the main characteristic of this model is that the price must reach both levels. If one of these levels has not been reached, the pattern is nonexistent. However, if after penetrating the 9% level the price also penetrates the level of 0%, the model should be aborted.

Figure 8. The IP1 (23.6%-9%) pattern, GBP/USD, H1**Figure 9. Correction developing after the IP1 pattern has been formed, GBP/USD, H1****Figure 10. The IP1 (23.6%-9%) pattern, USD/CAD, H1****Figure 11. Correction is developing in the aftermath of the IP1 pattern formation, USD/CAD, H1**

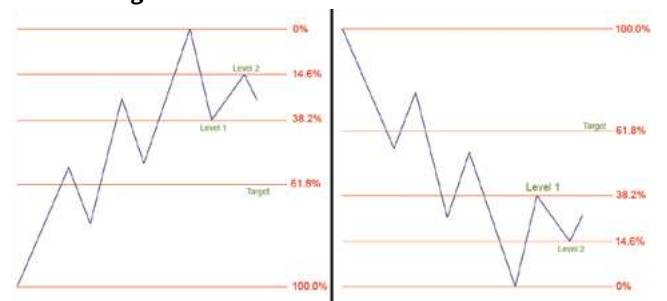
The target level of the IP1 pattern is the 50% level, since most often, having reached it, the price bounces off this level (Figure 7). In some situations, the price may reach the 61.8% level, but much more commonly the 50% ends up as the target level.

Over the period from 2005 to 2012, on the five pairs studied, 396 IP1 patterns have been observed (the top quantity among all patterns). The pattern IP1's performance stats is shown in Figure 12. The distinguishing characteristic of the IP1 pattern is its very high P/L ratio: within this model, the take-profit level is 4.6 times greater than the stop-loss, which, given the positive statistics of the pattern, makes it an excellent trading tool.

Figure 12. Statistical data of the IP1 pattern

4.2 The IP2 pattern

The second internal pattern of the retracement is formed in the process of price movement between the 38.2% and 14.6% levels. The diagram of the pattern's development is shown in Figure 13.

Figure 13. The IP2 (38.2%-14.6%) pattern, bearish and bullish diagrams

The key levels of the IP2 pattern:

L1 = 38.2%

L2 = 14.6% (market-entry level)

Stop = 0% (a stop-loss order should be entered at this level, because if the price does not break the 0%, the pattern becomes false).

Target = 61.8% (a take-profit order should be placed at this target level).

The pattern's P/L ratio equals 3.3:1

This price model has been discovered in the manner similar to that of the IP1 pattern: by noticing that upon reaching the 38.2% level (the first key level of retracement) the price sometimes appears to resume the trend but stops in some cases short of the 9% level and then continues the correction development. By watching the major currency pairs of the Forex market, the key level for this model has been identified as 14.6%. An example of the price's behavior near this level is shown in Figures 14 and 15.

Figure 14. Correction on the EUR/USD pair, with the 38.2%-14.6% pattern forming



Figure 15. Correction development on the EUR/USD pair in the aftermath of the IP2 (38.2%-14.6%) pattern's formation



Figures 14 and 15 demonstrate how clearly the 14.6% level affects the price movement after it turns around in

the 38.2% level's vicinity. Upon reaching this level, the price resumes correction movement and goes on to the key levels of retracement. Figures 16 through 19 show the same pattern being formed on the GBP/USD and USD/CHF currency pairs.

Figure 16. The beginning of the IP2 pattern's formation on the GBP/USD pair, H1



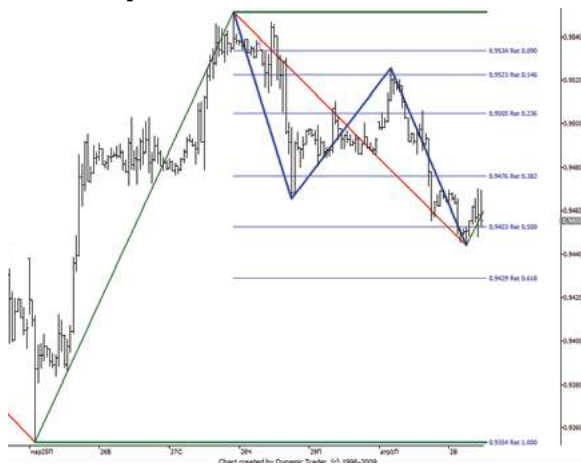
Figure 17. The outcome of the IP2 pattern's formation on the GBP/USD pair, H1



Figure 18. The beginning of the IP2 pattern's formation on the USD/CHF pair, H1



Figure 19. The outcome of the IP2 pattern's formation on the USD/CHF pair, H1



Over the period from 2005 to 2012, on the five pairs studied, 240 IP2 have been observed. The pattern of IP2's performance stats is shown in Figure 20. An important feature of the IP2 pattern is a high P/L ratio: the take-profit level in this model is 3.3 times higher than the stop-loss level. Although this is less than the IP1 ratio, it still fits the criterion of the potential profit level being at least twice as high as that of potential loss.

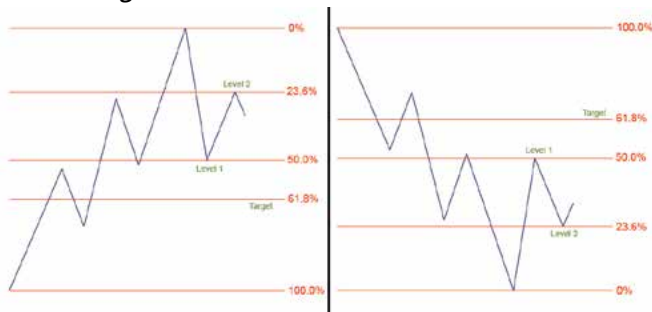
Figure 20. Statistical data of the IP2 pattern
IP2, 2005-2012, H1



4.3 The IP3 pattern

The IP3 pattern is formed based on two retracement levels: 50.0% and 23.6%. This model has been discovered before the others on the currency market, since additional levels of retracement are not necessary for its identification. This model's distinctive feature is that the price reaches the 50% retracement level, goes back to the 23.6% level and may continue correction development up to the key level of 61.8%, at which point the trader may take the profit. Figure 21 shows the pattern's diagram.

Figure 21. The IP3 (50.0%-23.6%) pattern, bearish and bullish diagrams



The key levels of the IP3 pattern:

L1 = 50.0%

L2 = 23.6% (market-entry level)

Stop = 0%

Target = 61.8% (a take-profit order should be placed at this target level).

The pattern's P/L ratio equals 1.6:1

According to observations, most often the price penetrates the 23.6% level and reaches 14.6%. However, this does not indicate the possible failure of the model, because the level indicating another scenario is 0%, and loss would occur only if the price tested that level.

An important feature of this pattern is that the price may reach the 50% level right away and may form the IP1 and IP2 patterns before testing the 50% level. Examples of this pattern forming are shown in Figures 22 through 25.

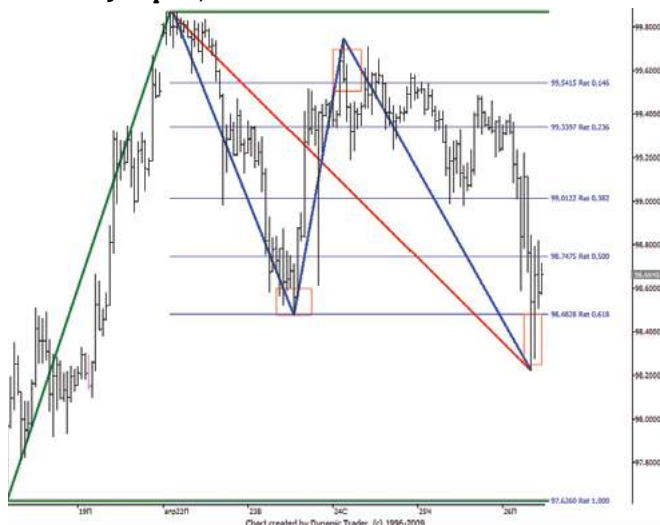
Figure 22. The beginning of the IP3 pattern's formation on the GBP/USD pair, H1



Figure 23. The outcome of the IP3 pattern's formation on the GBP/USD pair, H1



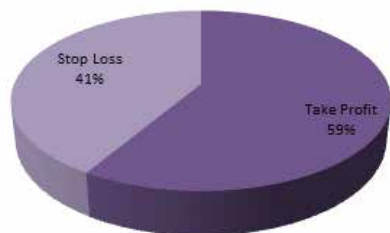
Figure 29. The outcome of the IP4 pattern's formation on the USD/JPY pair, H1



In Figure 28, the IP4 pattern is formed on the USD/JPY currency pair. The 61.8% level was tested, after which the price turned around and grew to the 14.6% level. The fact that this level has been reached speaks of the possible development of correction to the 61.8% level, which is exactly what happened two days after the 61.8%-14.6% model was formed (Figure 29).

Over the period from 2005 to 2012, on the five pairs studied, 87 IP4 have been observed. The pattern of IP4's performance stats is shown in Figure 30. The IP4 pattern has the lowest percent of profitable cases, in comparison with the other internal patterns of retracement: only 59% of models ended with a take-profit order. Nevertheless the IP4 model has a high P/L ratio of 3.3:1 and therefore is more profitable than otherwise, which is reflected in the statistical data for the IP4 pattern in Chapter 5.

Figure 30. Statistical data of the IP4 pattern
IP4, 2005-2012, H1



According to the examples and statistics of the model formation presented in this chapter, a definite conclusion may be drawn that the first posed hypothesis (*"In the process of moving between the levels of Fibonacci retracement, the price forms certain typical models, which can be designated technical analysis patterns"*) has been confirmed in its entirety, by searching for the models on the major currency pairs over the period between 2005 and 2012. There are four main models of the internal patterns of retracement, which are typical price movement sequences occurring regularly during the process of correction changes on the Forex currency market.

According to the given examples of pattern formation based

on the two additional levels of Fibonacci retracement (9% and 14.6%), the second hypothesis posed (*"There exist additional levels of Fibonacci retracement, based on which it is possible to identify more patterns"*) has also been confirmed. The 9% and 14.6% ratios are Fibonacci levels that allow most models of correction—IP1 (23.6%-9%), IP2 (38.2%-14.6%) and IP4 (61.8%-14.6%)—to be identified. If these levels were absent, it would have been impossible to identify most of the important price patterns, and trading in the Forex market would have come down to watching for only one model to form, IP3 (50%-23.6%).

Thus, two of the three hypotheses posed have been confirmed with the evidence presented above.

5. Statistical Analysis of the Internal Patterns of Retracement

The use of internal patterns in trading entails the graphical construction of retracement and visual identification of the patterns due to the fact that creating an automatic algorithm for pattern recognition would be very difficult.

The same is true for testing these patterns based on the past price changes: the statistical analysis of internal patterns has been conducted through visual examination of these models, with "manual" preparation and pattern recognition within the history of price changes.

The historical interval chosen for the statistical analysis of the internal patterns of retracement has been the period from 2005 to 2012.

The analysis has been conducted on the main currency pairs of the Forex market: EUR/USD, GBP/USD, USD/CHF, USD/JPY, USD/CAD. The analysis has been conducted for the hourly timeframe.

In the process of research, 927 internal patterns have been identified, of which some have ended with testing the target level, and others, with reaching a stop-loss order.

Figure 31. Table of the internal patterns of retracement, 2005-2012, H1

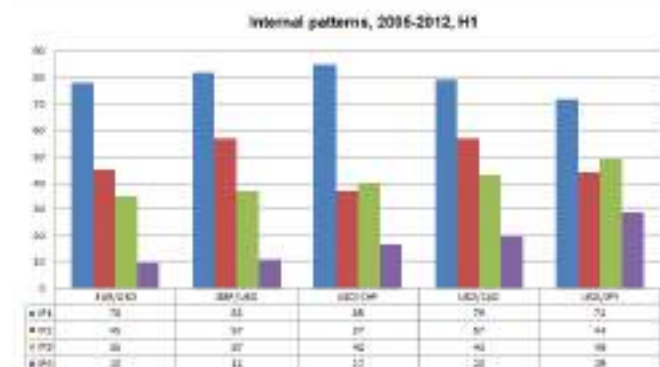


Figure 31 shows a combined table of the internal patterns of retracement formed on the major currency pairs over the period of 2005-2012. The greatest number of patterns during this period has formed on the USD/CAD currency pair (199 models) and the least number, on the USD/CHF pair. However, on the USD/CHF pair, the IP1 pattern has formed more often—85 times.

The most frequently encountered model is IP1, while the IP4 model is the rarest to occur on the currency market. The

USD/JPY pair has seen the IP4 model forming most often 429 times. Also, the USD/JPY currency pair has seen the IP3 pattern forming more frequently than the other pairs.

Figure 32 shows a comparative forecasting performance diagram of the internal patterns of retracement on the five major currency pairs. This table demonstrates that the internal patterns of retracement perform very well as forecasting models.

As a conclusion of the statistical examination, it can be noted that not a single currency pair had shown a number of loss patterns which would be greater than the number of the profitable patterns of the same type. This proves that one can actively use these models in trading and expect successful results based on IP.

Figure 33 shows the results of IP-based trading on the five major currency pairs over the period from 2005 to 2012. The startup capital was \$100,000, with the trade volume of one contract.

The statistical data show that the highest profit has been gained from trading on the GBP/USD currency pair, and the lowest on the USD/JPY pair (considering that the profit factor of the USD/JPY pair exceeds the profit factor of the GBP/USD pair: 4.29 vs. 3.93).

The greatest profit factor (5.38) has been observed on the USD/CHF pair; the profit on this pair has also been high, making it the second best currency pair in terms of the profit amount, after the GBP/USD pair.

The highest average profit per trade (\$2,049) has been observed on the GBP/USD pair, and the lowest (\$1,263) on the USD/JPY pair. The most number of trades (199) has been made on the USD/CAD pair; this pair also has a high profit factor of 4.67.

Based on the stats displayed in Figure 32, it can be concluded that the internal patterns of retracement bring the highest profit when trading the GBP/USD and USD/CHF currency pairs, while the lowest profit among the major pairs has been observed on USD/JPY. The reason behind this is the volatility of the

Figure 32. Statistical analysis of the internal patterns

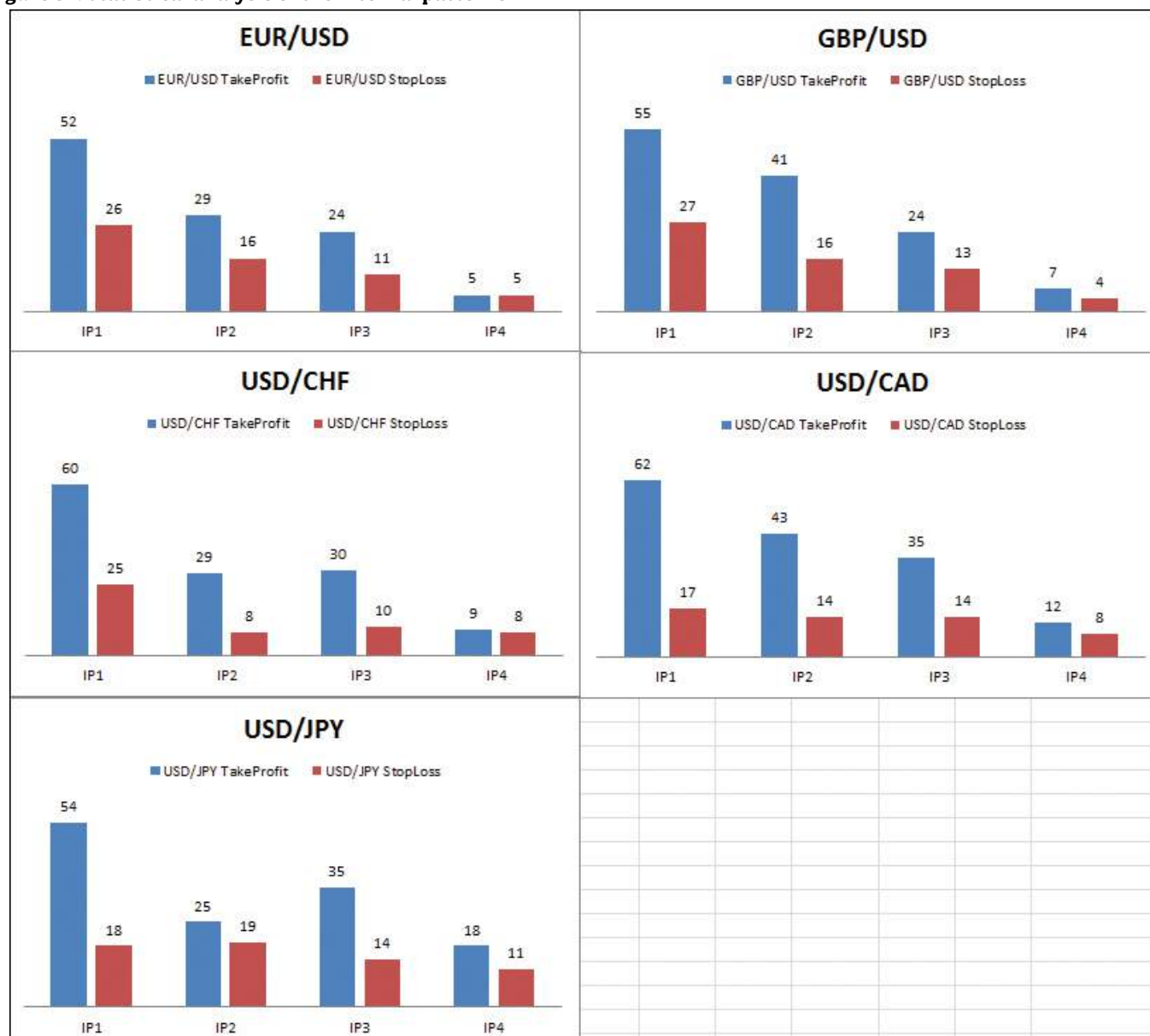


Figure 33. The results of trading on the major currency pairs using the internal patterns of retracement

	EUR/USD	GBP/USD	USD/CHF	USD/CAD	USD/JPY
Total Net Profit	137,160\$	194,010\$	152,750\$	150,850\$	128,000\$
Gross Profit	183,760\$	260,170\$	174,150\$	191,860\$	166,790\$
Gross Loss	46,600\$	66,160\$	32,400\$	41,010\$	38,790\$
Profit Factor	3.94	3.93	5.38	4.67	4.29
Total Trades	168	187	179	199	194
Profit Trades (% of total)	110 (65.5%)	127 (67.9%)	128 (71.5%)	143 (71.9%)	132 (68%)
Loss Trades (% of total)	58 (34.5%)	60 (32.1%)	51 (28.5%)	56 (28.1%)	62 (32%)
Average Profit Trade	1,670\$	2,049\$	1,382\$	1,360\$	1,263\$
Average Loss Trade	-763\$	-1,085\$	-611\$	-685\$	-625\$
Maximal Drawdown	-1.82%	-3.96%	-1.38%	-2.03%	-2.25%
Average Win/Loss P&L	2.19	1.88	2.26	1.98	2.02
Largest Profit Trade	10,450\$	9,710\$	5,150\$	10,500\$	5,000\$
Largest Loss Trade	-2,150\$	-5,550\$	-1,770\$	-3,590\$	-2,610\$
Maximum Consecutive Wins (\$)	12 (16,740\$)	8 (13,810\$)	9 (17,760\$)	10 (12,170\$)	11 (15,390\$)
Maximum Consecutive Losses (\$)	3 (-2,290\$)	4 (-2,850\$)	3 (-1,790\$)	4 (-1,420\$)	4 (-1,100\$)
Maximal Consecutive Profit (count)	2,210\$ (12)	4,580\$ (8)	3,820\$ (9)	4,580\$ (10)	2,160\$ (11)
Maximal Consecutive Loss (count)	-1,210\$ (3)	-1,100\$ (4)	-640\$ (3)	-620\$ (4)	-360\$ (4)

Figure 34. The results of trading on EUR/USD using the internal patterns of retracement

EUR/USD	IP1	IP2	IP3	IP4
Total Net Profit	75,130\$	33,480\$	27,210\$	3,160\$
Gross Profit	92,170\$	47,040\$	38,080\$	6,470\$
Gross Loss	-17,040\$	-13,560\$	-10,870\$	-3,310\$
Profit Factor	5.4	3.47	3.5	1.95
Total Trades	78	45	35	10
Profit Trades (% of total)	52 (66.6%)	29 (64.4%)	24 (68.5%)	5 (50.0%)
Loss Trades (% of total)	26 (33.4%)	16 (35.6%)	11 (31.5%)	5 (50.0%)
Average Profit Trade	1,772\$	1,622\$	1,587\$	1,294\$
Average Loss Trade	-655\$	-847\$	-988\$	-662\$
Maximal Drawdown	-1.6%	-2.37%	-2.92%	-1.65%
Average Win/Loss P&L	2.7	1.91	1.60	1.95
Largest Profit Trade	10,450\$	3,310\$	3,970\$	1,720\$
Largest Loss Trade	-1,760\$	-2,150\$	-1,570\$	-910\$
Maximum Consecutive Wins (\$)	6 (8,240\$)	8 (10,130\$)	6 (14,340\$)	2 (2,810\$)
Maximum Consecutive Losses (\$)	4 (-1,980\$)	2 (-2,760\$)	4 (-3,820\$)	2 (-1,700\$)
Maximal Consecutive Profit (count)	2,210\$ (6)	2,030\$ (8)	3,970\$ (6)	1,720\$ (2)
Maximal Consecutive Loss (count)	-670\$ (4)	-2,150\$ (2)	-1,100\$ (4)	-910\$ (2)

Figure 35. The results of trading on GBP/USD using the internal patterns of retracement

GBP/USD	IP1	IP2	IP3	IP4
Total Net Profit	82,540\$	80,490\$	24,920\$	7,730\$
Gross Profit	103,510\$	98,050\$	47,770\$	10,840\$
Gross Loss	-20,970\$	-17,560\$	-22,850\$	-3,110\$
Profit Factor	4.93	5.58	2.09	3.49
Total Trades	82	57	37	11
Profit Trades (% of total)	55 (67.0%)	41 (72%)	24 (64.8%)	7 (63.6%)
Loss Trades (% of total)	27 (33.0%)	16 (28%)	13 (35.2%)	4 (36.4%)
Average Profit Trade	1,882\$	2,391\$	1,990\$	1,549\$
Average Loss Trade	-776\$	-1,098\$	-1,778\$	-778\$
Maximal Drawdown	-2.54%	-2.26%	-6.51%	-2.03%
Average Win/Loss P&L	2.43	2.17	1.11	1.99
Largest Profit Trade	9,710\$	6,000\$	5,710\$	2,580\$
Largest Loss Trade	-2,080\$	-2,740\$	-1,010\$	-1,320\$
Maximum Consecutive Wins (\$)	9 (14,070\$)	7 (14,070\$)	8 (9,860\$)	3 (5,590\$)
Maximum Consecutive Losses (\$)	3 (-3,480\$)	3 (-3,4100\$)	3 (-4,340\$)	3 (-2,570\$)
Maximal Consecutive Profit (count)	2,920\$ (9)	4,580\$ (7)	2,830\$ (8)	2,580\$ (3)
Maximal Consecutive Loss (count)	-2,080\$ (3)	-1,440\$ (3)	-1,910\$ (3)	-1,320\$ (3)

respective pairs: GBP/USD has high volatility, and the average profit per trade on GBP/USD is 1.6 times higher than on USD/JPY.

The maximal drawdown on the currency pairs varies from -3.96% (GBP/USD) to -1.38% (USD/CHF), which is generally a very good figure.

Figure 34 shows the statistics of the internal patterns from 2005 to 2012 when trading the EUR/USD pair.

The highest profit has been made when trading based on the IP1 (profit factor 5.4), the lowest based on the IP4 pattern (profit factor 1.95). However, each pattern has shown total profit by the end of the period in question, which means high performance of the models. The greatest average profit per trade has been made when trading based on the IP1 pattern, while the greatest average loss has been observed for the IP3 pattern.

The maximal drawdown on EUR/USD has varied from -2.92% (IP3) to -1.6% (IP1). The most profitable patterns for the period in question have been the IP1 and IP2 patterns.

Figure 35 shows the statistics of the internal patterns from 2005 to 2012 when trading the GBP/USD pair. The statistical data for the GBP/USD is similar to the EUR/USD data.

The highest profit has been made when trading based on the IP1 (profit factor 4.93), the lowest, based on the IP4 pattern (profit factor 3.49). However, each pattern has shown total profit by the end of the period in question, which means high performance of the models. The greatest average profit per trade has been made when trading based on the IP2 pattern, while the greatest average loss has been observed for the IP3 pattern.

The maximal drawdown on GBP/USD has varied from -6.51% (IP3) to -2.03% (IP4). The -6.51% for IP3 is high enough, but the pattern has still performed well and over the examined period exhibited growth of the startup capital. The most profitable patterns for the period in question have been the IP1 and IP2 patterns.

According to the outcomes of testing the patterns, which have

demonstrated very high forecasting effectiveness, as well as based on real-life trading using the patterns as presented in Chapter 4 of this paper, it becomes possible to confirm fully the third hypothesis, posed as the basis of this study ("Using the internal patterns of retracement that are formed as the correction develops, it is possible to determine the target of the correctional movement").

The foremost factor confirming the hypothesis is the following condition that has been applied during manual testing of the patterns:

- If, after the pattern is formed, the price does not reach its key level (the patterns' key levels are described in Chapter 4), this pattern must be considered false even though the price has moved significantly in the direction of the target level from the entry point.

Example. The price forms the IP1 pattern and in the correction movement reaches the 38.2% level, then turns around and, without touching 50% (the target level of IP1), moves beyond the level of 0%. Despite the fact that the pattern has begun forming, in the end the price reached the stop-loss level (0%); therefore, such a pattern is considered false, leading to loss.

The most remarkable feature of the patterns, which allows their profitable application in the market, is the high P/L ratio of the models. And even if the number of losing cases is equal to the number of profitable ones, the trader can still expect to make a profit when applying the model.

6. Conclusion

The objective of this paper is to describe new methods of trading based on Fibonacci retracement, to add to the existing body of knowledge new and unique ways of application of this technical instrument in analysis of exchange markets.

Four main internal Fibonacci patterns have been introduced, the laws of their formation described, and the statistics of their application over a 7-year period presented.

Over the period in question, 927 cases of the internal patterns of retracement have been observed on five major currency pairs, and trading based on most of them has been profitable. The highest profit figures have been observed when trading the GBP/USD currency pair.

Three hypotheses posed as the basis for research have been expounded on in this paper. The formation mechanism of four internal patterns of retracement, as well as the financial outcome of their application in trading, has been illustrated with examples.

The results of the research leave no doubt as to the usefulness of applying the internal patterns of Fibonacci retracement to trading: the simplest method of constructing Fibonacci retracement and identifying the models to base the trading on makes these models a new, highly productive trading tool.

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Software and Data

Dynamic Trader, version 6.0.1.119, Copyright 1996-2009, Robert C. Miner, Dynamic Traders Group, Inc., Tucson, USA
 Microsoft Office Excel 2010, Microsoft Corp., Redmond, USA
 Data provided by MetaQuotes

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Endnotes

- i. The percentage figures close to these levels, namely 14.5% and 8.8%, are popular among Russian traders. These levels have been arrived at empirically, without referring to the Fibonacci series, and are used as a matter of common practice. However, the present paper makes use of the precise levels derived from the Fibonacci sequence, 14.6% and 9%.
- ii. The auto-swings can be constructed using any technical analysis software with the ZigZag indicator. For instance, with the ever-popular among the Forex traders MetaTrader software by MetaQuotes, the necessary ZigZag parameters should be 100-0-0. These figures are the closest match to the auto-swings settings in the Dynamic Trader program used in this paper.

Confirmation of the Market Trend and Trend Reversal by “Bake-Ashi” Analysis

by Yoshinobu Sakai, MFTA, CFTe

Abstract

The candlestick is a fairly perfected theoretical method providing abundant information and diverse buy/sell signals. But like all other technical analysis methods, not all buy/sell signals appearing in candlestick chart analysis is real.

This paper proposes bake-ashi, a technical analysis method that features shape changing as the trend changes and time passes. The background of the bake-ashi theory is analysis of multiple candlesticks. In bake-ashi, diverse buy/sell signals of multiple candlesticks are integrated into a simple pattern.

The market changes constantly, and the importance of the price information varies with the market situation. Bake-ashi analysis is a new method of technical analysis focusing on the buy/sell balance and market psychology, which change with the relation between past market action and the present price level.

Introduction

Technical analysis is based on three basic principles:

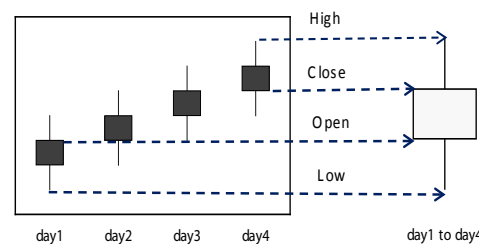
1. Market action takes everything into account, 2. Price movements form a trend, and 3. History repeats itself. In reality, however, history does not repeat itself perfectly. Chart patterns do not exactly repeat themselves, either. A perfect market does not exist, so market prices do not take everything into account. As a result, some of the buy/sell signals of technical analysis prove to be wrong. These fake buy/sell signals may mislead us about directionality of the market price. This is because technical analysis is an analytical model based on past experience, and each method of technical analysis has its own advantages and disadvantages. This means that only one method of technical analysis is enough to fully confirm the market trend and trend reversal.

Candlestick chart analysis is no exception. A candlestick is composed of four types of price information (opening, closing, highest and lowest prices), and price movements are highlighted by colors (black or white candlesticks). Technical analysis by candlestick chart is quite versatile, as it can be used for single wick as well as multiple wick analysis, with many patterns of buy/sell signals.

However, it is difficult to analyze all the information, such as the four prices and colors, all the time, and depending on the market situation, it may contain a noise for analysis (unnecessary or ignorable information). While the theory of candlestick analysis has been perfected by prior studies, it provides a wide variety of buy/sell signals, which means the signals appear frequently. As a result, as in the case of other technical analysis methods, buy/sell signals obtained by single wick or multiple wick analysis may not always function as signals. Some of them may prove to be fake buy/sell signals. In addition, visually highlighting price movements by black or

white candlestick may sometimes lead to misinterpretation of the chart. For example, Figure 1 shows a series of black candlesticks, so the market may seem bearish at a glance, but actually, the price went up between Day 1 and Day 4, so the market cannot be judged as bearish.

Figure 1. Series of black candles



That's why this paper presents technical analysis using “bake-ashi”. “Bake” comes from the Japanese word “bakeru” meaning “change” or “transform”.

Bake-ashi is an analytical method designed to: (1) minimize the noises occurring from price changes in the market, (2) identify distinctive phenomena when the market has hit a top or bottom, and (3) make it easy to visually recognize the market trend. If a day's price movement is the reverse of the trend of a given period, the shape is represented by a line connecting the highest and lowest prices of the day (called “bo-ashi” in Japanese). If the day's price movement is in line with the trend, the portion contributing to the trend is shown in a black or white body. Thus, bake-ashi is an analytical method for changing the form depending on the price trend. The result is a chart consisting partly of bo-ashi and partly of candlesticks. By selecting what is important from the abundant information contained in a candlestick chart in response to the market situation, a simple chart pattern showing the top or bottom can be obtained. This is one of the advantages of bake-ashi analysis.

The average candlestick and the high-low bar chart are analytical methods for grasping the trend visually. But while they make it easier to grasp the general trend, it is not so easy to track minute price movements. In contrast, while the trend can be grasped visually in a bake-ashi chart, daily minute movements are not disregarded—the bake-ashi looks different depending on whether a price decline is just an adjustment in an uptrend or a decline forming a downtrend.

The most distinctive feature of bake-ashi is that a chart once created may be altered. When new data has been added and the start date of bake-ashi has been changed, the shapes of bake-ashi do not change if the relation between past prices and the present price is unchanged. The shapes of bake-ashi are altered from the ones created in the past if the relation between

past prices and the present price has changed. As candlesticks represent market psychology, a change in the bake-ashi form represents a change in market psychology.

In technical analysis, "views from the eyes of a bird, an insect and a fish" are essential (i.e., macro analysis, micro analysis and analysis of the flow [trend]). Bake-ashi focuses on analysis of the flow. A change in the bake-ashi form suggests the possibility of a change in the trend or instability of the price movement. It is believed that bake-ashi is an unprecedented technical analysis method because it is focused on the "changes in the value" of price information reflecting the phase of the market and alters a chart once created. In addition, bake-ashi is an effective technical analysis method because it expresses changes in the market condition by a relatively simple form.

Method

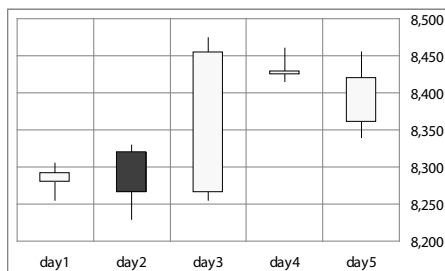
1. How to create a bake-ashi chart

The following samples (see Table 1 and Figure 2) are used for explanation purposes.

Table 1. Sample data

Date	Opening	High	Low	Closing	1=Uptrend 0=Downtrend
day5	8,360	8,455	8,340	8,420	1
day4	8,425	8,460	8,415	8,430	1
day3	8,265	8,475	8,255	8,455	1
day2	8,321	8,330	8,230	8,265	0
day1	8,280	8,305	8,255	8,292	1

Figure 2. Candlesticks representing sample data



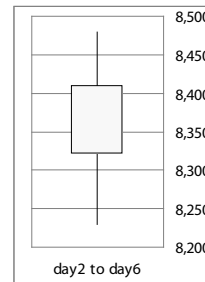
1. To judge whether the market was in an uptrend, downtrend, or sideways trend in a given period by consolidating the candlestick. (See Table 2 and Figure 3)

Table 2. Consolidated sample data

Date	Opening	High	Low	Closing	1=Uptrend 0=Downtrend
day1 to day5	8,280	8,475	8,230	8,420	1

2. To extract the essential portion of information that contributed to the formation of the real body (white or black) of the consolidated candlestick by comparing the consolidated candlestick with the pre-consolidated individual candlesticks in the period.

Figure 3. Consolidated candlestick

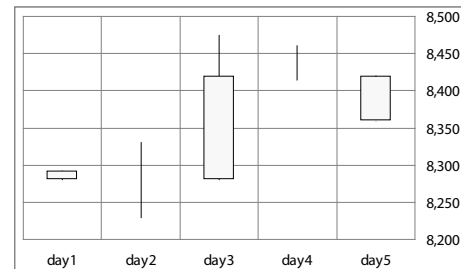


For example, when the consolidated candlestick and pre-consolidated candlestick were in an uptrend, and the pre-consolidated candlestick contributed to the formation of the real body of the consolidated candlestick, the high and low prices of the pre-consolidated candlestick are deleted as unnecessary information. And thus, the restructured candlestick is displayed as a white candlestick, which is composed of opening price and closing price (See Table 3, day1 and day5 and Figure 4, day1 and day5). But the top and bottom prices in a given period should be displayed as important prices. (See Table 3, day3 and Figure 4, day3)

Table 3. Sample data of bake-ashi

Date	Opening	High	Low	Closing
day5	8,360	8,420	8,360	8,420
day4		8,460	8,415	
day3	8,280	8,475	8,280	8,420
day2		8,330	8,230	
day1	8,280	8,292	8,280	8,292

Figure 4. Bake-ashi

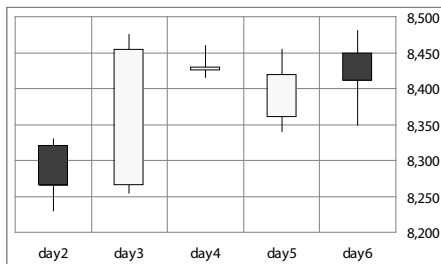


3. When the consolidated candlestick and pre-consolidated candlestick were an opposite trend, the opening price and closing price are deleted as unnecessary information. And thus, the restructured candlestick is displayed like a bo-ashi chart, which is composed of high price and low price (see Table 3, day2 and Figure 4, day2). Similarly, when the pre-consolidated candlestick has not contributed to the formation of the real body of the consolidated candlestick, the restructured candlestick is displayed like a bo-ashi chart, which is composed of high price and low price (see Table 3, day4 and Figure 4, day4).
4. One of the things to be noted in creating a bake-ashi chart is how to set the opening price and closing price when the candlestick at a certain point and the consolidated candlestick are in the same trend. When the real body of the candlestick at a certain point constitutes only a portion of the real body of the consolidated candlestick, bake-ashi should be created only for the portion constituting the real body. Because the opening price of the consolidated candlestick is replaced by the opening price at a certain point, and the closing price of the consolidated candlestick is replaced by the closing price at a certain point, day3 in Figure 2 is expressed as day3 in Figure 4 in bake-ashi method.

5. Another thing to be noted is the number of candlesticks to be consolidated. For example, if the consolidation period covers five days, candlesticks in multiples of 5, such as 5, 10 or 15, should be used to create a bake-ashi chart.
6. When new data has been added, process as follows.

Table 4. Sample data

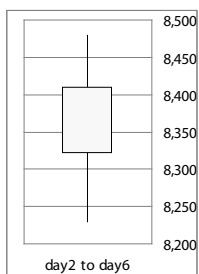
Date	Opening	High	Low	Closing	1=Uptrend 0=Downtrend
day6	8,450	8,480	8,350	8,410	0
day5	8,360	8,455	8,340	8,420	1
day4	8,425	8,460	8,415	8,430	1
day3	8,265	8,475	8,255	8,455	1
day2	8,321	8,330	8,230	8,265	0

Figure 5. Candlesticks representing sample data

In Table 4 and Figure 5 assume new data for day6 has been added. Then, the consolidation period is changed from day1-day5 to day2-day6. Table 5 and Figure 6 show the new consolidated candlestick.

Table 5. Consolidated sample data

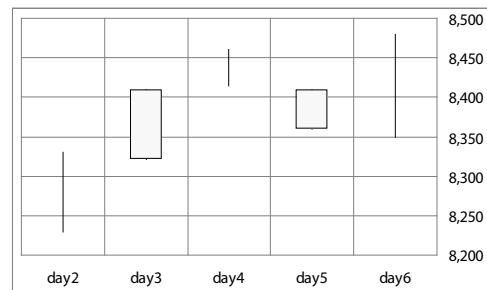
Date	Opening	High	Low	Closing	1=Uptrend 0=Downtrend
day2 to day6	8,321	8,480	8,230	8,410	1

Figure 6. Consolidated candlestick

When creating a bake-ashi, compare the newly consolidated candlestick incorporating added data with individual candlesticks, and follow steps 2 to 4 above. Then, the bake-ashi will look like Table 6 and Figure 7.

Table 6. Sample data of bake-ashi

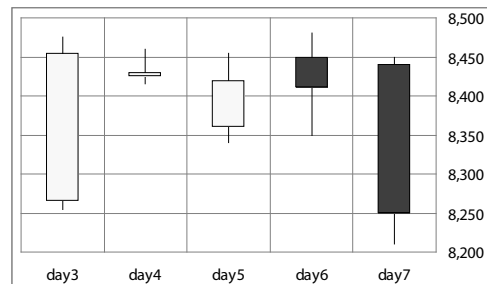
Date	Opening	High	Low	Closing
day6		8,480	8,350	
day5	8,360	8,410	8,360	8,410
day4		8,460	8,415	
day3	8,321	8,410	8,321	8,410
day2		8,330	8,230	

Figure 7. Bake-ashi

When further new data for day7 has been added as shown in Table 7 and Figure 8, reconsolidate the candlesticks in the period of day3 to day7 (see Table 8 and Figure 9). Then, restructure the bake-ashi by comparing the consolidated candlestick with individual candlesticks (see Table 9 and Figure 10).

Table 7. Sample data

Date	Opening	High	Low	Closing	1=Uptrend 0=Downtrend
day7	8,440	8,450	8,210	8,250	0
day6	8,450	8,480	8,350	8,410	0
day5	8,360	8,455	8,340	8,420	1
day4	8,425	8,460	8,415	8,430	1
day3	8,265	8,475	8,255	8,455	1

Figure 8. Candlesticks representing sample data**Table 8. Consolidated sample data**

Date	Opening	High	Low	Closing	1=Uptrend 0=Downtrend
ay3 to day7	8,265	8,480	8,210	8,250	0

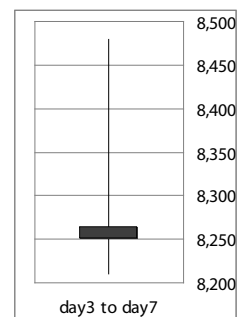
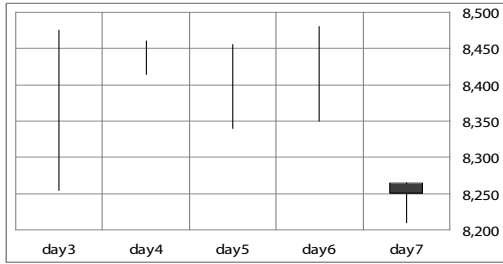
Figure 9. Consolidated candlestick

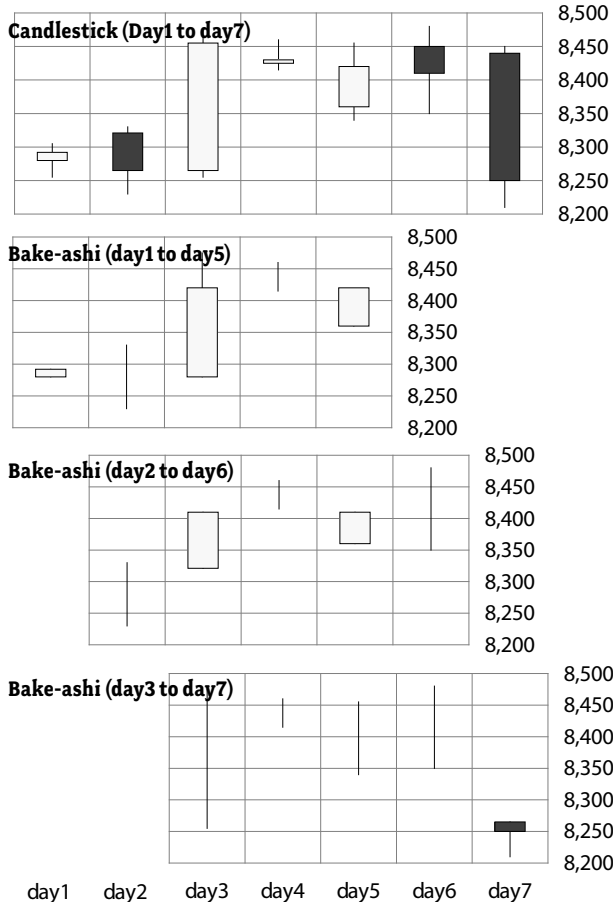
Table 9. Sample data of bake-ashi

Date	Opening	High	Low	Closing
day7	8,265	8,265	8,210	8,250
day6		8,480	8,350	
day5		8,455	8,340	
day4		8,460	8,415	
day3		8,475	8,255	

Figure 10. Bake-ashi

7. Figure 11 shows transition of bake-ashi from day1 to day7 resulting from these steps.

As in the case of day3 and day5 of Figure 11, bake-ashi of the same date may have different forms if based on different base dates. Also, bake-ashi sometimes has a body shorter than the candlestick, as in the case of day7 above.

Figure 11. Transition of bake-ashi from day1 to day7

The points in figure 11 are expressed in functions as follows. Functions of consolidated candlestick:

$$O^{\text{con}} = O_1$$

$$H^{\text{con}} = \text{Max} (H_1, H_2, \dots, H_t)$$

$$L^{\text{con}} = \text{Min} (L_1, L_2, \dots, L_t)$$

$$C^{\text{con}} = C_t$$

Functions of bake-ashi:

$$O_t^{\text{bake}} = \text{if}(\text{or}([T_t + T^{\text{con}} = 0, \text{and}(T_t + T^{\text{con}} = 2, O_t < O^{\text{con}}, C_t < O^{\text{con}}), \text{and}(T_t + T^{\text{con}} = 2, C_t > C^{\text{con}}, O_t > C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, C_t < C^{\text{con}}, O_t < C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, O_t > O^{\text{con}}, C_t > O^{\text{con}})], ""), \text{if}(\text{or}(\text{and}(T_t + T^{\text{con}} = 2, O_t < O^{\text{con}}, O^{\text{con}} < C_t, C_t < C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, O_t > O^{\text{con}}, C^{\text{con}} < C_t, C_t < O^{\text{con}})), O_t^{\text{con}}, \text{if}(\text{and}(T_t + T^{\text{con}} = 2, O_t < O^{\text{con}}, O_t^{\text{con}}, \text{if}(\text{and}(T_t + T^{\text{con}} = -2, O_t > O^{\text{con}}, O_t^{\text{con}}, O_t)))))$$

$$H_t^{\text{bake}} = \text{if}(\text{or}([T_t + T^{\text{con}} = 0, H_t = H^{\text{con}}, \text{and}(T_t + T^{\text{con}} = 2, O_t < O^{\text{con}}, C_t < O^{\text{con}}), \text{and}(T_t + T^{\text{con}} = 2, C_t > C^{\text{con}}, O_t > C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, C_t < C^{\text{con}}, O_t < C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, O_t > O^{\text{con}}, C_t > O^{\text{con}})], H_t), \text{if}(\text{and}(T_t + T^{\text{con}} = 2, C_t > O^{\text{con}}, C_t^{\text{bake}}), \text{if}(\text{and}(T_t + T^{\text{con}} = -2, O_t^{\text{bake}} > O), O_t^{\text{bake}}, H_t)))$$

$$L_t^{\text{bake}} = \text{if}(\text{or}([T_t + T^{\text{con}} = 0, L_t = L^{\text{con}}, \text{and}(T_t + T^{\text{con}} = 2, O_t < O^{\text{con}}, C_t < O^{\text{con}}), \text{and}(T_t + T^{\text{con}} = 2, C_t > C^{\text{con}}, O_t > C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, C_t < C^{\text{con}}, O_t < C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, O_t > O^{\text{con}}, C_t > O^{\text{con}})], L_t), \text{if}(\text{and}(T_t + T^{\text{con}} = 2, O_t^{\text{bake}} > O), O_t^{\text{bake}}, \text{if}(\text{and}(T_t + T^{\text{con}} = -2, C_t^{\text{bake}} > O), C_t^{\text{bake}}, H_t)))$$

$$C_t^{\text{bake}} = \text{if}(\text{or}([T_t + T^{\text{con}} = 0, \text{and}(T_t + T^{\text{con}} = 2, O_t < O^{\text{con}}, C_t < O^{\text{con}}), \text{and}(T_t + T^{\text{con}} = 2, C_t > C^{\text{con}}, O_t > C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, C_t < C^{\text{con}}, O_t < C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, O_t > O^{\text{con}}, C_t > O^{\text{con}})], ""), \text{if}(\text{or}(\text{and}(T_t + T^{\text{con}} = 2, O_t < O^{\text{con}}, O^{\text{con}} < C_t, C_t < C^{\text{con}}), \text{and}(T_t + T^{\text{con}} = -2, O_t > O^{\text{con}}, C^{\text{con}} < C_t, C_t < O^{\text{con}})), C_t, \text{if}(\text{and}(T_t + T^{\text{con}} = 2, C_t > C^{\text{con}}, C_t^{\text{con}}, \text{if}(\text{and}(T_t + T^{\text{con}} = -2, C_t < C^{\text{con}}, C_t^{\text{con}}, C_t)))))$$

Here, The consolidation period is expressed as t , and points in time are expressed as 1, 2, 3... and t . The oldest point in time is 1 and the latest point in time is t .

O_t : Opening price at point in time t

H_t : High price at point in time t

L_t : Low price at point in time t

C_t : Closing price at point in time t

O^{con} : Opening price in consolidation period from point in time 1 to point in time t

H^{con} : High price in consolidation period from point in time 1 to point in time t

L^{con} : Low price in consolidation period from point in time 1 to point in time t

C^{con} : Closing price in consolidation period from point in time 1 to point in time t

O_t^{bake} : Opening price of bake-ashi at point in time t

H_t^{bake} : High price of bake-ashi at point in time t

L_t^{bake} : Low price of bake-ashi at point in time t

C_t^{bake} : Closing price of bake-ashi at point in time t

T_t : Trend at point in time t . $T_t = 1$ means an uptrend, and $T_t = -1$ means a downtrend.

T^{con} : Trend in consolidation period from point in time 1 to point in time t . $T^{\text{con}} = 1$ means an uptrend, and $T^{\text{con}} = -1$ means a downtrend.

"": Blank because there is no appropriate price.

if(logical test, [value if true], [value if false]): Return one value if a condition we specify evaluates TRUE, and another value if that condition evaluates FALSE.

and(logical 1, logical 2, ...): Return "TRUE" if all of its arguments are TRUE; Return "FALSE" if one or more arguments evaluates FALSE.

or(logical 1, logical 2, ...): Return "TRUE" if any argument is TRUE; Return "FALSE" if all arguments are FALSE.

2. Definitions of unnecessary information (noise) in bake-ashi

The bake-ashi uses definitions of unnecessary information (noise) to extract price information that is contributing to the trend of a given period. Price information regarded as noise by the definitions is not extracted. However, it is treated as noise only for the day, and when new data has been added, price information is examined again to judge whether it is noise. If the relation between past prices and the present price has changed, price information treated as noise in the past may be treated as necessary information. Conversely, price information treated as necessary in the past may be treated as noise as a result of re-judgment. A noise is defined in 1 through 6 below.

1. H_t when $T^{con} = T_t$ and $H^{con} > H_t$, and L_t when $T^{con} = T_t$ and $L^{con} < L_t$

When the day's trend is the same as the trend of the consolidation period, the day's high price, which was not the high price of the consolidation period, and the day's low price, which was not the high price of the period.

When the trend is reversing, the latest high or low price tends to be the target. To keep only the price information likely to be the target, extract only one high price and one low price during the consolidation period, and treat other price information as noise.

2. O_t when $T^{con} = T_t = 1$ (uptrend) and $O^{con} > O_t$

When both the consolidation period and the day had an uptrend, opening price, which was lower than the opening price of the consolidation period.

3. C_t when $T^{con} = T_t = 1$ (uptrend) and $C^{con} < C_t$

When both the consolidation period and the day had an uptrend, closing price, which was higher than the closing price of the consolidation period.

4. O_t when $T^{con} = T_t = -1$ (downtrend) and $O^{con} < O_t$

When both the consolidation period and the day had a downtrend, opening price, which was higher than the opening price of the consolidation period.

5. C_t when $T^{con} = T_t = -1$ (downtrend) and $C^{con} > C_t$

When both the consolidation period and the day had a downtrend, closing price, which was lower than the closing price of the consolidation period.

In cases 2, 3, 4 and 5, even if the day's trend was the same as the trend of the consolidation period, opening/closing prices not contributing to the body of the consolidated candlestick are prices later adjusted, so the information is treated as noise. Therefore, in accordance with the degree of contribution to the

body of the consolidated candlestick, opening/closing prices are replaced by the opening/closing prices of the consolidation period, or they may be deleted for the time being if they are making no contribution to the body of the consolidated candlestick.

6. O_t and C_t when $T^{con} \neq T_t$ (different trends)

The day's opening price and closing price when the day's trend was opposite to the trend of the consolidation period.

When this definition applies, only the day's high price and low price remain, forming a bo-ashi on the chart. As color information is treated as noise, bake-ashi charts do not have alternately appearing black and white bodies often seen in candlestick charts. So bake-ashi charts make it easier to visually identify trend directionality; the market is bullish when many white candlesticks appear and bearish when many black candlesticks appear. This is one of the advantages of bake-ashi over candlestick charts.

The definitions of noise are designed to indicate the strength of a trend more clearly than in candlestick charts by limiting the scope of information used to create a chart. Unlike candlestick charts, bake-ashi charts do not show a mixture of black and white candlesticks in an uptrend. The more candle bodies appear, the stronger the trend.

3. Consolidation in the period and restructuring of candlesticks

When creating bake-ashi, consolidation and restructuring of candlesticks are closely related to pattern analysis of multiple wicks.

Figure 12. "Evening star pattern" and consolidated candlestick

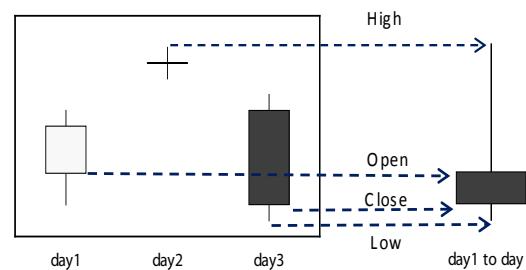
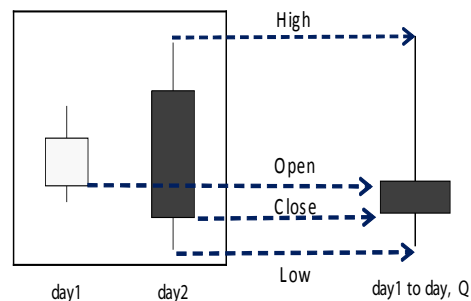


Figure 13. "Bearish engulfing patterns" and consolidated candlestick



Consolidation in a period

Figure 12 shows an "evening star pattern" and Figure 13 shows "bearish engulfing patterns." Both are considered a

bearish signal. Consolidating multiple candlesticks makes it easier to understand why they are considered a bearish signal. The candlesticks of Figure 12 (day1, day2, day3) are consolidated into a black candlestick with a long upper shadow. The candlesticks of Figure 13 are also consolidated into a black candlestick with a long upper shadow, like that of Figure 12. In candlestick chart analysis, a long upper shadow suggests strong resistance to higher quotation, so generally, it is a signal of weakening of an uptrend. That's why the evening star pattern and bearish engulfing patterns are considered a bearish signal. Trend reversal signals from combinations of candlesticks are effective, but this is one of the reasons why candlestick charts create many buy/sell signals.

When creating bake-ashi, multiple candlesticks are consolidated for three objectives:

1. To reduce the number of patterns of reversing trend signals by consolidating patterns of multiple candlesticks. Candlestick charts have a mixture of black and white bodies, so buy/sell signals of not only single wick, but also combinations of multiple wicks, must be considered. But in bake-ashi, analysts need not consider patterns of buy/sell signals because candlesticks are always consolidated.
2. To judge by consolidation whether there is a combination of candlesticks that can be a buy/sell signal.
3. To summarize the market directionality during the period by consolidating information on whether the trend was going up or down in the period after all.

Candlestick analysis may use consolidation in the form of weekly or monthly charts, but other forms of consolidation are rarely seen. In contrast, bake-ashi analysis has the flexibility of setting the consolidation period freely to fit the trade period or cycle. These are the advantages of bake-ashi over candlestick analysis

Restructuring of candlesticks

In bake-ashi, candlesticks are restructured in response to consolidated candlestick and the trend for two objectives.

1. To express the degree of contribution to the trend by restructuring. If many bake-ashi with bodies appear, it means there is a trend in the period. If many bo-ashi appear, it means many of the price movements are not contributing to the trend (directionality of price movements is not clear).
2. To see where in the consolidation period shadows appear. Appearance of shadows means there is resistance to higher or lower quotation. A longer wick suggests stronger resistance. Therefore, where on the chart a shadow appears is an important point in bake-ashi analysis.

Figure 14. Two price movement patterns and candlestick

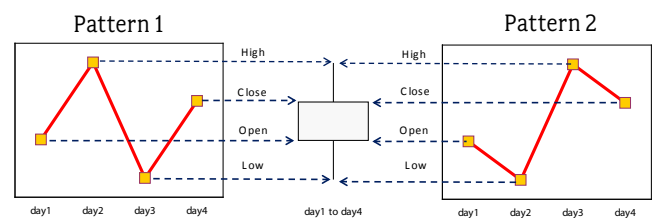
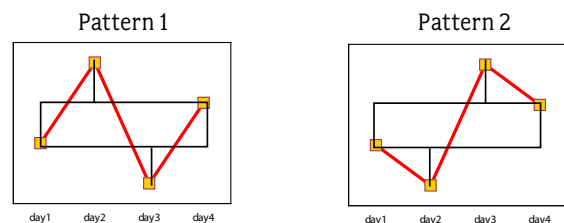


Figure 14 shows two patterns of price movement and a candlestick. The closing price of Pattern 1 seems to be a point in a rebound process from a bottom, while the closing price of Pattern 2 seems to be a point in a fall from a top. But these price movement patterns are represented by the same candlestick form, although buying and selling occurred in different orders. Therefore, it is difficult to judge whether the price is on the way up or has peaked.

Now let us look at Figure 15. It shows that when the factor of time is considered, the two price movement patterns bring different candlestick forms.

Figure 15. Candlesticks with passage of time



If the price movements of Figure 14 and Figure 15 are expressed by four candlesticks, day2 of Pattern 1 and day3 of Pattern 2 would have white bodies. But the prices were adjusted by later price actions, so the visual information of white candlesticks no longer suggests a price increase in the period.

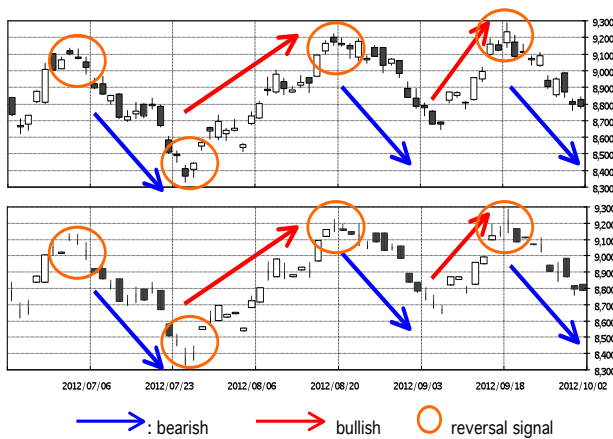
On the other hand, in bake-ashi, the upper shadow on day2 and the lower shadow on day3 of Pattern 1 of Figure 15 and the lower shadow on day2 and the upper shadow on day3 are expressed as bo-ashi. This means the forms were restructured in bake-ashi and replaced with information indicating that the price was adjusted. Bake-ashi shows that on day4 of Pattern 1, there is resistance to lower quotation, whereas on day 4 of Pattern 2, there is resistance to higher quotation.

As seen from the above, bake-ashi makes it easier visually to see when a shadow appeared (i.e., when price adjustment occurred). This is also one of the advantages of bake-ashi over candlestick analysis.

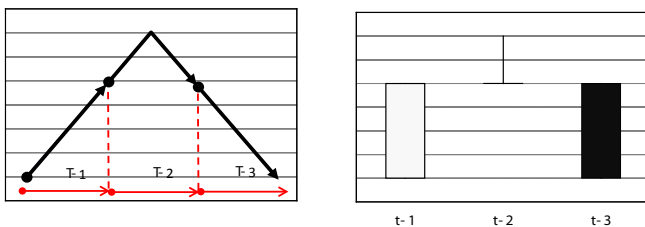
Sell/buy signals of bake-ashi

Figure 16 shows a candlestick chart and a bake-ashi chart with the consolidation period of 10 days for the Nikkei 225 Index. As the bake-ashi chart in Figure 16 shows, a bearish market is represented by a black body, and a bullish market is represented by a white body. Also, the reversal signal from a downtrend to an uptrend is represented with a "black-bar-white" formation, and the reversal signal from an uptrend to a downtrend is represented with a "white-bar-black" formation.

These patterns and reversal signals in bake-ashi will be explained using a sample model. (See Figure 17)

Figure 16. Candlestick Charts and Bake-ashi charts (the Nikkei 225 Index)

"t-1", "t-2" and "t-3" represent the consolidation period used to prepare the bake-ashi. "t-1", which is a period of an uptrend, is displayed with a white body of a candlestick, and "t-3", which is a period of a downtrend, is displayed with a black body of a candlestick. "t-2", where the reversal point is located, is displayed with a small real body and a "gravestone" with a long upper shadow. In candlestick analysis, a gravestone appearing at the top of a trading range indicates the end of a trend.

Figure 17. Sample model

In single wick candlestick analysis, a gravestone does not always appear at the trend reversal point. However, in multiple-candlestick-based analysis, candlesticks are consolidated, and the reversal point tends to be a candlestick with a small real body and long shadows, such as a "gravestone", "paper umbrella" and "dragonfly". Bake-ashi focuses on this point. That the consolidated candlestick has a small real body and a long shadow means that the composition ratio of the pre-consolidation candlesticks against the real body of the post-consolidation candlestick becomes low. Therefore, the restructured candlestick shape is more easily displayed as a bo-ashi. Thus, since in bake-ashi, bo-ashi is likely to occur at the trend reversal point, the trend reversal signals can be unified.

When a bo-ashi has appeared, it should be noted where it appeared. When only bo-ashi appears in a bake-ashi chart, it means the market is in a sideways trend because the closing price was at a similar level as the opening price after some fluctuations. Also, when a bo-ashi appears between the same color bodies, like "white-bar-white" or "black-bar-black", it is just a price adjustment and not a buy/sell signal.

Shapes of bake-ashi

Bake-ashi is a model for evaluating the balance of past and present price levels, so the chart varies depending on the points of time to be compared (length of period or start date). Therefore, it is important to see how the shapes of bake-ashi change from various perspectives.

1. Difference of bake-ashi form due to difference in consolidation period

Figure 18 shows candlestick charts and 100-day, 50-day, 10-day and 5-day bake-ashi charts of the Nikkei 225 Index. Like this, forms of bake-ashi vary in charts of the same period if the consolidation periods are different. This is because the relationship of price levels differs depending on which point of time in the past is compared with the present (e.g., 100 days ago and the present in the case of 100-day consolidation period; 5 days ago and the present in the case of 5-day consolidation period). In the case of the 100-day consolidation period, the chart has some white bodies, which means the price increased in the period.

Figure 18. Candlestick Charts and 100, 50, 10, 5-day Bake-ashi charts (the Nikkei 225 Index)

In the case of the 50-day consolidation period, the first half of the chart shows some black bodies and the second half shows some white bodies, which means the market shifted from a downtrend to an uptrend. The 10-day and 5-day charts show black and white bodies more clearly, with clear short-term fluctuations and signals, such as "white-bar-black" and "black-

bar-white". Different consolidation periods result in different bake-ashi forms, but when the bake-ashi takes the form of the same bo-ashi despite different consolidation periods (marked by green circles in the charts), it is a point of short-term trend reversal, and at the same time it indicates upper side resistance or support line. Thus, it is important to check for points where the bake-ashi appears in the same form despite different consolidation periods. For example, bo-ashi, which corresponds to a shadow of a consolidated candlestick, indicates upper side resistance or support line, so it can be a signal of trend reversal or a new target rate or stop-loss level after trend reversal.

Setting the consolidation period is like setting the period of a moving average line. Just as a moving average line of a longer period shows a broader trend, bake-ashi of a longer consolidation period makes it possible to grasp a broader price relationship at a glance. In Figure 18, the price increased from 100 days ago after all, and considering that bo-ashi indicates price adjustments and not many white bodies appeared, the upward pressure was small during the period.

Thus, a bake-ashi chart of a longer consolidation period tends to indicate strength/weakness and directionality of the trend. On the other hand, in a bake-ashi chart of a shorter consolidation period, the focus is more on where buy/sell signals appear. This is because many buy/sell signals of candlestick analysis are combinations of two to five candlesticks.

2. Difference of bake-ashi form due to difference in start date

The most distinctive feature of bake-ashi is that a chart, once created, may be altered when new data has been added and the relation between past prices and the present price has changed.

Figure 19 shows a candlestick chart and bake-ashi charts of different consolidation periods (length: 5 days) of EUR/US dollar (Forex) rates arranged in chronological order. Period A shows the bake-ashi chart created first. Period B is a new chart recreated by adding new data to Period A. Likewise, Period C is a new chart recreated by adding new data to Period B. In this way, charts up to Period E were created.

Points to be noted are as follows:

- A white body appears on 26-Jul. in the chart for Period A, but the following charts show bo-ashi on 26-Jul. The bake-ashi of the following day (27-Jul.) is a black body with a long upper shadow in many of the charts, which suggests that this level was the top.
- The bake-ashi from 5-Aug. to 10-Aug. change in form between black body/bo-ashi and white body/bo-ashi every time new data is added. This suggests that the buy/sell balance was unstable in this price range.
- The chart for Period D shows only black bodies and bo-ashi. Many occurrences of bo-ashi below the price range of the black body suggest that resistance to lower quotation (hesitation to lower the price) is becoming stronger.
- White candles appeared when new data for Period E was added.
- In the charts for Period A to Period E, the lowest price was recorded on 5-Aug. In bake-ashi charts, this is represented by a white body with a lower shadow or bo-ashi.

Figure 19. Candlestick charts and Bake-ashi charts (EUR/US Dollar (Forex) rates)

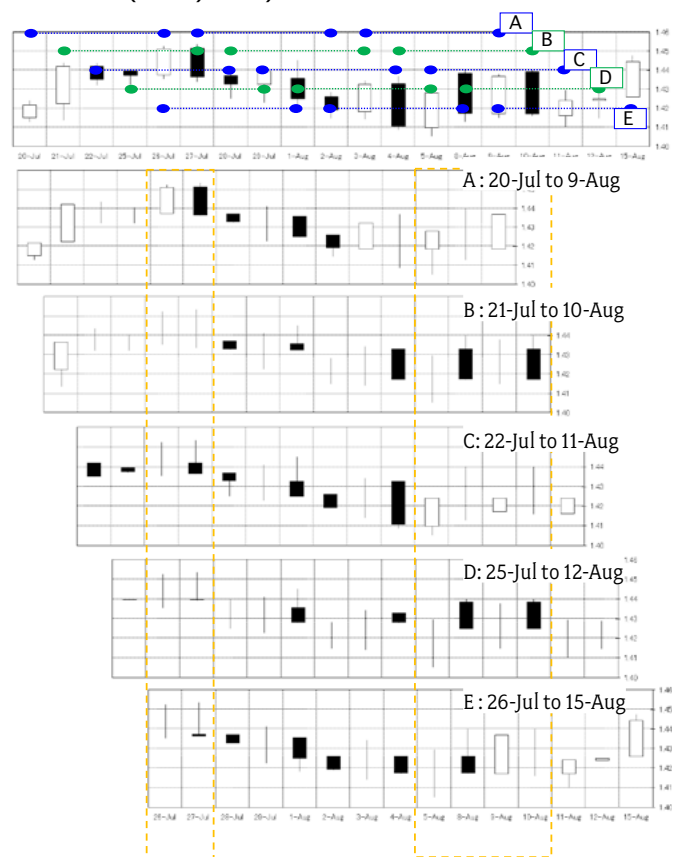
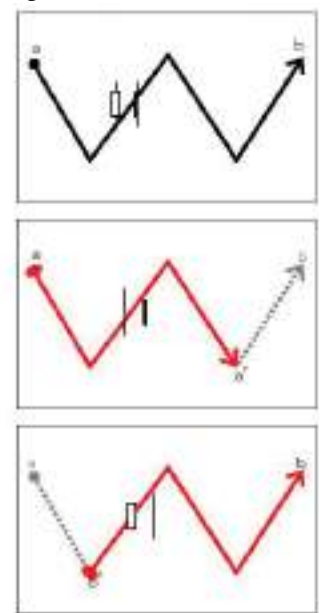


Figure 20. Market with trend



Figure 21. Market with no trend



Rapid changes in the form of bake-ashi mean that the market is not moving in one direction. In other words, the relation (which is higher) of the opening price and the closing price is changing day to day during the consolidation period. Therefore, a range where the bake-ashi form changed frequently is a range of sideways trend. In Period E, the range was broken upward, so many white bake-ashi candlesticks appeared.

By shifting the start date gradually, strength/weakness of the trend and trend reversal can be checked by observing

changes in the bake-ashi shape. This will be demonstrated by sample models in Figure 20 through Figure 22.

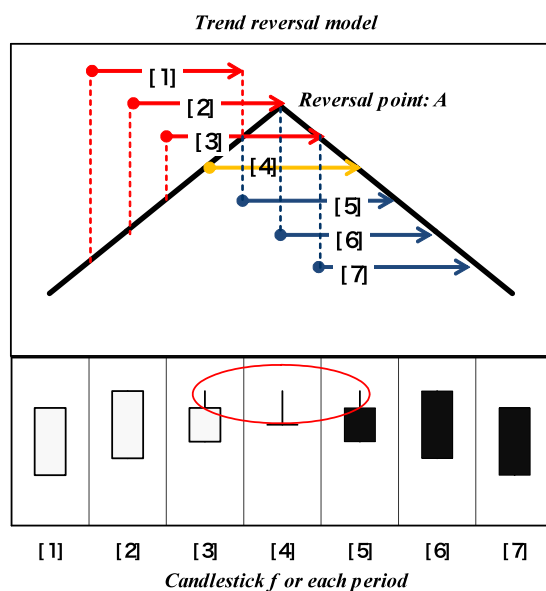
Figure 20 shows a sample model of market condition with a trend continuing for a period (a-b), with white and black candlesticks existing in the trend as minor fluctuations. In this case, bake-ashi of the consolidation period a-a' and the consolidation period b'-b will have the same form. This is because both periods have an uptrend and the relation of "Price at starting point < Price at end point" is unchanged.

On the other hand, Figure 21 shows a sample model of market with no trend for a period (a-b), with white and black candlesticks existing in the period as minor fluctuations. If bake-ashi is created by the same procedure as Figure 20, the consolidation period a-a' has a downtrend because Price at starting point (a) > Price at end point (a'). So, the white candlestick turns into bo-ashi, while the black candlestick remains as black bake-ashi, indicating the same trend. But the consolidation period b'-b has an uptrend because Price at starting point (b') < Price at end point (b). As a result, the black bake-ashi created in the consolidation period a-a' turns into bo-ashi, and the bo-ashi turns into a white bake-ashi. In this way, a change in the trend during the period causes a change in the shape of bake-ashi.

Figure 22 shows a sample model of a market in uptrend up to the trend reversal point A and in downtrend thereafter.

[1] to [7] are the same period. "Candlestick for each period" shows candlesticks created for Period [1] to Period [7] by shifting the consolidation period. Period [1] and Period [2] show white candles, indicating an uptrend, which means the market was bullish in the period. Period [3] also shows a white candle, but it has an upper shadow, which suggests upper side resistance is growing. In Period [4], a "gravestone" with an upper shadow appears, which turns into a black candle with an upper shadow in Period [5]. Then Period [6] and Period [7] show black candles, indicating a downtrend. In this way, when candlesticks are created while shifting the time axis, a white candle shortens as the point of trend reversal approaches, turns into a small-bodied form such as the "gravestone", and then a black candle appears.

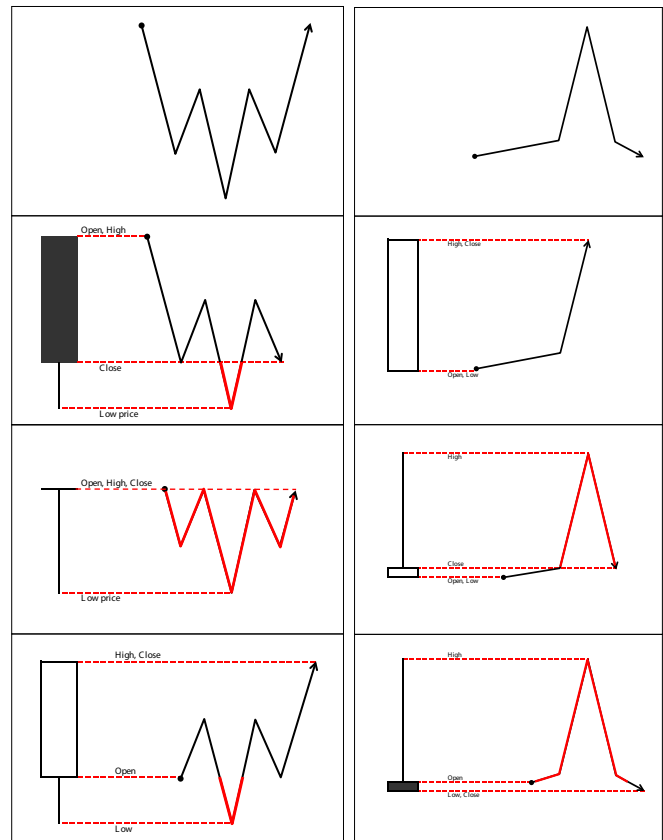
Figure 22. Sample model of trend reversal



Chronological analysis of bake-ashi focuses on these candlestick changes. A market shows unstable price movements around the trend reversal point as forces of buyers and sellers contend with each other. These "unstable" price movements make the relation of the opening price and the closing price change day to day during the consolidation period, causing the bake-ashi to change its shape.

This is demonstrated in Figure 23 in "reverse head and shoulders", a typical pattern of trend reversal, and "spike top" pattern, in which the price soars to an extremely high level.

Figure 23. Reverse head and shoulders pattern and spike top pattern



For both patterns, candlesticks of different start dates were created. The parts shown in red correspond to shadows. By changing the start date, in the reverse head and shoulders pattern, a black candle turns into a dragonfly and then into a white candle. In the spike top pattern, a long white candle turns into a short-bodied candle with a long upper shadow.

In bake-ashi analysis, candlestick patterns such as "white-bar-black" and "black-bar-white" are signals of trend reversal. A pattern of bake-ashi forms changing with passage of time can also be a trend reversal signal. For confirmation of top or bottom by chronological analysis, a sell signal in bake-ashi is "white-bar" on the previous day, and new data appear as black. This means the top has been confirmed. Conversely, if "black-bar" appears on the previous day and new data appears as white, it is a buy signal, meaning that a bottom has been confirmed.

Changing the start date does not cause a big difference in the location where a trend reversal signal appears. However, the fact that the same bake-ashi form does not appear when the start

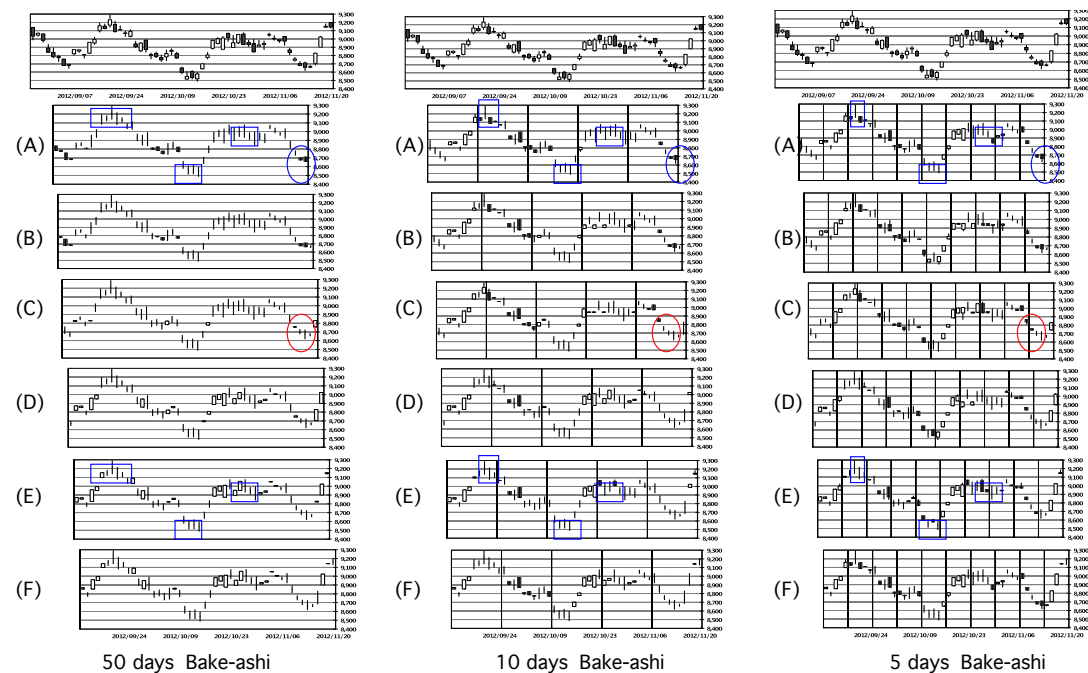
date has been changed is deemed a disadvantage of bake-ashi. However, the degree of difference between bake-ashi charts of different start dates is an indicator of the present market condition. This is believed to be an advantage and the essence of bake-ashi analysis. If the bake-ashi form is unchanged whenever a bake-ashi chart is created, it means the trend is strong. If the bake-ashi form changes when the base date has been changed, it means price movements are unstable and not pointing in one direction.

Use of bake-ashi in trading

When using bake-ashi in trading, bake-ashi charts of different consolidation periods must be used in chronological order.

Figure 24 shows candlestick charts and 50-day, 10-day and 5-day bake-ashi charts of the Nikkei 225 Index arranged in chronological order. The charts were prepared in the order of (A), (B), (C), (D), (E) and (F) adding new data, so (F) is the chart with the latest date.

Fig. 24. Bake-ashi charts of 50 days, 10 days and 5 days arranged in chronological order (the Nikkei 225 Index)



- Although the consolidation periods are different, bo-ashi appeared in the parts marked by blue rectangles, and black bodies appeared in the parts marked by blue circles. In bake-ashi, a black body means bearishness and a bo-ashi means adjustment, so the market at this point is bearish in the short to medium term. The upper side resistance range is 8900 to 9050 and the support range is 8500 to 8600.
- The newly added data appear as short white bodies in the candlestick chart but as bo-ashi in bake-ashi charts in each of the periods, showing a pattern of "black-bar". Also, the ratio of black candles in the 50-day bake-ashi chart decreased, suggesting a possibility that confirmation of a bottom of the downtrend may be approaching.
- In the chart of each consolidation period, the part showing

black bodies up to the previous day turned into bo-ashi (marked by red circles). The chart with a consolidation period of 50 days changed to combination of white bodies and bo-ashi. In the bake-ashi chart of the 5-day consolidation period, new data appeared as white bodies, which, combined with the "black-bar" pattern appearing on the previous day, result in a "black-bar-white" pattern, a signal of reversal from a downtrend (buy signal). From these points, it is confirmed that the market changed its tone from bearish to bullish (change of trend). At the same time, a new support range of 8600 to 8700 is obtained.

- Compared with (C), more white bodies appeared in the bake-ashi chart of the 50-day consolidation period. White bodies also appeared in the bake-ashi chart of the 10-day consolidation period. The 10-day bake-ashi chart of (C) shows a "black-bar" pattern for the last 10 days, so appearance of the new data as "white" indicates re-confirmation of bottoming out.
- The newly added data appeared as white bodies in the bake-ashi chart of each consolidation period, suggesting continued bullishness of the market. As the upper side resistance

range set in (A) (8900 to 9050) has been broken, the new upper side resistance range is 9150 to 9300.

F. The price has reached the lower end of the upper side resistance range set in (E), forming a "white-bar" pattern. Sell if early liquidation is desired, or wait until new data added in the future appears as black bodies.

Bake-ashi has the form of a candlestick, so the calculation of targets such as "swing

target" and "bull/bear flag target" is also possible. In addition, when using bake-ashi for trading, it is important to look for key price levels of the market through chronological observation to find changing and unchanging bake-ashi forms. When the candlestick form changes as a result of a change in the start date even though the consolidation period is the same, it means the relation of price levels is changing, indicating instability of either price movements or buy-sell balance. In contrast, when the shape remains to be bo-ashi and unchanged despite changes in the consolidation period and start date, it means price movements are off the trend. Bake-ashi makes it easier to set such a price level as target rate or stop loss level.

One of the advantages of bake-ashi over candlestick analysis is that it enables forecasting a level where the market

sentiment will change in the future. Bake-ashi compares past and present price levels and expresses bullishness as a white body, bearishness as a black body and adjustment as bo-ashi, so the analyst only needs to compare the price level where the candle turns white (or black) with the opening price of the consolidation period. The price level found in this way can be a level of target rate or stop loss to suit the trading style or period.

Discussion

This paper uses daily data of EUR/US dollar (Forex) rates and the Nikkei 225 Index, but bake-ashi charts can be created for various issues, as long as there are opening, closing, highest and lowest prices. Weekly and monthly bake-ashi analysis is also possible.

In bake-ashi analysis, appearance of many white bodies means the market is bullish, and appearance of many black bodies means the market is bearish. When the market has hit the top, chart patterns such as "white-bar-black" or "white-black" appear. When the market has hit the bottom, chart patterns such as "black-bar-white" or "black-white" appear. Essentially, these patterns on the chart represent a change in market psychology of buy-sell balance from bullish-unstable (hesitation) to bearish or from bearish-unstable (hesitation) to bullish. When using bake-ashi analysis in actual trading, it is important to grasp the market psychology (i.e., read the trend) by observing various consolidation periods chronologically.

Price adjustments appear as bo-ashi in bake-ashi analysis, as they are price movements opposite to the trend. Therefore, frequent appearance of bo-ashi on the chart means that the relation between past and present prices is changing. If bo-ashi appears in the bake-ashi charts of all the consolidation periods, it indicates an adjusted price level.

A distinctive feature of bake-ashi is that a chart may be altered by adding new data. Extensive alteration means that the buy-sell balance is unstable with lack of a clear trend. Even when there is a trend, if a white (or black) body once created shortens as days go by, it means that the market psychology concerning the present trend is changing. Conversely, if a bake-ashi form once created remains unchanged, it means that the market psychology is unchanged from the past. Therefore, continued appearance of the same form of white body suggests a strong uptrend, and continued appearance of the same form of black body suggests a strong downtrend. The above-mentioned changes occur because in bake-ashi, candlesticks are constantly consolidated and restructured. As a result, any change in the consolidated candlestick suggests a change in the trend itself within the period. Any change in daily bake-ashi suggests a change in the buy-sell balance within the period. Any change in either the trend or the buy-sell balance is important, so any change in the consolidated candlestick or daily bake-ashi is an important point.

A bake-ashi chart may be altered at a later date, so a trend reversal signal that once appeared may be cancelled. In such a case, it must be confirmed that the market psychology actually is unchanged using a bake-ashi chart of a longer consolidation period. This is because a bake-ashi chart with a longer consolidation period indicates strength/weakness and directionality of the trend, whereas a bake-ashi chart with a

shorter consolidation period is more suited to looking for the occurrence of trend reversal signals.

If the candlestick remains to be bo-ashi and unchanged at a certain price level, there is strong sentiment of moving against the trend. It is possible to set such a price level as target rate at a time of trend reversal or stop loss level.

Conclusion

If a chart is a record of history, bake-ashi changes the history by changing the start date. Depending on the start date and the consolidation period, several versions of past can exist. It is true that the opening, closing, highest and lowest prices are unchanged facts that existed in the past. But in bake-ashi, these prices are deleted or extracted again depending on the market situation. This may be a weakness from the viewpoint of conventional analytical methods because a chart in technical analysis also has a role to provide information of past price movements.

However, is it really a weakness that bake-ashi changes its shape? Actual market prices are constantly changing, so the reasonable or overbought price levels change as well. The trend reversal point is not always the same price. Then, changing the shape depending on the relation between the past market action and the present can be an effective approach to cope with such changes.

In candlestick analysis, a candlestick, once created, never changes its form. In this way, it provides us with abundant information for analysis. On the other hand, price movements within a range trading, a price increase following an uptrend and an increase for adjustment in a downtrend are represented by the same white candle, so it requires further analysis to find out how important the white candle is (or how valuable the information is). Bake-ashi has the advantages of 1. easy visual presentation of a trend, 2. fewer patterns of buy/sell signals, and 3. visualization of market psychology itself.

Bake-ashi analysis is an effective method for continuous evaluation of past and present price levels, as it visualizes unpredictable changes of market psychology by changing the shapes and altering the chart.

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Equity Sector Rotation via Credit Relative Value

by Dave Klein

1. Introduction

Active investors face a balancing act between achieving superior returns compared to a benchmark while managing multiple types of risk. No matter how well an investment strategy performs over a long time horizon, short-term losses can tarnish the strategy's reputation and reduce investor enthusiasm. The holy grail of investment strategies provides consistent outperformance with lower volatility, lower drawdown risk and positively skewed returns. No approach will deliver all these elements all the time, but forming strategies that are mindful of these factors is a worthy exercise.

This paper outlines a long-only sector rotation strategy using highly liquid ETFs that achieves admirable results in back-test. At its heart, the strategy makes use of relative value across the corporate capital structure to rank sectors and judge when entry and exit are recommended. To implement the investment strategy, we use Standard & Poor's Select Sector SPDR ETFs due to their high liquidity and relatively long history. The nine ETFs can be used, when weighted appropriately, to replicate performance of the S&P 500 index. Our ultimate goal is to choose weights for a portfolio of these ETFs, possibly along with a risk-free asset, to deliver superior returns while mitigating risk.

Much theoretical work has been published over the past four decades tying the corporate capital structure to market valuations. Merton's structural model,¹ which posits that equity can be viewed as a call option on the assets of a firm, inspired many refinements and spawned an entire credit risk advisory industry. While credit and equity analysts focus on different parts of the capital structure, the basic equality of firm assets to firm equity and debt ties their work together. For our analysis, we move away from a structural model and focus on tradable assets across the corporate capital structure; specifically, corporate credit spreads and equity share prices.

As a general rule, equity values drop as credit risk rises and vice versa. With good proxies for credit risk, one can use this relationship to judge relative value between the credit and equity markets. The strategy outlined below utilizes this relationship at the index level. The intuition is that if credit risk rises (falls) among a suitably chosen basket of companies, then equity values will drop (rise) in an equity index. We do not require a one-to-one match between membership in the credit and equity indices. Indeed, the strategy uses the same credit index to judge the relative value (whether stocks are expensive or cheap) of the collection of sector ETFs.

The rest of this paper is divided into six sections. We discuss our data sources. Next, we look at a straightforward linear model to compare the relative value of credit and equity. We then move on to ranking sector ETFs based on the credit-equity

relative model and analyze an investment strategy based on the relative strength (ranks) of the sector ETFs. We then refine the strategy with the addition of switching between equity ETFs and Treasuries to boost returns and lower portfolio risk. We examine a realistic implementation of the strategy and finally present conclusions.

2. Data Sources

Table 1 lists the nine sector ETFs we use in our analysis. We pull historical prices from Yahoo! Finance (<http://finance.yahoo.com>). We use the St. Louis Fed's FRED Economic database (<http://research.stlouisfed.org/fred2>) to pull 3-month Treasury yields as well as option-adjusted spreads for Bank of America/Merrill Lynch's US High Yield B index, henceforth referred to as **HY/B**. We choose these data sources since the data are freely available to the public. The sector SPDRs were launched in December 1998, and our analysis period spans July 1999 through December 2012, a period of 13.5 years. This is a short period for equity analysis, but it includes two major market corrections as well as multiple periods of rising equity prices.

Table 1. Standard & Poor's Select Sector SPDR ETFs

Ticker	Description
XLV	The Consumer Discretionary Select Sector SPDR Fund
XLP	The Consumer Staples Select Sector SPDR Fund
XLE	The Energy Select Sector SPDR Fund
XLF	The Financial Select Sector SPDR Fund
XLV	The Health Care Select Sector SPDR Fund
XLI	The Industrial Select Sector SPDR Fund
XLB	The Materials Select Sector SPDR Fund
XLK	The Technology Select Sector SPDR Fund
XLU	The Utilities Select Sector SPDR Fund

3. Relative Value Across the Capital Structure

The core of the relative value model is the relationship between the HY/B credit index and the individual sector ETFs. To judge whether an ETF is expensive or cheap, we use a simple linear model:

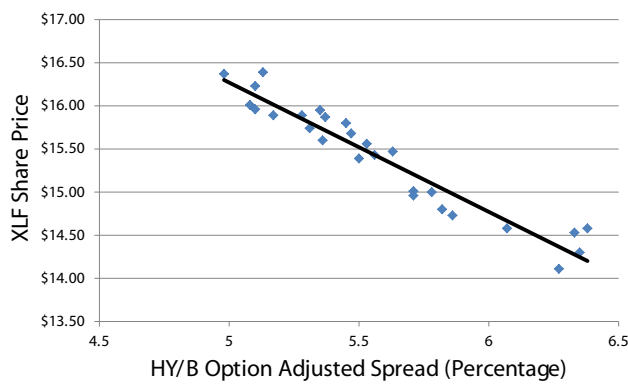
$$ETF_{Fair}(HYB_{Market}) = A * HYB_{Market} + B$$

We use the HY/B's option-adjusted spread as published in the St. Louis Fed's FRED database. Since credit spreads and equity values move in opposite directions as credit risk changes, we expect the A parameter in the equation to be negative. We calibrate

the model via Ordinary Least Squares (OLS) linear regression.

This type of credit-equity relationship is often non-linear when single companies are considered. The intuition is that, for companies with very low credit risk, there is almost no correlation between equity prices and credit spreads. For companies with high credit risk, credit spreads change more rapidly than equity prices because they can theoretically go to infinity. At the index level, it is possible to use a non-linear model but a linear model works well given the credit index chosen.¹ To illustrate the relationship, Exhibit 1 plots the HY/B index against XLF using weekly values from July 2012 through December 2012. Points below the trendline indicate that XLF is cheap compared to HY/B, and points above the trendline indicate that XLF is relatively expensive.

Exhibit 1: HY/B vs. XLF, Weekly Values from July 2012 through December 2012



Once the model has been calibrated via linear regression, we can estimate fair value for each sector ETF. More importantly, we can calculate how far, on a percentage basis, each ETF is away from fair value:

$$ETF_{disconnect} = \frac{ETF_{fair} - ETF_{market}}{ETF_{market}}$$

We use the disconnect in two ways. First, we rank the sector ETFs in order to select a basket of ETFs in which to invest. Second, we consider whether the disconnect is positive or negative to determine whether to invest in the ETF or in a risk-free asset. For the purposes of our analysis, we use 3-Month Treasury bills as our risk-free security.

We assume the investor invests in a basket of ETFs and rebalances on a weekly basis. We choose a weekly trade frequency, since it is not overly onerous for an active investor to adjust a portfolio of up to nine separate positions at this frequency. Later, once we have developed the full strategy, we implement a more realistic, lower-frequency strategy where only entries and exits are traded and positions in ETFs that remain in the portfolio are not adjusted. We note that it is possible to implement this strategy with a monthly trading frequency, although returns are lower.

4. Using HY/B to Rank Sector ETFs

As outlined above, once a timeframe and frequency are chosen, it is straightforward to use OLS regression to create a fair value model for each sector ETF using the HY/B index. Once

fair values are calculated, the ETFs can be ranked in descending order by fair percentage disconnect. If our model does a good job of ranking, a basket with top-ranked ETFs—those ETFs with the greatest disconnect—should generate higher returns than a basket containing bottom-ranked ETFs.

To begin our analysis, we use a 6-month timeframe and a weekly frequency. Thus, we regress 26 data pairs to generate our model. As a practical matter, we use the previous 26 weeks of data exclusive of the current trading day to build our regression. Further, since the HY/B value is published the following day, we use the previous day's HY/B value to calculate fair value for each ETF.

The motivation for the 6-month timeframe is as follows. Six months is long enough to develop a meaningful relationship between the credit index and the ETF but short enough to ignore factors like inflation and dividends. It is also short enough to enable regime changes, like major market disruptions, to pass quickly from influence. Although we use a 6-month timeframe throughout most of the analysis that follows, we consider the sensitivity of the model to different timeframes later in the paper.

For purposes of notation, let **Basket_N** denote a basket containing the N top-ranked ETFs. In this manner Basket₁ contains a single ETF and Basket₉ contains all nine ETFs. Our Basket_N trading strategy can be stated by the following rule:

Basket_N Strategy: Each week, invest in an equal-weighted basket of the N top-ranked ETFs

Baskets are rebalanced on a weekly basis. Notice that the membership of Basket₉ will not change since all ETFs are in the basket. We expect the baskets with fewer ETFs to generate greater returns than the baskets with a greater number of ETFs at the expense of higher volatility.

Exhibit 2 shows the equity curves of the basket strategies and the SPY ETF from July 1999 through December 2012 with dividends reinvested. As expected, the Basket_N strategies generate returns over the time period in strictly descending order. Each strategy outperforms SPY quite handily, implying that even the simple strategy of holding the sector ETFs in equal weight and rebalancing weekly (*the Basket₉ strategy*) is worth consideration, assuming transaction costs and tax liabilities can be minimized.

Exhibit 2: Equity Curves for Basket_N Strategies

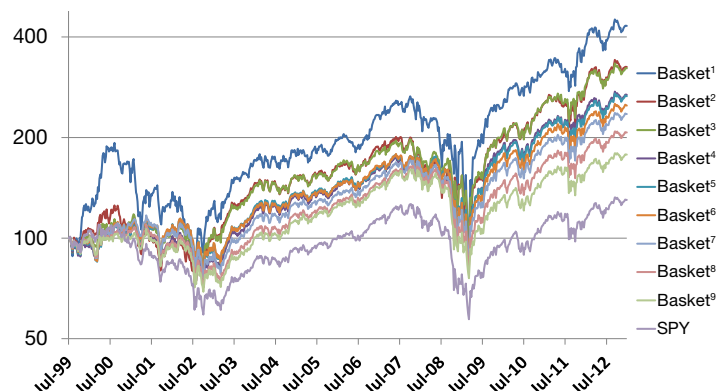


Table 2: Return & Risk Statistics for Basket_N Strategies, SPY (Jul 99 – Dec 12)

	Basket ₁	Basket ₂	Basket ₃	Basket ₄	Basket ₅
CAGR (13.5 years)	12.4%	9.9%	9.8%	8.2%	8.1%
Volatility	31.5%	25.0%	22.7%	21.8%	21.3%
Sharpe Ratio (2.2%)	0.32	0.31	0.34	0.28	0.28
Sortino Ratio	0.44	0.45	0.49	0.39	0.38
Skewness	0.08	0.29	0.28	0.07	-0.07
MaxDD	-63.2%	-54.0%	-49.7%	-49.2%	-48.2%
Information Ratio	0.43	0.55	0.71	0.68	0.81
	Basket ₆	Basket ₇	Basket ₈	Basket ₉	SPY
CAGR (13.5 years)	7.6%	7.1%	6.0%	4.7%	2.1%
Volatility	20.8%	20.4%	20.1%	19.9%	20.3%
Sharpe Ratio	0.26	0.24	0.19	0.13	0.00
Sortino Ratio	0.35	0.32	0.25	0.16	-0.01
Skewness	-0.07	-0.14	-0.20	-0.35	-0.37
MaxDD	-48.9%	-48.8%	-50.5%	-52.8%	-54.8%
Information Ratio	0.80	0.82	0.76	0.56	

Of course, returns should not be viewed in isolation. Table 2 presents return and risk statistics for each strategy and SPY, including dividends, for the period of July 1999 through December 2012. As expected, volatility decreases as more securities are added to the basket. The Sharpe and Sortino ratios are generally decreasing as well, although volatility and drawdown hurt Basket₁ and Basket₂. Maximum drawdown (MaxDD) is still large in magnitude for all the basket strategies, a fact that motivates a refinement to the basket strategy discussed later in the paper.

The information ratio is an interesting statistic to use when balancing risk and return compared to a benchmark. The statistic provides a risk-adjusted measure (the ratio of alpha divided to the standard deviation of alpha) of portfolio outperformance to a benchmark, the S&P 500 in our case. An information ratio above 0.5 places a strategy in the top quartile of active returns.¹ By this measure, Basket₅ through Basket₇ provide a clear advantage to the other basket strategies, and all baskets except Basket₁ have information ratios above 0.5.

Given its relatively high CAGR and high information ratio, we use the Basket₆ strategy to further analyze strategy performance. The reason for choosing Basket₆ rather than Basket₅ or Basket₇, for example, is to maintain consistency as we refine the strategy below. We also note that different investors may prefer different basket sizes given the variety of return and risk statistics.

Next, we consider the sensitivity of the ranking strategy to the regression timeframe employed. The analysis above used

a 6-month timeframe. Table 3 compares performance of the Basket₆ strategy for the 3, 4, 5, 6, 7, 8 and 9-month timeframes from October 1999 through December 2012. Note that the beginning of our time period is later than the prior analysis to accommodate the 7, 8 and 9-month timeframes. Most statistics are similar, although the 7-month and 8-month timeframes provide superior information ratios and CAGR. Our use of a 6-month timeframe throughout this paper is admittedly arbitrary. It stems from past work in single-name credit-equity models and the credit-implied tactical asset allocation model mentioned previously. There is nothing “magic” about the 6-month timeframe, and investors would do well to consider a 7 to 8 month period as well.

When back-testing a rotation strategy, it is informative to consider how often each candidate security is held within the portfolio. Superior returns can be “data-mined” by simply picking the securities with the greatest return and holding them over the back-test period. Table 4 displays the percentage of time each sector ETF is held in the Basket₆ portfolio and also the CAGR of the ETF over the entire analysis period, July 1999 through December 2012. If the ETF selections were distributed evenly, we would expect each to be included 6/9 (66.7%) of the time. The Basket₆ strategy holds XLF and XLK the most, the two sector ETFs with the worst dividend-adjusted performance over the period. It holds XLE the least amount of time, and this ETF had the best performance over the time period.

Table 3: Performance and Risk Statistics for Basket₆ Strategy by Varying Model Regression Timeframe (Oct 99 – Dec 12)

	3 Months	4 Months	5 Months	6 Months	7 Months	8 Months	9 Months
CAGR (13.5 years)	8.0%	8.2%	8.2%	8.3%	9.0%	8.9%	7.6%
Volatility	21.0%	21.1%	21.0%	20.9%	21.0%	20.9%	20.9%
Sharpe Ratio	0.28	0.28	0.28	0.29	0.32	0.32	0.26
Sortino Ratio	0.37	0.39	0.38	0.38	0.44	0.43	0.35
Skewness	-0.06	-0.11	-0.14	-0.08	-0.12	-0.17	-0.22
MaxDD	-48.1%	-47.5%	-48.3%	-48.9%	-47.3%	-49.1%	-52.4%
Inf. Ratio	0.87	0.86	0.84	0.84	0.93	0.92	0.75

Table 4. CAGR and %Time ETF Is Included in the Basket₆ Portfolio (Jul 99 – Dec 12)

	CAGR (July 99-Dec 12)	Percentage of Weeks in Portfolio
XLY	4.8%	66.8%
XLP	4.6%	68.6%
XLE	9.1%	55.3%
XLF	-1.8%	72.9%
XLV	3.9%	64.8%
XLI	3.6%	74.0%
XLB	5.0%	64.1%
XLK	-1.9%	71.7%
XLU	4.8%	61.9%

Of course, it is important to look at performance when the ETF is held to get a sense for how well the strategy does at ranking sectors. To accomplish this, we consider how each sector ETF performs when included in the portfolio compared to the average return of the three ETFs not held each week in the Basket₆ portfolio. The motivation is to compare the returns missed by the portfolio by including one of the ETFs at the expense of the excluded ETFs.

For example, assume for one week that XLY is included in the portfolio and XLP, XLE and XLF are excluded. We record XLY's 1-week log return and the average of XLP, XLE and XLF's log returns. We do this for each week in the time period and each ETF held that week.

Table 5 displays the annualized return for each sector ETF when included in the portfolio, the annualized return of the three ETFs excluded, and the difference (outperformance) between the returns. All sector ETFs show positive outperformance compared to the excluded ETFs, which implies that the strategy does a reasonable job of picking six ETFs each week. Outperformance is not uniform across sectors, and two ETFs (XLP and XLK) have negative performance when held in the portfolio. While this type of outperformance is gratifying, more can be done to improve performance and mitigate risks. In the next section, we consider an enhancement to the strategy that helps limit portfolio losses.

Table 5. Annualized Return and Percentage Time Each ETF Is Held in the Basket₆ Portfolio

	ETF Annualized Return	Annualized Return of 'Excluded' ETFs	Strategy Outperformance
XLY	2.0%	-4.2%	6.3%
XLP	-2.0%	-11.3%	9.3%
XLE	33.6%	12.3%	21.3%
XLF	11.3%	7.3%	4.0%
XLV	5.0%	-3.2%	8.2%
XLI	7.0%	-3.0%	10.0%
XLB	6.0%	-1.7%	7.6%
XLK	-4.5%	-6.1%	1.5%
XLU	4.3%	-4.6%	8.9%

5. Beyond Ranks – Tactical Asset Allocation

The Basket_N strategy analyzed above produces superior results to a buy-and-hold SPY investment policy. Further, the strategy increases returns as N decreases, and risk can be balanced with return by varying the number of ETFs held in the basket. Still, the drawdown of each basket is comparable to the buy-and-hold SPY investment and sometimes worse. Additionally, volatility is higher for most baskets compared to SPY.

To address the drawdown issue as well as boost portfolio return and lower portfolio volatility, we return to our fair value regression model. Previously, we paid no attention to the sign of the percentage difference from fair. Now, we enhance our Basket_N strategy by switching between the sector ETFs and 3-month Treasury bills depending on whether the sign of the difference is positive (that is, the ETF is *inexpensive*) or negative (the ETF is *expensive*). Our new **tactical asset allocation (TAA_N)** strategy is as follows:

TAA_N Strategy:

1. Each week, choose the N top-ranked ETFs and divide assets into N equal shares.
2. For each of the chosen ETFs:
 - a. If the fair value is greater than market value, invest the asset share in the ETF.
 - b. If not, invest the asset share in 3-month Treasuries instead.

In this manner, we still choose the top-N ETFs as in the Basket_N strategy. However, we only invest in those ETFs for which our fair value model has a *positive* expected return. The tactical asset allocation strategy, while simple in concept, has two advantages to the Basket_N strategy outlined above. It raises the expected return of the basket while limiting portfolio drawdown. The mechanics and motivation for this type of tactical asset allocation strategy were discussed in Klein's "Credit-Implied Tactical Asset Allocation."² A key difference between that strategy and this one is that we are investing in multiple ETFs, some of which may be inexpensive and others of which may be expensive. Thus, we are often partially invested in the stock market while generally also being invested in lower-volatility Treasuries.

In declining markets, the strategy helps limit losses. In ascending markets, the strategy throttles gains. Overall, the trade-off of lower gains in up markets is offset by limiting portfolio drawdown. Exhibit 3 displays the equity curves of the nine TAA_N strategies from July 1999 through December 2012 as well as SPY's equity curve. Periods where the strategy is heavily invested in Treasuries, such as 2003, are much less volatile than SPY.

To get a better sense of how a TAA_N strategy compares to the comparable Basket_N strategy, Exhibit 4 displays the TAA₆, Basket₆ and SPY equity curves. The superior returns and diminished drawdown of the TAA₆ strategy are readily apparent. However, since the strategy is generally invested at least partially in Treasuries, it lags the Basket_N strategy during bull markets.

For example, for the period stretching from October 7, 2002, through April 23, 2007, the Basket_N strategy returned 117% compared to the TAA_N strategy's 77% and SPY's 103%. This is a challenge faced by strategies that seek to limit drawdown. Many investors will not care that the TAA strategy produced its 77% return with far less volatility. In hindsight, they might only regret that they missed out on a 117% gain. Still, an investor who takes the long view will recognize that a lower volatility strategy that limits drawdown can be far more desirable than a buy-and-hold strategy or one that exposes a portfolio to sharp market corrections.

To illustrate this point, we note that the TAA₆ portfolio peaked on April 28, 2008, and recovered to that level on July 13, 2009, a period of just over one year. A weekly buy-and-hold SPY portfolio (with dividends) peaked much earlier, on October 8, 2007, and did not recover until March 12, 2012, a period of almost four and a half years. Not only was the drawdown much less severe for the TAA₆ portfolio, but the period between high water marks was also far shorter.

We again consider how the strategy performs for different choices of basket size. Table 6 shows return and risk statistics for the TAA portfolios. The returns are greater for each TAA strategy compared to its associated Basket strategy, and volatility is strictly decreasing as basket size increases. Volatility is lower than the comparable basket's volatility as well. However, CAGR is not strictly decreasing with increasing basket size. For example, there is a benefit to holding more ETFs in the TAA₆ portfolio compared to the TAA₄ portfolio. The introduction of switching to Treasuries for expensive ETFs helps mitigate the losses when stocks are overvalued and provides an investment synergy over the time period considered.

The choice of basket size gives an investor the opportunity to tailor a portfolio based on expected return, drawdown, and risk-adjusted outperformance. An investor who favors low drawdown and low volatility over higher returns might choose the TAA₉ portfolio over TAA₆ because of its risk characteristics. An investor who favors high returns above all else might

Exhibit 3: Equity Curves of TAA_N Strategies (Jul 99 – Dec 12)

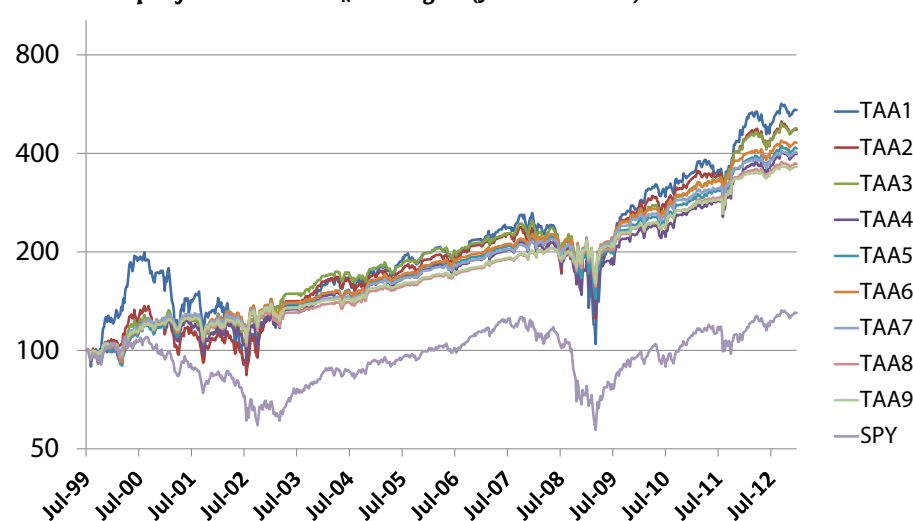


Exhibit 4: Equity Curves of TAA₆ Strategy, Basket₆ Strategy, and SPY Strategies (Jul 99 – Dec 12)

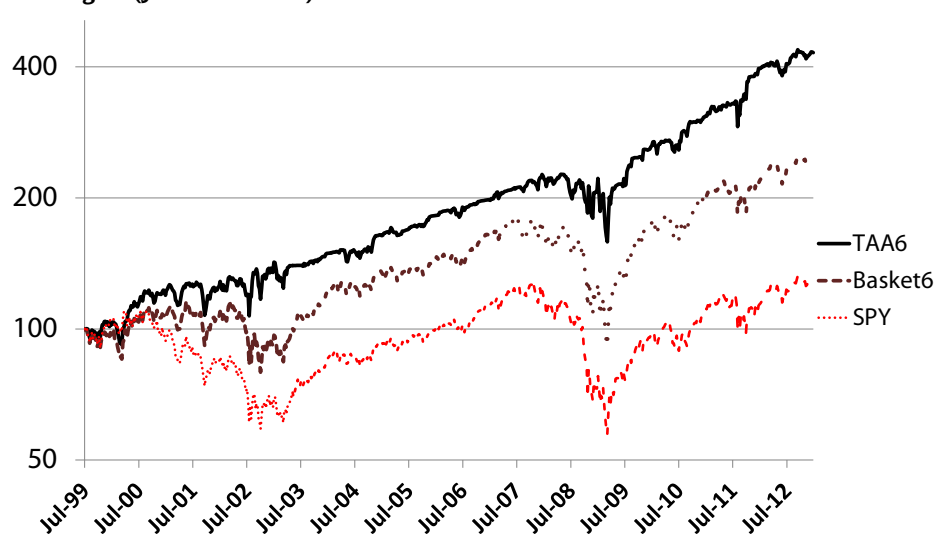


Table 6: Return & Risk Statistics for TAA_N Strategies, SPY (Jul 99 – Dec 12)

	TAA ₁	TAA ₂	TAA ₃	TAA ₄	TAA ₅
CAGR (13.5 years)	14.5%	13.2%	13.3%	11.7%	12.0%
Volatility	31.0%	23.9%	21.1%	19.5%	18.3%
Sharpe Ratio (2.2%)	0.40	0.46	0.53	0.48	0.54
Sortino Ratio	0.50	0.62	0.70	0.62	0.68
Skewness	0.08	0.33	0.41	0.28	0.28
MaxDD	-60.3%	-47.6%	-44.7%	-41.3%	-36.3%
Information Ratio	0.50	0.72	0.86	0.79	0.82
	TAA ₆	TAA ₇	TAA ₈	TAA ₉	SPY
CAGR (13.5 years)	12.4%	11.8%	11.1%	10.9%	2.1%
Volatility	17.2%	16.2%	15.0%	13.9%	20.3%
Sharpe Ratio	0.59	0.59	0.59	0.62	0.00
Sortino Ratio	0.75	0.73	0.73	0.79	-0.01
Skewness	0.42	0.40	0.60	0.85	-0.37
MaxDD	-30.1%	-27.5%	-26.6%	-25.8%	-54.8%
Information Ratio	0.83	0.76	0.69	0.65	

choose TAA₁ because of its dominant expected return. For the remainder of this discussion, we focus on the TAA₆ strategy since it offers a mix of high information ratio and enviable risk characteristics.

In the appendix, Table 8 breaks out TAA₆ return by year and month with red cells indicating losses and green cells indicating gains. One immediate takeaway is the fact that the strategy made gains in every year of the analysis period. Granted, a 0.5% gain in 2008 could just as easily have been a loss based on what day of the week the portfolio was rebalanced. However, we believe a long-only investor would happily break even with TAA₆ rather than endure the loss made by SPY in 2008. Gains are by no means uniform throughout the period. As the equity curves show, the strategy often does best in down stock markets due to its combination of switching to Treasuries from overvalued ETFs and staying long undervalued ETFs.

Also in the appendix, Table 9 breaks out TAA₆ relative outperformance compared to SPY over the same period. We define *outperformance* as strategy performance minus SPY performance. Red cells indicate when SPY outperforms the strategy and green cells indicate when the strategy outperforms SPY. The strategy outperforms SPY in 86 of the 162 months in the time period, 53% of the time. However, average monthly outperformance was 2.9% and average monthly underperformance was -1.6%, further skewing the strategy toward outperformance.

The best year for outperformance was 2008 followed by 2002, both down years for the market. The worst year for outperformance was 2003, when the market made strong gains and equities were consistently deemed expensive by the ETF relative value models.

2003 and late 2010 through mid-2011 bring one of the challenges of the strategy into sharp focus. Through an entire cycle, the strategy performs admirably, but investors often do not focus on full cycles. An investor at the end of 2003 might ignore the spectacular outperformance the strategy provided through 2002 and instead focus on the relatively paltry gains of 4.8% that the strategy produced in 2003. Often, missing out on losses is not felt as keenly as missing out on gains. Still, periods of strategy underperformance do not tend to last long, and an investor with a two- or three-year time horizon would have been amply rewarded for sticking with the strategy throughout the time period analyzed.

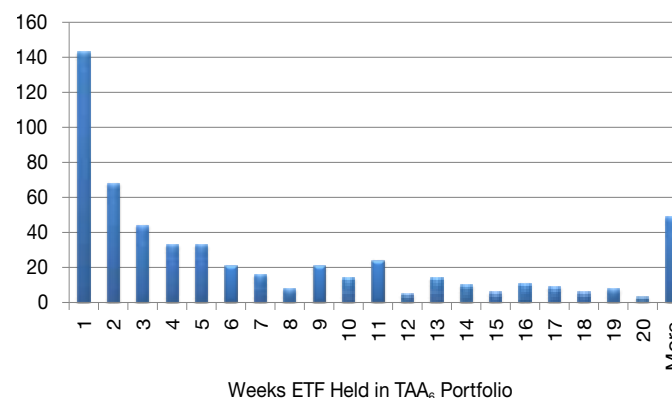
6. Real-World Implementation – Reducing Portfolio Transactions

The ETF ranking strategy combined with tactical asset allocation produces a portfolio with superior returns and benign risk characteristics. Until now, we ignored transaction costs. We continue to ignore tax consequences because this type of strategy is not designed to minimize tax liabilities. Switching between ETFs will produce short-term capital gains, and this strategy will add to the tax liability of a non-exempt investor compared to a buy and hold investment strategy.

When digging into the TAA₆ strategy from July 1999 through December 2012, we find that a sector ETF is included in the

portfolio for an average of 7.7 weeks before exiting. Exhibit 5 charts the count of ETFs by the consecutive weeks held. Note that by “held” we mean the ETF is one of the top 6 ranked ETFs, regardless of whether it is deemed expensive or inexpensive relative to the HY/B index. The longest an ETF was held is 68 weeks, and 1 week is the holding period for more than a quarter of the positions.

Exhibit 5: Count of ETF Positions by Weeks Held in TAA₆ Portfolio (Jul 99 – Dec 12)



Because almost three-quarters of positions are held more than one week, we examine the effect that refraining from rebalancing the portfolio has on return and risk. “Refraining from rebalancing” means a position is not altered until the underlying ETF either drops out of the portfolio or moves from expensive to cheap or cheap to expensive. This drops the number of transactions to 1,717 (2.4 per week) from 4,764 (6.8 per week) over the time period of July 1999 through December 2012. Theoretically, that would drop the transaction costs by approximately 64% and make the strategy easier to execute. Table 7 compares the return and risk statistics for the TAA₆ portfolio and the “lower-frequency” execution of the TAA₆ strategy, ignoring transaction costs.

Table 7: Return & Risk Statistics for TAA₆ and TAA₆ Lower-Frequency Strategies

	TAA ₆ Weekly Rebalance	TAA ₆ Lower Frequency
CAGR (13.5 years)	12.4%	12.2%
Volatility	17.2%	17.0%
Sharpe Ratio (2.2%)	0.59	0.59
Sortino Ratio	0.75	0.73
Skewness	0.42	0.38
MaxDD	-30.1%	-30.6%
Information Ratio	0.83	0.81

Given how similar the statistics are, we would not be surprised to see the lower frequency implementation beat the weekly-rebalanced implementation once realistic transaction costs are considered. Regardless, the two implementations present almost identical return and risk characteristics, making the lower-frequency implementation preferable simply due to its lower number of transactions.

7. Conclusions

This paper extends the fundamental relationship of asset prices across the corporate capital structure to the index level. We construct linear relative value models using the HY/B credit index and S&P sector ETFs and then rank the ETFs based on their distance from fair value. This ranking underlies a straightforward relative strength investment strategy that produces superior absolute and risk-adjusted returns when compared to the S&P 500. Further, we extend the strategy to only invest in ETFs that are viewed as inexpensive and to take a position in Treasuries for those that are viewed as expensive; an enhancement that boosts returns, lowers volatility, limits portfolio drawdown, and results in faster recovery to previous high water marks.

We believe this type of relative strength investment strategy is worth consideration for investors with multi-year investment horizons. We also note that, given the use of the credit market to judge relative value, this investment strategy is uncorrelated to many popular ranking methodologies and can be used in conjunction with them as an enhancement to existing strategies. The strategy outlined is certainly not fail-safe, but it does present the investor with a straightforward

procedure to adjust the return vs. risk characteristics of an equity portfolio by changing the size of the investment basket. Further, the strategy is designed for long-only investors and can be implemented using highly-liquid index ETFs.

Notes

1. Merton, Robert C., "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", *Journal of Finance*, Vol. 29, No. 2, (May 1974), pp. 449-470.
2. For an example of using a non-linear model, please see Klein's "Credit-Informed Tactical Asset Allocation," (June 1, 2011) http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1872163.
3. Grinold, Richard C. and Ronald N. Kahn, 2000. "Active Portfolio Management: A Quantitative Approach for Providing Superior Returns and Controlling Risk". New York: McGraw-Hill.
4. Klein, David, Credit-Informed Tactical Asset Allocation (June 1, 2011). <http://ssrn.com/abstract=1872163>.

Note from the Editor

The author Dave Klein is the winner of the NAAIM Wagner Award 2013. This paper was originally submitted for this contest. IFTA is thankful to Greg Morris and the National Association of Active Investment Managers for the permission to print this document. For further information, please refer to www.naaim.org/resources/wagner-award/.

Appendix. TAA₆ Strategy Performance and Outperformance by Month

Table 8: TAA₆ Strategy Performance by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1999							2.6%	-1.0%	1.3%	1.8%	-3.4%	-3.6%	-2.5%
2000	0.9%	-5.9%	2.6%	9.2%	4.7%	-1.6%	4.9%	-1.6%	4.7%	0.4%	6.8%	2.8%	30.7%
2001	-0.1%	4.5%	2.6%	-0.2%	0.4%	2.1%	3.4%	3.0%	-3.0%	3.6%	-1.9%	2.0%	17.2%
2002	1.3%	1.5%	0.7%	4.3%	1.7%	1.1%	15.0%	7.2%	-2.9%	-1.0%	0.0%	4.1%	36.9%
2003	0.4%	-0.3%	2.0%	-4.3%	-4.4%	-3.6%	1.9%	-2.4%	-0.6%	-1.2%	-0.1%	-3.0%	-14.7%
2004	-1.2%	-1.2%	1.3%	0.1%	0.5%	1.0%	0.6%	-0.5%	0.3%	1.0%	0.1%	-1.4%	0.6%
2005	2.2%	0.1%	1.3%	-0.3%	-0.8%	0.1%	-1.1%	0.4%	0.9%	3.0%	-1.6%	-0.3%	3.8%
2006	1.8%	-0.6%	-1.4%	0.0%	0.6%	2.3%	0.0%	-1.7%	-0.8%	-2.4%	-1.9%	-0.2%	-4.3%
2007	0.0%	3.5%	-1.0%	-4.4%	-1.4%	1.9%	3.1%	-0.3%	-1.0%	1.7%	3.0%	4.4%	9.4%
2008	3.1%	1.7%	-1.2%	-1.1%	0.1%	-0.1%	2.8%	3.3%	10.2%	15.2%	-0.3%	8.3%	49.2%
2009	-3.2%	0.1%	4.6%	-4.0%	-3.0%	4.0%	-0.5%	1.6%	-1.5%	-1.6%	-0.8%	-0.3%	-4.8%
2010	3.2%	-1.0%	-4.4%	-1.2%	5.8%	4.5%	0.7%	4.7%	-1.4%	-3.8%	-2.3%	-1.8%	2.4%
2011	0.0%	-0.3%	-0.1%	-1.3%	6.0%	-3.5%	4.7%	11.2%	6.3%	-1.8%	1.5%	1.1%	25.4%
2012	-3.7%	-1.9%	-2.6%	2.8%	0.7%	-0.5%	1.2%	-0.8%	-0.5%	0.4%	0.1%	-0.1%	-4.7%

Table 9: TAA₆ Strategy Outperformance Relative to SPY

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1999							-2.0%	0.8%	-2.0%	5.6%	1.7%	-1.6%	2.2%
2000	-1.3%	-7.6%	11.3%	6.2%	4.8%	-1.2%	5.5%	0.5%	-0.2%	0.3%	-0.9%	-0.4%	16.9%
2001	5.3%	-4.0%	-5.9%	10.3%	1.3%	-0.2%	0.2%	-2.9%	-10.5%	10.0%	0.5%	5.4%	7.6%
2002	-4.7%	6.9%	0.0%	-4.0%	0.7%	-5.7%	-0.7%	13.0%	-12.6%	14.0%	3.3%	3.3%	10.7%
2003	-6.8%	-2.8%	7.2%	1.2%	0.1%	0.1%	-0.3%	1.9%	0.8%	0.8%	1.4%	1.8%	4.8%
2004	0.2%	0.7%	0.9%	-2.6%	1.0%	0.7%	-0.2%	1.2%	1.5%	0.7%	5.5%	0.0%	9.7%
2005	2.0%	2.3%	-2.6%	-1.3%	2.3%	0.8%	1.5%	0.5%	0.4%	2.7%	1.9%	0.3%	11.3%
2006	1.7%	0.6%	0.2%	0.6%	-1.9%	3.3%	0.1%	1.2%	0.7%	1.3%	0.4%	0.4%	8.8%
2007	2.4%	-1.9%	2.8%	1.5%	0.7%	0.8%	-0.7%	1.6%	2.9%	-1.1%	1.4%	0.4%	11.3%
2008	0.6%	-1.4%	1.8%	1.7%	-1.2%	-9.7%	2.8%	5.8%	-9.3%	6.9%	-15.7%	23.4%	0.5%
2009	-13.9%	-14.4%	24.8%	4.3%	1.1%	-0.9%	11.3%	4.1%	0.0%	-1.3%	5.4%	2.5%	18.9%
2010	-0.7%	1.6%	1.9%	0.1%	-5.5%	0.4%	10.4%	1.8%	2.8%	0.2%	1.2%	2.2%	17.0%
2011	3.8%	-0.7%	1.7%	0.9%	0.4%	0.6%	0.7%	1.0%	0.4%	12.8%	1.5%	2.8%	28.5%
2012	1.6%	-0.2%	1.5%	-0.6%	-5.9%	6.5%	3.5%	0.2%	2.4%	-1.3%	-0.2%	1.3%	8.8%

Investing with Volume Analysis: Identify, Follow, and Profit from Trends—By Buff Plez Dormeier

Reviewed by Regina Meani, CFTe

Volume and its analysis form one of the underlying tenets of Technical Analysis. Yet, in recent years, the increasing effects of technology, in particular the advent of “dark pools” and “high frequency trading,” has brought its value as an analysis tool into question and has perhaps seen many analysts forgo its use in favour of other methods.

Buff Dormeier reaffirms its position as a highly valued tool and presents us with his belief that “volume analysis provides a superior view of the market’s internal structure that other forms of analysis do not offer.”¹

Chapters 1 through 8 lightly tread through the early history of Technical Analysis and touch on some of its basic concepts and theories, but for the beginners among us, it may be prudent to do some further investigation into these areas, and the texts referred to by Dormeier provide an excellent starting point. What this early section of the book provides is the groundwork before moving on to the more advanced concept of volume analysis.

In chapters 9 through 17, we are provided with a thorough investigation of volume, including how to measure volume information, highlighting the more commonly used oscillators and indicators and exploring volume-weighted price indicators. Dormeier manipulates these indicators such as moving averages and the MACD with volume, taking things a step further with the Trend Thrust Indicator. We are then presented with Dormeier’s innovation of the Volume Price Confirmation Indicator (VPCI), which reconciles volume and price as determined by each entity’s proportional weight. The author provides rigorous testing for many of these applications, and for the VPCI, he finds that it is “a tool capable of substantially accelerating profits, reducing risk, and empowering the investor to make more reliable investment decisions.”²

A compendium of breadth indicators is presented to us in chapter 18. The author explains that breadth, like volume, deals with market participation and is a gauge of the overall depth of the trend and its internal strength; it can be used to validate price action and reveal liquidity. He further identifies, through the signals from the indicators, how the large institutions move

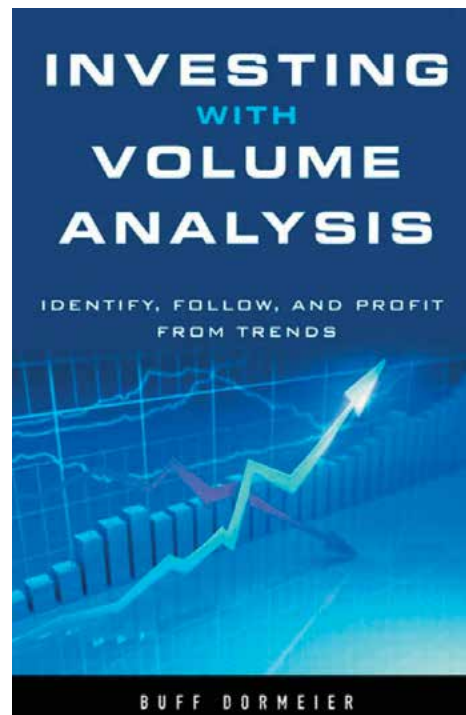
their money as opposed to retail, in itself an important guide.

And finally, he asks us to “Buff up” our volume by introducing Capital Weighted Volume, where he explores the disconnection between price and volume as determined by the exchanges for their indices and provides some solutions. He demystifies the influence of dark pools and high-frequency trading, gives us sage advice on the merits of optimization, and warns the investor to make sure that they use the indicator’s information correctly and to coordinate them in a proper fashion.

Endnotes

¹ B.P. Dormeier, *Investing with Volume Analysis: Identify, Follow, and Profit from Trends*, FT Press, New Jersey, 2013, p. 11

² Ibid, p. 204





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May 2

Paper submission deadline

October 15

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International Federation of Technical Analysts

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Shawn Lim is currently a student studying economics at University College London. His research interests lie in asset pricing and portfolio theory, and he has written and published a number of articles in journals such as the International Journal of Economics and Finance and the Journal of

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Regina Meani covered world markets as a technical analyst and associate director for Deutsche Bank prior to freelancing. She is an author and has presented internationally and locally and lectured for the Financial Services Institute of Australasia (FINSIA), Sydney University, and the Australian Stock

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Viktor Pershikov is senior financial analyst at InstaForex, a Russian ECN Forex broker. He is the author of the book "Complex technical analysis of the currency market" (Editus pub., 2012). Mr. Pershikov has vast experience in teaching the strategies of technical analysis based on his own educational method and

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