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Point and Figure charting: A computational methodology and trading rule performance in the S&P 500 futures market

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Abstract

This paper empirically contributes to the existing trading rule literature by providing a methodology for the calculation of Point and Figure charts using ultra-high-frequency data and tests trading rules using eight objective, pre-defined trading rules on S&P 500 futures contracts traded between 1990 and 1998. To assess the robustness of reported profits, a bootstrapping adjustment was conducted to determine the forecasting power of the PF trading rules. The results producing mixed statistical significance with some rules proving significant while many others were not.

JEL classification: C52; C61; C63; G10
Keywords: Point and Figure; Trading rules; Ultra-high-frequency data; Technical analysis; Futures markets

1. Introduction

Point and Figure charting is a technical analysis technique in which time is not represented on the *x*-axis, but merely price changes (independent of time) are recorded via a series of 'X's for increasing price movements and 'O's for decreasing price movements. Trading rules are then defined over particular patterns in the 'X's and 'O's—somewhat analogous to conventional charting. As such, 'Point and Figure' concentrates solely on changes in asset prices, regardless of the time required to produce such price movements. This means that data, particularly ultra-high-

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frequency data, can be considerably condensed by discarding small price changes, while still capturing user-determined levels of 'material' price changes on a continuous basis.

Anecdotal evidence suggests that the technique has been known and used by practitioners for over 100 years. Indeed, the earliest reference to Point and Figure charting known to us is deVilliers (1933), who claims that the method has "…grown from crude beginnings more than fifty years ago [and is] …herewith described for the first time" (deVilliers, 1933:7). Moreover, Point and Figure charting is now a standard feature on many widely used professional market analysis software systems.[1] Taylor and Allen (1992), surveyed foreign exchange dealers in London about their analytical techniques and found that over 90% of survey respondents relied on technical analysis at some point for asset allocation decisions. Therefore, we assume here that Point and Figure does play some role in the trading strategies of financial markets practitioners, but the academic literature has largely ignored the question of the usefulness of this technique.

The relevant literature on Point and Figure is extremely small—to our knowledge only three academic works have been published, two written in German by Hauschild and Winkelmann (1985) and Stottner (1990) and the most recent by Elliot and Hinz (2002).[2] The remainder of the literature has been published in the form of books including Aby (1996), Cohen (1960), Dorsey (1995), Seligman (1962), Wheelan (1954), Zieg and Kaufman (1975) and Davis (1965).[3]

Hauschild and Winkelmann (1985) examined several simple Point and Figure trading rules using daily data on 40 companies listed on German equity markets between 1970 and 1980. Their use of daily data can produce some problems with the calculation of Point and Figure results.[4] While they did not present results for individual firms, based on their aggregated results across all firms, the Point and Figure technique was unable to outperform a simple buy-and-hold strategy for the period.

Stottner (1990) also focused on equity markets examining 445 German and overseas companies. The data set comprised closing data for periods of between 70 months and 14 years prior to the conclusion of the test in February 1989. Stottner (1990) used Point and Figure charting but in a manner more akin to a simple filter-rule strategy with no complex pattern assessment. As with Hauschild and Winkelmann (1985), he also found that Point and Figure produced trading results inferior to a simple buy-and-hold strategy. However, the use of the filter rule type approach by Stottner (1990) casts some doubt as to the ability to fully assess the results as an accurate reflection of Point and Figure trading rule performance during the test period. This is because the technique adopted in Stottner (1990) considers very simple Point and Figure trading rules without testing the rules that have appeared in much of the popular (practitioner) Point and Figure literature.

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[1] For example, Bloomberg, Reuters, TradeStation and MetaStock include Point and Figure as part of their technical analysis software.

[2] Both German articles gratefully translated by Ralf Becker, an econometrics PhD student at Queensland University of Technology.

[3] Most of these works provide reasonably elementary treatment of the subject and/or provide largely unstructured methodologies that are unsuitable for rigorous academic journals. Examples of poor methodology include the use of spurious trendlines that have little a priori value, vaguely defined/subjective chart 'patterns' and trade entry/exit 'rules' which become so onerous in their specification that they are unlikely to be of practical value due to the rarity of such complex conditions being met.

[4] For example, when dealing with Open, High, Low, Close data inferences/guesses must be made about whether the day's highest price was traded before the day's low to determine whether a price reversal has occurred during that day. Furthermore, if only closing prices are used then trading activity through the day (which may have produced a buy/sell signal) is not recorded reducing the accuracy of the recorded price movements.

As an example from the non-academic literature, Davis (1965) examined daily price data for 1100 US equities between 1954 and 1964 with remarkable results. Of the eight different buy signals examined, profits were produced on 71–92% of trades across the different rules. All eight of the sell signals examined were profitable in greater than 80% of trades modelled in the simulation. Claims of such startling profitability demands a scientific assessment of his method using recent data to see if such consistent profitability is available to contemporary exponents of the Point and Figure trading technique.

Accordingly, the current paper is designed to bridge that gap between the practitioner and academic literature by providing a rigorous test of the various Point and Figure chart 'patterns' said to produce profitable trading opportunities. These are tested by identifying each of the patterns, then simulating the trades specified by the trading rules on S&P 500 futures contracts and reporting the profitability.

The remainder of this paper is structured as follows. Section 2 provides a computational specification of Point and Figure as applied in this paper. Section 3 defines the trading signals/rules that are analysed, while Section 4 presents the results and the paper concludes in Section 5. Appendix A is also provided documenting the step-by-step approach to constructing a Point and Figure chart.

2. Specification of Point and Figure

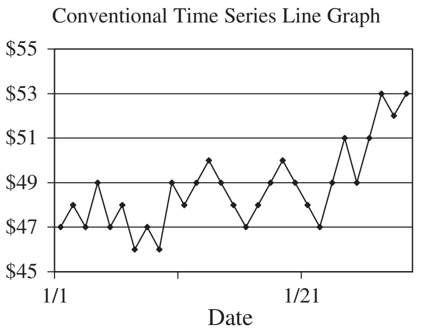
The technique for converting data into the Point and Figure format has remained largely unchanged since the methodology outlined in deVilliers (1933). In the past, Point and Figure has generally been described by example alone, while our methodology mathematically defines the processes involved, providing researchers with a clear set of computational guidelines. The appendix to this paper provides an example of Point and Figure chart construction to aid understanding of this technique.

Point and Figure relies on the specification of two variables. First, the number of Points Per Box (PPB) which specifies the coarseness of the data-filtering such as \$0.50, \$1.00, \$2.00 and so on. Thus, PPB determines what will be considered a 'significant' price change. The second variable is the Reversal (REV) size. This determines by how many 'Boxes' the price must change to have the movement recorded. An example of Point and Figure compared to a conventional line graph is presented in Fig. 1 and is adapted from an example in deVilliers (1933). The sequence of price movements can be readily understood in the conventional time-series plot where the first price/data point for a security is \$47. The price then trades at \$48, then returns to \$47, then to \$49 and so on until the last data point at \$53. In this example PPB = \$1 and REV = 3—the price must reverse by \$3.00 to be recorded.

Point and Figure requires data rounding to occur via a series of continuous modulus operations rounding to the value specified for PPB.[5] The input price data are rounded-up when prices are declining and rounded-down when prices are increasing. The opening direction of prices, i.e. falling or rising must first be determined. Some authors will adopt the first price as the starting point, though this can cause significant computational difficulties. In this research, prices are read from a data file/feed until the remainder of Price, P_t, divided by PPB equals zero according to Eq. (1).

$$\mathrm{MOD}(P_t, \mathrm{PPB}) = 0 \qquad (1)$$

[5] Modulus operations involve dividing x by y and reporting the remainder, therefore MOD (11, 3) = 2.



Point and Figure Chart

53							X
52							X
51							X
50			X		X		X
49	X		X	O	X	O	X
48	X	O	X	O	X	O	X
47	X	O	X	O		O	
46		O					

Fig. 1. Example of a conventional time-series plot converted to a Point and Figure chart.

Prices continue to be input to establish whether prices are rising or falling on the initial movement being recorded. Assuming that PPB = \$1.00 and REV = 3, then subsequent prices, P_n, from the data file are input until either Eq. (2) or Eq. (3) is true.

$$P_n \geq P_t + 3(\mathrm{PPB}) \tag{2}$$

$$P_n \leq P_t - 3(\mathrm{PPB}) \tag{3}$$

Had Eq. (2) been satisfied first, all subsequent raw input prices, P_r, read are rounded down via the modulus operation per Eq. (4) to produce the filtered price, P_f, rounded per the Point and Figure methodology.

$$P_f = \begin{cases} P_n & * \\ \left[\left(\dfrac{P_n}{\mathrm{PPB}}\right) - \dfrac{\mathrm{MOD}(P_n, \mathrm{PPB})}{\mathrm{PPB}}\right](\mathrm{PPB}) & ** \end{cases} \tag{4}$$

* where MOD (P_n, PPB) = 0; ** where MOD (P_n, PPB) ≠ 0.

Had Eq. (3) been satisfied initially instead of Eq. (2), the data would have needed to be rounded-up per Eq. (5).

$$P_f = \begin{cases} P_n & * \\ \left[1 + \left(\dfrac{P_n}{\mathrm{PPB}}\right) - \dfrac{\mathrm{MOD}(P_n, \mathrm{PPB})}{\mathrm{PPB}}\right](\mathrm{PPB}) & ** \end{cases} \tag{5}$$

* where MOD (P_n, PPB) = 0; ** where MOD (P_n, PPB) ≠ 0.

Data continues to be read according to the modulus operations above until P_n triggers the next entry. If prices were increasing, and so Eq. (2) was initially satisfied, the next price recorded is where $P_n \geq (P_f + \text{PPB})$ or price declines from the highest point in that movement where $P_n \leq [P_f - \text{REV(PPB)}]$.

Had prices been declining, and so Eq. (3) was satisfied, prices would continue to be rounded-up per Eq. (5). Prices would then continue to be read until either $P_n \leq (P_f - \text{PPB})$ or price increases from the lowest point in that movement so that $P_n \geq [P_f + \text{REV(PPB)}]$. These processes are repeated until all data are exhausted.

One concern about the Point and Figure technique arises from what price is recorded when rounding input data. Slippage is an issue that must be given serious consideration when conducting research in this area. For illustrative purposes assume that a new entry should be made on a Point and Figure chart and a buy signal (explained in the next section) is generated when a price of 105.0 is reached. If the price trades at 105.0 then the entry could be validly made and the trade simulated at that price. But if the market is more volatile and the price generating the entry at 105.0 actually traded at 105.25, then the long position assumed to be taken at 105.0 would overstate profits. Analogous to this problem is when 'gapping' in the price series occurs. That is where for example the market closes at 104.5 and re-opens the next day at 106.0, but a buy signal was to be generated at 105.0. This also overstates profits because the trade is simulated to occur at 105.0 but could not have been taken until 106.0.

In this research, efforts have been made to address this problem by having the price that caused the movement to be recorded, rather than just the rounded Point and Figure value. Samples of converted Point and Figure data output have shown that this issue has been adequately dealt with by the use of 'actual' price rather than simply 'rounded' price.

3. Specification of trading rules

Zieg and Kaufman (1975) produced a Point and Figure methodology capable of being reproduced. This consisted of a well-defined set of eight buy and eight sell strategies, labelled B1 to B8 and S1 to S8, respectively. Their technique is adopted in the current study and the eight pairs of trading rules are illustrated in Fig. 2.[6]

The Double Top: B1 (Double Bottom: S1) formation occurs by prices rising above (falling below) the previously established highest (lowest) price. It implies that prices trading above (below) a previous high (low) suggest that the market is subject to an increase in demand (supply) beyond the local maxima (minima) and that the stronger demand (supply) will persist. Consequently, the continued buying (selling) should cause prices to increase (decrease) thereby producing a long (short) trading signal. The Double Top/Bottom formation is, by definition, the most widely observed trading pattern in Point and Figure—all of the more sophisticated patterns discussed below must contain this basic pattern.

The Double Top with Rising Bottom: B2 (Double Bottom with Declining Top: S2) formation extends B1 (S1) by adding the requirement that the previous low (high) is higher (lower) than its preceding low (high) as measured on the columns of O's (X's). The rationale of this formation may be that the presence of higher highs (lower lows) and higher lows (lower highs) indicates more pronounced and sustained demand (supply) has emerged in the market and that prices will

[6] With some Point and Figure signals, their mathematical specification can be simplified into simple logical Boolean statements. The Boolean specifications for the trading rules examined in this paper are available in technical appendix from the authors.

continue to reflect this increasing demand (supply). This would suggest the expected persistence of rising (falling) prices so producing a profitable long (short) position.

The Breakout of Triple Top: B3 (Breakout of Triple Bottom: S3) formation suggests that prices have traded to a previous high (low) on two separate occasions, only to be met with supply (demand) at that price level. On the third occasion, demand (supply) has been strong enough to

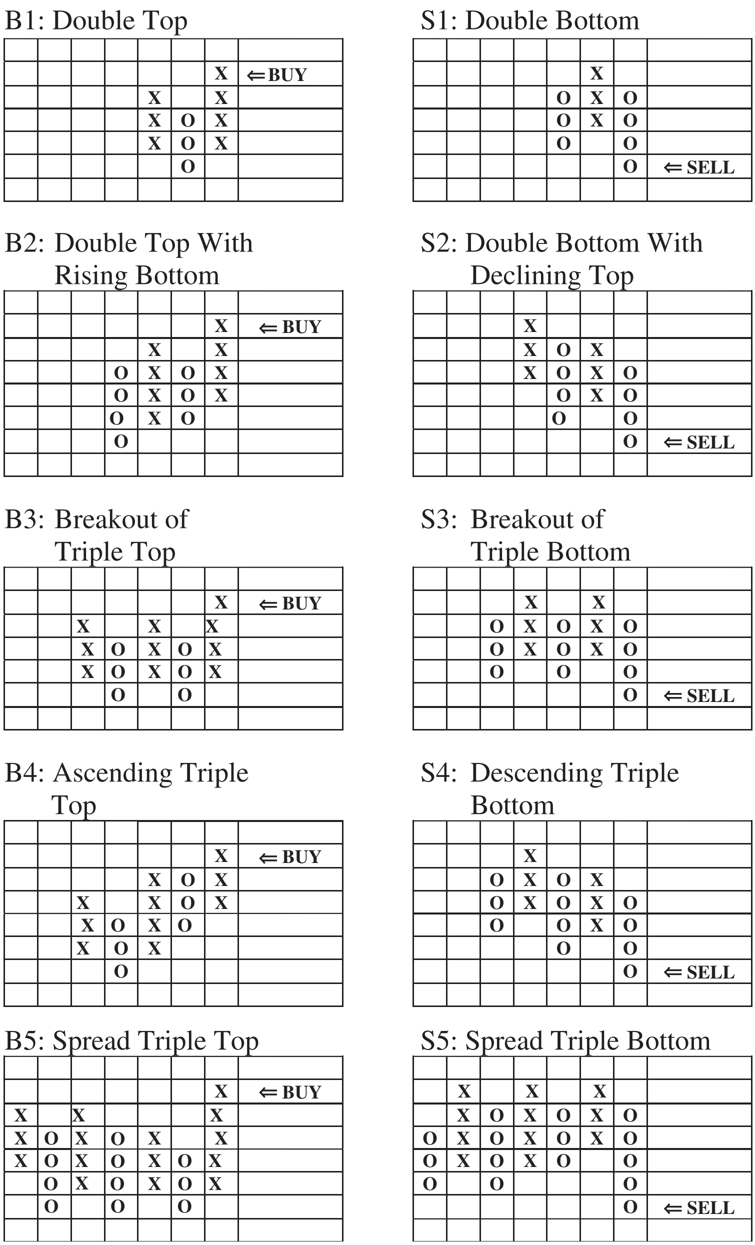


Fig. 2. Point and Figure trading rules—eight buy/sell cases.

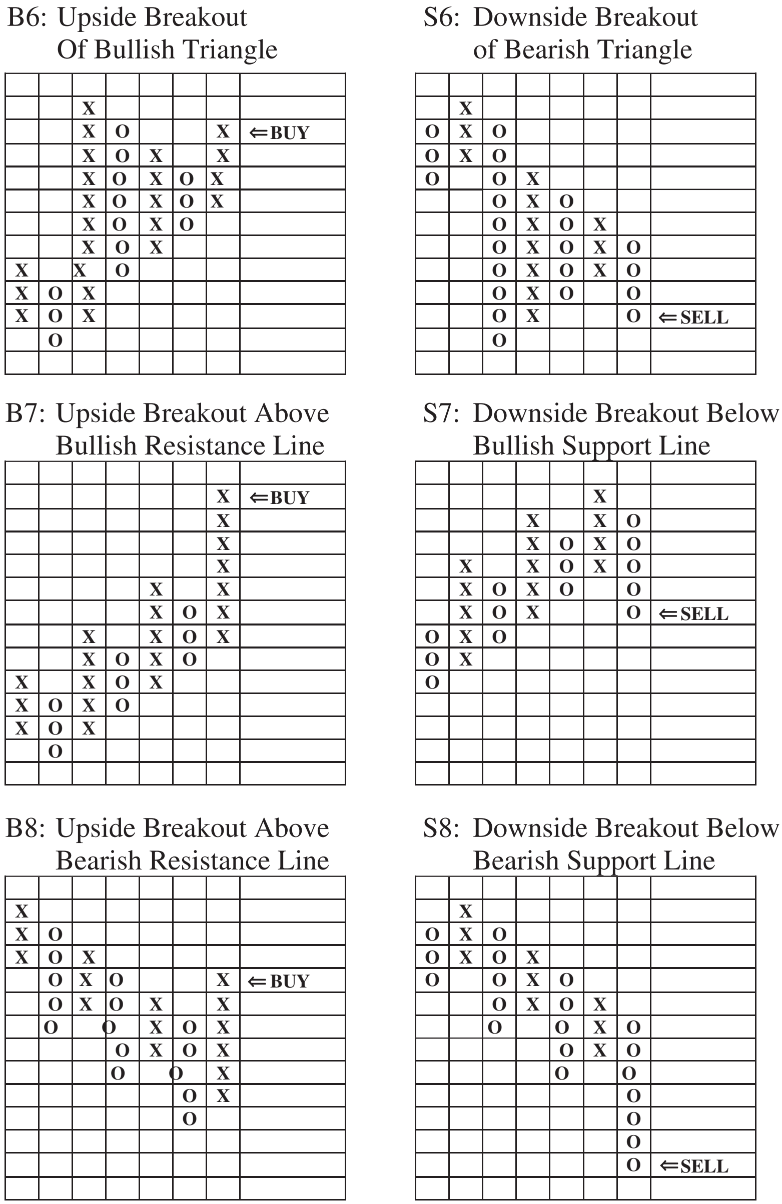


Fig. 2 (*continued*).

satisfy sellers (buyers) at that level and the increased demand (supply) has been sufficient to cause a price increase (decrease). The implication is therefore that the demand (supply) will continue to be present and that prices will continue to rise (fall) producing a profitable long (short) trading opportunity.

The Ascending Triple Top: B4 (Descending Triple Bottom: S4) extends the Breakout of Triple Top (Breakout of Triple Bottom) by requiring the lows (highs) shown in the columns of O's (X's) be higher (lower) and the highs (lows) indicated by the columns of X's (O's) to all be rising (falling). Again, the inference is that the sustained demand (supply) indicated by the persistently rising (falling) prices will continue producing a long (short) trading opportunity.

As with the Breakout Triple Top (Breakout Triple Bottom), the Spread Triple Top: B5 (Spread Triple Bottom: S5) formation implies that supply (demand) has previously entered the market at a given price. Rising (falling) prices beyond the previously determined high (low) suggests that the supply (demand) has now been satisfied and sufficient demand (supply) has now emerged to cause prices to continue to increase (decline). Consequently, the expected increase in demand (supply) should produce profitable long (short) trading opportunities.

The 'triangle' formation and its many variants such as bullish/bearish triangles, rising/falling wedges and so on, have long appeared in technical analysis (see Edwards & Magee, 1961). Such formations imply that a lack of information coming into the market has led to neither supply nor demand dominance and consequentially no direction in prices. The triangle pattern may imply that inventory readjustment is occurring rather than price being information-driven. The 'breakout' of the triangle (B6/S6) would then suggest that either new information has arrived in the market or a significant inventory readjustment is occurring. The analyst may then infer that prices will continue to move in the same direction as the price breakout from the triangle's apex and be positioned long (short).

In general, within the technical trading literature, the rationale for why a buy (sell) level appears where it does is not intuitively clear. The use of 'support'/'resistance' lines have appeared widely in practitioner literature since Edwards and Magee (1961) and are applied here in Point and Figure. The basic idea may be interpreted as demand (supply) steadily outstripping supply (demand) producing some form of demand/supply resistance (support). The breach of the trendline then suggests a stronger demand (supply) influence relative to previous movements. Specifically, the trader, responding to an Upside Breakout Above Bullish Resistance Line: B7 (Downside Breakout Below Bullish Support Line: S7), aims to open a long (short) position to capitalise on this exuberance in anticipation of its continuance. Trading strategy S7 implies that a reversal in price direction should occur once the upward-sloping trendline is breached.

As with signals B7:S7, the use of a trendline is employed for the B8/S8 trading rules. In the case of B8, a breach of the trendline suggests that a reversal in price direction has occurred and the trader should open a long position to capitalise. Conversely, S8 suggests that, while prices are still moving lower, a more vigorous supply situation has emerged and the trader should hold a short position to capitalise on the expected continuance of price decline.

When considering the above trading rules/patterns, all cases except B5, S5, B7 and S8 decompose into the simple Double Top/Bottom formation. It is expected that the additional signal conditions, e.g. Triple Top, grew to minimise the transaction costs associated with frequent trading where almost every change in price direction recorded would generate a trading signal from B1:S1.

To assess the impact of different PPB values, in the current paper, a sensitivity analysis is conducted presenting results for S&P 500 futures. Specifically, PPB values are tested at PPB = \$100 and \$200. This corresponds to changes in the S&P futures contract of 0.4 and 0.8, respectively. Further, all orders are assumed to be 'Stop' orders where a buy/sell signal is produced. This means that trades are made during one of the up/down movements without waiting for a closing price as relied on in much of the technical trading rule literature.

The issue of execution costs is also important in the current research. In accordance with numerous trading rule studies, transaction costs–for brokerage and an amount for poor order execution–are modelled into the results. These have been set at $100 round-turn per futures contract traded in accordance with comparable amounts in Lukac et al. (1988), Babcock (1989), Bilson and Hsieh (1987), Boothe and Longworth (1986), Lukac and Brorsen (1989), Sweeney (1986) and Taylor (1993).

Zieg and Kaufman (1975) suggest that positions should be taken corresponding to each trading signal generated by the trading rules. Consequently, the number of contracts taken on each trading signal is one contract, although much larger positions may be accumulated from successive buy or sell signals. For each individual signal pair, e.g. B4:S4, the long (short) position generated by the signal is closed out by the first occurrence of S1:B1, respectively in accordance with Davis (1965). This exit strategy is used because some of the more complex signals, such as B8:S8, may not get the opposing signal for that pair (i.e. S8:B8, respectively) and need some other position exit requirement.

Given the similarity between signals B1:S1 and the other trading rules, more than one position may be initiated at the same price due to the overlap of signals. Similarly, if signal B1 is acted upon, and another B1 signal is generated, then two positions will be held. Subsequent positions will also be taken and no limits on the position size have been imposed for this simulation. The trading rules do not require the specification of a trade exit signal as an opposing trade entry signal will cause termination of all long (short) positions and new short (long) positions to be taken. All positions are closed on the last price of the final day for each year.[7]

4. Data and results

Results are presented here for the S&P 500 futures contract between 1990 and 1998. The S&P 500 futures contract value is calculated as 250 times the index, giving a dollar value of $250 per ‘big point’. The spot contract, or nearest contract to expiry, has been used to avoid liquidity problems that may be present in distant contracts. The futures contract price series were adjusted to remove any artificial profits/losses on contract expiration.[8]

Table 1 provides a summary of the trading result annual averages by trading rule.[9] Specifically, the table provides a summary of trading performance outlining the Number of Trades (NumTrades) each trading rule undertook, the percentage of these trades that were profitable before transaction costs (%Profitable), the Gross Profit (dollar profit/loss before any allowance for transaction costs) and Net Profit adjusted for transaction costs [calculated as Gross Profit − (NumTrades × $100)].

[7] We also performed analysis on trading rules applied to the whole sample period and the outcome is discussed later in the context of our bootstrapped robustness checking.

[8] Contract rollover is performed automatically via the ‘Autoroll’ technique in the data extraction software from Tick Data Inc. That is, the spot contract is automatically ‘rolled’ into the next contract when volume in the following contract exceeds the volume in the expiring contract. The price differential on rollover date is removed by adjusting all subsequent prices by the differential amount to reflect how a trader would, for example, roll a long position by selling the position in the expiring contract and simultaneously re-opening the long position in the subsequent contract expiry. Ma, Mercer, and Walker (1992), found that the S&P 500 futures were robust across rollover methods and the rollover method used here should not produce significant impacts on the data examined.

[9] A more detailed set of results outlining year-by-year performances of each trading rule is available from the authors upon request.

Table 1
Trading rule result summary—total profitability

Strategy	3BR $100PPB	4BR $100PPB	5BR $100PPB	3BR $200PPB	4BR $200PPB	5BR $200PPB
B1:S1						
NumTrades	18,278	9128	10,110	4012	2393	1685
%Profitable †	43	43	40	41	43	43
Gross profit	1,463,200	1,393,772	1,248,537	588,800	825,888	630,724
Net profit	−364,600	480,972	237,537	187,600	586,588	462,224
B2:S2						
NumTrades	8433	5509	6168	2286	1494	1067
%Profitable †	42	41	38	38	41	40
Gross profit	708,800	722,936	629,550	434,000	410,974	353,849
Net profit	−134,500	172,036	12,750	205,400	261,574	247,149
B3:S3						
NumTrades	2201	891	908	504	144	79
%Profitable †	48	42	43	45	54	40
Gross profit	331,800	177,873	192,062	83,200	101,349	35,775
Net profit	111,700	88,773	101,262	32,800	86,949	27,875
B4:S4						
NumTrades	5517	3540	3933	1498	999	705
%Profitable †	41	41	37	39	40	42
Gross profit	381,800	454,561	328,651	180,200	262,537	265,011
Net profit	−169,900	100,561	−64,649	30,400	162,637	194,511
B5:S5						
NumTrades	429	143	170	90	34	26
%Profitable †	43	48	47	46	56	54
Gross profit	18,400	37,148	43,925	14,800	23,000	16,800
Net profit	−24,500	22,848	26,925	5800	19,600	14,200
B6:S6						
NumTrades	6	6	0	0	2	0
%Profitable †	33	33	0	0	50	0
Gross profit	100	−300	0	0	400	0
Net profit	−500	−900	0	0	200	0
B7:S7						
NumTrades	49	24	22	19	5	2
%Profitable †	52	54	27	58	40	0
Gross profit	11,000	9375	−3025	5200	8350	−400
Net profit	6100	6975	−5225	3300	7850	−600
B8:S8						
NumTrades	63	27	16	21	9	3
%Profitable †	46	45	50	48	66	67
Gross profit	−500	7200	2625	9600	5525	6000
Net profit	−6800	4500	1025	7500	4625	5700
Totals						
NumTrades	34,977	19,302	21,355	8477	5124	3566
%Profitable	43	42	39	40	42	42

Table 1 (*continued*)

Strategy	3BR $100PPB	4BR $100PPB	5BR $100PPB	3BR $200PPB	4BR $200PPB	5BR $200PPB
Totals						
Gross profit	2,914,600	2,802,565	2,442,325	1,315,800	1,638,023	1,307,759
Net profit	−583,100	872,365	306,825	468,100	1,125,623	951,159

B1: double top; B2: double top with rising bottom; B3: breakout of triple top; B4: ascending triple top; B5: spread triple top; B6: upside breakout of bullish triangle; B7: upside breakout above bullish resistance line; B8: upside breakout above bearish resistance line; S1: double bottom; S2: double bottom with declining top; S3: breakout of triple bottom; S4: descending triple bottom; S5: spread triple bottom; S6: downside breakout of bearish triangle; S7: downside breakout below bullish support line; S8: downside breakout below bearish support line.

† % Profitable results for all trades in that category.

As expected, signals B1:S1 produced the largest number of trades and the number of trades for subsequent trading rules declined as entry/exit conditions became more restrictive. One important methodological difference adopted in this paper–i.e. using the price that triggered the Point and Figure entry to be recorded rather than simply the rounded value–has meant that signal B6:S6 recorded very few trades.[10]

All PPB and REV levels tested during the trading period produced positive net profits except for the smallest filtering level tested, namely PPB = $100 and REV = 3. Although these values produced positive Gross Profits of $2,914,600 the large number of transactions (34,977) negated the economic value of such a strategy. Further, while all PPB and REV values produced Gross Profits, most have a percentage of profitable trades less than 43% of trades. It can be concluded that the average profit on successful trades was higher than the average loss on the losing trades.

The highest net profit recorded during the test period was produced with PPB = $200 and REV = 4. Most trading rule variable selection represents some form of trade-off between a large number of transactions with low average profit per trade (often failing to cover transaction costs) and a lower number of transactions with higher average profit per trade (often requiring greater funding costs as larger unrealised losses may need to be funded). This balance between gross profitability ($1,638,023) and number of annual transactions (5124) produced superior net profitability ($1,125,623) during the test period for PPB = $200 and REV = 4.

In accordance with Brock, Lakonishok, and LeBaron (1992), a *t*-test was performed examining the differences in the mean returns of the trading rules and the zero-expected return for the S&P futures contract.[11] The most notable feature of these tests is that in all cases neither gross nor net profits generated in the simulation were significantly different from zero.

[10] This result would likely be different had simply rounded values been used, but would have led to significant profit reporting inaccuracies.

[11] The *t*-statistic for the annual profitability was calculated as,

$$\frac{\mu_r - \mu}{\sqrt{(\sigma^2/N + \sigma^2/N_r)}}$$

where μ_r and N_r are the mean dollar return and the number of years in the test, respectively, and μ and N are the zero expected return and number or years in the test. Following Connolly (1989), using a Bayesian approach, we calculate sample size-adjusted critical values for all *t*-statistics (in response to Lindley's, 1957 paradox). Specifically, at the 5 % level the Critical Value = $[(T-1)(T^{1/T}-1)]^{0.5}$—for example, with T = 19,302, instead of the usual rule of thumb = ±1.96, we have a size-adjusted 5% Critical Value = ±3.14.

Table 2
Trading rule result summary—annual totals for all trading rules

Strategy	1990	1991	1992	1993	1994	1995	1996	1997	1998	Totals
PPB = $100										
REV = 3										
NumTrades	1213	976	719	635	845	969	2765	11,719	15,136	34,977
%Profitable	39	42	39	41	40	44	41	43	44	43
Gross profit	38,300	93,700	−8600	−41,500	3800	94,700	234,700	1,036,500	1,463,000	2,914,600
Net profit	−83,000	−3900	−80,500	−105,000	−80,700	−2200	−41,800	−135,400	−50,600	−583,100
PPB = $100										
REV = 4										
NumTrades	717	573	423	377	514	568	1610	5231	9289	19,302
%Profitable	41	37	40	40	40	41	42	42	42	42
Gross profit	87,111	114,871	1162	−19,550	57,112	59,136	281,223	985,300	1,236,200	2,802,565
Net profit	15,411	57,571	−41,138	−57,250	5712	2336	120,223	462,200	307,300	872,365
PPB = $100										
REV = 5										
NumTrades	424	284	256	348	393	1131	3718	6329	8472	21,355
%Profitable	39	29	41	38	38	41	43	39	38	39
Gross profit	81,175	−20,387	15,613	63,300	12,012	223,537	679,675	702,600	684,800	2,442,325
Net profit	38,775	−48,787	−9987	28,500	−27,288	110,437	307,875	69,700	−162,400	306,825
PPB = $200										
REV = 3										
NumTrades	319	261	164	152	261	247	769	2284	4020	8477
%Profitable	33	36	33	43	43	36	43	43	40	40

Gross profit	−61,600	22,400	−52,800	3400	31,600	−19,400	175,800	385,800	830,600	1,315,800
Net profit	−93,500	−3700	−69,200	−11,800	5500	−44,100	98,900	157,400	428,600	468,100
PPB = $200										
REV = 4										
NumTrades	184	147	94	92	112	158	445	1360	2532	5124
%Profitable	41	37	33	44	51	41	47	44	41	42
Gross profit	35,412	77,150	−2537	−4813	84,425	41,637	346,949	458,000	601,800	1,638,023
Net profit	17,012	62,450	−11,937	−14,013	73,225	25,837	302,449	322,000	348,600	1,125,623
PPB = $200										
REV = 5										
NumTrades	116	100	69	52	85	105	290	967	1782	3566
%Profitable	42	28	50	27	46	34	45	43	42	42
Gross profit	19,674	26,800	43,749	−32,037	38,237	19,962	259,824	391,350	540,200	1,307,759
Net profit	8074	16,800	36,849	−37,237	29,737	9462	230,824	294,650	362,000	951,159
Totals										
NumTrades	2973	2341	1725	1656	2210	3178	9597	27,890	41,231	92,801
%Profitable	39	38	39	40	41	41	42	42	41	41
Gross profit	200,072	314,534	−3413	−31,200	227,186 *	419,572	1,978,171 *	3,959,550 *	5,356,600 *	12,421,072 *
Net profit	−97,228	80,434	−175,913	−196,800	6186	101,772	1,018,471 *	1,170,550	1,233,500	3,140,972

B1: double top; B2: double top with rising bottom; B3: breakout of triple top; B4: ascending triple top; B5: spread triple top; B6: upside breakout of bullish triangle; B7: upside breakout above bullish resistance line; B8: upside breakout above bearish resistance line; S1: double bottom; S2: double bottom with declining top; S3: breakout of triple bottom; S4: descending triple bottom; S5: spread triple bottom; S6: downside breakout of bearish triangle; S7: downside breakout below bullish support line; S8: downside breakout below bearish support line.

* *t*-test of PPB, REV profit significant at 0.05 level (large sample size adjusted).

Table 3
Trading rule net profits and buy-and-hold performance

Result	Year								
	1990	1991	1992	1993	1994	1995	1996	1997	1998
Buy-and-hold	−46.90	80.35	13.75	28.05	−12.95	138.90	94.70	196.20	216.60
Net profit	−97,228	80,434	−175,913	−196,800	6186	101,772	1,018,471	1,170,550	1,233,500

Table 1 examined the average of rules B1…B8/S1…S8 across all years but, as with many averages, they may fail to provide sufficient information for meaningful conclusions to be drawn. Table 2 outlines the performance of all trading rules by year providing a somewhat different picture of the performance across different PPB and REV levels reported in Table 1. Table 2 reveals that the use of Point and Figure trading rules produced very mixed profits when minor trends and lower volatility were observed in the early-mid 1990s. Once the higher volatility was observed in the late 1990s substantial profits were produced by the trading rules applied with Gross Profits in excess of $1,000,000 being reported. Indeed, in 1996 both Gross and Net Profits are statistically significant, while Gross Profits are significant in 1997 and 1998. Had it not been for the last 3 years of the sample data, the profitability of Point and Figure in contemporary stock index futures market would have been highly questionable for practitioners and well within academic expectations of market efficiency. Generally, we see that the increase in volatility triggered more trades and that these trades generally produced positive gross profits.[12]

This of course raises questions about the future profitability of Point and Figure trading rules as the S&P rises to higher levels in the future. The preceding results would, at first glance, suggest that profitability should increase as the S&P rises. The increase in profitability may well be offset by higher transaction costs as the execution of market orders occur at larger bid/ask spreads accompanying the rise in S&P value.

In accordance with numerous trading rule studies, the results are compared with a Buy-and-Hold control.[13] The Net Profit results are shown in Table 3 compared with the Buy-and-Hold control. The table reveals the performance of a simple Buy-and-Hold strategy in S&P 500 futures measured in points to provide some indication of any upward/downward price bias during the test period. Of course, the Buy-and-Hold control for futures will be different than the underlying index due to presence of spot/next contract differentials at expiry/rollover dates.

As the trading rules adopted allow more than one futures contract to be acquired it becomes difficult to really compare the holding of a single futures contract against a multiple position trading strategy. Consequently while only limited information can be drawn from Table 3, it does show that some form of positive drift was present in the futures contract.

Table 4 reveals some of the variables that may have had some importance in producing the reported profits. To explain the potential for volatility and returns to contribute to the drastic shifts in profitability across time, various correlation coefficients were calculated on the data in Table 5 to determine the impact of volatility and returns on Point and Figure profitability.

[12] Various simple regressions confirmed that volatility and return trends strongly explain the drastic shifts in profitability of the Point and Figure trading rules across time.

[13] Although it should be noted that Peterson and Leuthold (1982), regarded the Buy-and-Hold as useful as a Sell-and-Hold strategy under the assumption that futures markets price series largely reflect a drift-less random walk.

Table 4
S&P 500 futures: return and volatility characteristics

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Mean daily return %*	−0.05%	0.09%	0.01%	0.03%	−0.01%	0.10%	0.06%	0.10%	0.09%
Mean daily S.D. %*	1.09%	0.92%	0.63%	0.55%	0.66%	0.52%	0.81%	1.25%	1.39%
Mean daily return Pt†	−0.19	0.32	0.05	0.11	−0.05	0.55	0.37	0.78	0.86
Mean daily S.D. Pt†	3.67	3.48	2.60	2.50	3.06	2.89	5.55	11.31	14.99
Number of trades	2973	2341	1725	1656	2210	3178	9597	27,890	41,231
Gross profit	200,072	314,534	−3413	−31,200	227,186	419,572	1,978,171	3,959,550	5,356,600
Net profit	−97,228	80,434	−175,913	−196,800	6186	101,772	1,018,471	1,170,550	1,233,500

† Daily returns and standard deviations measured in points.
* Daily returns and standard deviations measured as percentage changes.

In generating the correlation coefficients, various characteristics were examined such as the relationship between Gross Profits and the Number of Trades (NumTrades). The correlation coefficients are represented by $\rho_{X,Y}$ where X and Y represent Gross Profits and NumTrades, respectively, in this example. Returns, r, were measured by two methods. These were the daily percentage returns, that is $r_{\%}=(P_t-P_{t-1})/P_t$ and the daily change in point value, that is $r=P_t-P_{t-1}$. The volatility, measured by the standard deviation, was also measured for $r_{\%}$ and r. These values were then considered across time for various performance data such as Gross and Net Profits and the number of trades signalled in the simulation.

Table 5 clearly shows some of the very strong determinants of profitability of Point and Figure trading rules during the test period. The higher the standard deviation of simple point value returns, the higher the number of trades undertaken by the trading rules generating a correlation coefficient, ρ, between the standard deviation, S.D., and the number of trades, NumTrades, such that $\rho_{\text{S.D.,NumTrades}}=1.00$. The standard deviation of returns in points translated in higher gross profits producing a $\rho_{\text{S.D.,GrossProfit}}=0.99$ where profitability was not diminished by transaction costs. From these results, it may be assumed that the increase in volatility triggered more trades, and that these trades generally produced positive gross profits.

Table 5
S&P 500 futures: correlation results indicating contribution to profitability

X,Y variables	Correlation coefficient ($\rho_{X,Y}$)
Buy-and-hold vs. Net profit	0.82
Mean daily return % vs. Net profit	0.57
Standard deviation % vs. Net profit	0.71
Mean daily return Pt vs. Net profit	0.81
Standard deviation Pt vs. Net profit	0.88
Mean daily return % vs. Gross profit	0.52
Standard deviation % vs. Gross profit	0.81
Mean daily return Pt vs. Gross profit	0.83
Standard deviation Pt vs. Gross profit	0.99
Mean daily return % vs. NumTrades	0.48
Standard deviation % vs. NumTrades	0.82
Mean daily return Pt vs. NumTrades	0.81
Standard deviation Pt vs. NumTrades	1.00
NumTrades vs. Gross profit	0.99
NumTrades vs. Net profit	0.87

Table 6
t-statistics of bootstrapped sample results by year (PPB = $200 and REV = 4)

Year	B1:S1	B2:S2	B3:S3	B4:S4	B5:S5	B6:S6	B7:S7	B8:S8
1990	0.24	0.07	0.62	0.04	0.33	0.00	0.00	0.00
1991	0.67	0.71	0.39	0.70	−0.72	0.00	0.00	1.69
1992	−0.59	−0.42	1.22	−0.03	0.00	0.00	0.00	0.00
1993	−0.41	−0.06	0.04	−0.14	0.00	0.00	0.00	0.00
1994	1.21	1.10	−0.17	0.63	0.00	0.00	−6.53	0.00
1995	0.14	0.18	−0.09	0.44	0.00	0.00	0.00	0.00
1996	3.84	2.30	2.75	1.98	−0.09	0.00	0.00	−1.28
1997	2.29	1.12	1.29	0.82	0.53	0.00	−0.45	0.00
1998	1.33	0.60	1.05	0.38	1.39	0.01	2.15	0.81

The highest value corresponding to an increase in Net Profitability, where an allowance for transaction costs has been deducted, appears due to the higher simple point value volatility producing $\rho_{\text{S.D.,NetProfit}} = 0.88$. Similarly, the presence of a positive drift in the price series implied by the positive Buy-and-Hold returns appears to have contributed to Net Profits producing $\rho_{\text{Buy-and-Hold,NetProfit}} = 0.88$ during the test period.

So it appears that the greatest profitability has arisen through the higher volatility on the simple number of points, rather than percentage volatility. This is hardly surprising given that speculators will not profit from percentage gains per se, but from the total dollar value of the change in the S&P 500 Index futures contract. While the use of percentage returns may be suitable for other asset classes, the correlations above would suggest that percentage returns are not as important to futures traders as simple point returns for the S&P 500 futures.

To assess the robustness of the trading rules, the original tick data was bootstrapped to create simulated data sets. To this end, 500 randomised data sets were created for each of the nine test years and another 500 simulated for the entire data set was produced. Given the enormous processing overhead involved in analysing UHF data, only results for the most statistically significant trading rule, that is, PPB = $200 and REV = 4, were reproduced. Table 6 reveals that only limited statistical significance was observed. Signal pairs B1:S1 produced statistical significance at the 0.01 level for 1996, however the only other statistical significance was reported in 1997 where significance fell to the 0.05 level. The year of 1996 also saw significance reported at the 0.05 level for signal pairs B2:S2, B3:S3 and B4:S4.

When considering the aggregated data where the bootstrapping was conducted across the entire 9-year sample period for filtering levels of PPB = $200 and REV = 4, a somewhat different picture emerges. Table 7 shows that highly significant results were obtained for the signal pair B1:S1, and that significance above the 0.05 level was reported for signal pairs B2:S2 and, B3:S3 while significance at the 0.05 level is reported for signal pairs B4:S4, B5:S5 and B7:S7.

With respect to the reported profitability in Davis (1965) evidence was presented showing the foregoing trading rules had the percentage of profitable trades generally over 80% for all trading

Table 7
t-statistics of bootstrapped sample results across entire data set (PPB = $200 and REV = 4)

	B1:S1	B2:S2	B3:S3	B4:S4	B5:S5	B6:S6	B7:S7	B8:S8
t-statistic	4.18	2.84	2.59	2.09	2.00	0.01	2.18	1.09

rules/chart patterns—a primary motivating factor for the current research. Such high levels of profitable trade percentages were not reflected in this study where the percentage of profitable trades was almost exclusively less than 50%. As such, this outcome casts severe doubt over the robustness of the Davis work and should caution traders and practitioners alike from blindly applying the Point and Figure methodology in the hope of easy profits.

Some possible reasons for this divergence may include:

(i) Although such high levels of signal reliability were present in equity markets for individual stocks, this was not reflected when the broader index was examined where the combined effects of individual stock movements produced a more random data set with fewer predictable elements detectable by the trading rules;
(ii) The market has become more random/efficient since the original Davis study was performed and/or
(iii) Differences in the rule specification as the mathematical description of the Davis research was not provided, merely the patterns and the results.

No clear answer emerges as to the reasons for such differences. The current paper has merely sought to test the trading rules in a contemporary.

5. Conclusion

This study has tested the plausibility of trading rules using specific buy/sell signals accompanying Point and Figure charting, claimed to be one of the oldest practitioner techniques with origins dating back to the 19th century. The trading rules, in contrast with other popular ‘chart patterns’, provided a replicable trading rule methodology and were applied to the S&P 500 futures contracts traded between 1990 and 1998.

Our results suggest that while profits were available to speculators on the S&P 500 futures contract, as with trading rule studies generally, profits were not consistently statistically available. This is because loss-generating years were reported—profits were only available on aggregate. Further, most of the profits appear to have derived from the relatively high volatility levels. During years when volatility was low, profit results were mixed, although the higher daily volatility observed in the late 1990s meant that large profits were available to speculators using Point and Figure trading rules. However, bootstrapping produced fairly mixed statistical results.

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Appendix A. Constructing a Point and Figure chart

This section provides a numerical example for the modification of data using the structure of Point and Figure charting. Assume that we set the values of the Points Per Box (PPB) = $1.00 per

Table A1
Hypothetical data set for point and figure chart

Observation number	Price	Observation number	Price
1	100	11	99
2	101	12	100
3	102	13	101
4	101	14	102
5	99	15	101
6	98	16	100
7	97	17	101
8	98	18	99
9	99	19	100
10	100	20	99

box and the Reversal Size (REV) = 3. Given the hypothetical price data set in Table A1 the data is transformed into Point and Figure by the following steps.

Step 1: Ensure that the first data point (100) can be divided equally, that is with no remainder, by the value set for PPB. As \$100/\$1 produces an integer result, and consequently no remainder, \$100 is used as the starting value. Had the first value been \$100.25, data would have continued to be read until a remainder of zero was produced. Therefore the technique disregards data if the remainder is not zero and does not record them in any way.

Step 2: At this point it is unknown whether the data is rising or falling and so no entry is made on the Point and Figure chart until a value of the first data point plus/minus the REV level is established, that is Price = \$100 ± \$3. Data is read until the price \$97 is input, which in this example occurs at observation number 7. At this point the first entry of the four data points are made on the Point and Figure chart and are entered below as shown in Fig. A1.

Step 3: Having established the initial direction, data continues to be read until either a price of \$96 is read, causing an 'O' to be recorded at \$96, or the price of the local minima plus REV times PPB is read, that is \$97 + (3 × \$1). As a price of \$100 is encountered before \$96, the evolution of the Point and Figure chart now appears in Fig. A2.

As prices are now rising and the last entry recorded was \$100, data continues to be read until either a price of \$101 is read, causing an 'X' to be recorded at \$101, or the price of the local

Price				
\$102				
\$101				
\$100	**O**			**First Entry – Observation 1**
\$99	**O**			**First Entry – Observation 5**
\$98	**O**			**First Entry – Observation 6**
\$97	**O**			**First Entry – Observation 7**
\$96				

Fig. A1. Point and Figure example part 1.

Price				
$102				
$101				
$100	**O**	**X**		**Second Entry – Observation 10**
$99	**O**	**X**		**Second Entry – Observation 9**
$98	**O**	**X**		**Second Entry – Observation 8**
$97	**O**			
$96				

Fig. A2. Point and Figure example part 2.

Price				
$102				
$101		**X**		**Third Entry – Observation 13**
$100	**O**	**X**		
$99	**O**	**X**		
$98	**O**	**X**		
$97	**O**			
$96				

Fig. A3. Point and Figure example part 3.

maxima minus REV times PPB is read, that is $100—(3 × $1). As a price of $101 is encountered before $97, the Point and Figure chart now appears as in Fig. A3.

Similarly, a price of either $102 or $98 will trigger the next entry. As the following price read is $102, the Point and Figure chart now appears as shown in Fig. A4.

Now that the local maxima is $102, data continues to be read until either $103 or $99 is read. As the next material price, according to the values used for PPB and REV, to be read is $99, the final Point and Figure chart now appears as shown in Fig. A5.

Price				
$102		**X**		**Fourth Entry – Observation 14**
$101		**X**		
$100	**O**	**X**		
$99	**O**	**X**		
$98	**O**	**X**		
$97	**O**			
$96				

Fig. A4. Point and Figure example part 4.

Price				
$102		**X**		
$101		**X**	**O**	**Fifth Entry – Observation 15**
$100	**O**	**X**	**O**	**Fifth Entry – Observation 16**
$99	**O**	**X**	**O**	**Fifth Entry – Observation 18**
$98	**O**	**X**		
$97	**O**			
$96				

Fig. A5. Point and Figure example part 5.

As all data is now exhausted, the final Point and Figure chart is shown in Fig. A5. Data size is dramatically reduced from 20 original data points down to 3 data points that recorded only 12 of the price observations. Point and Figure charting totally dispenses with time on the *x*-axis and time data is totally lost in the filtration process. Therefore it does not record how long it took for an entry to be made, but merely the movements in price.

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