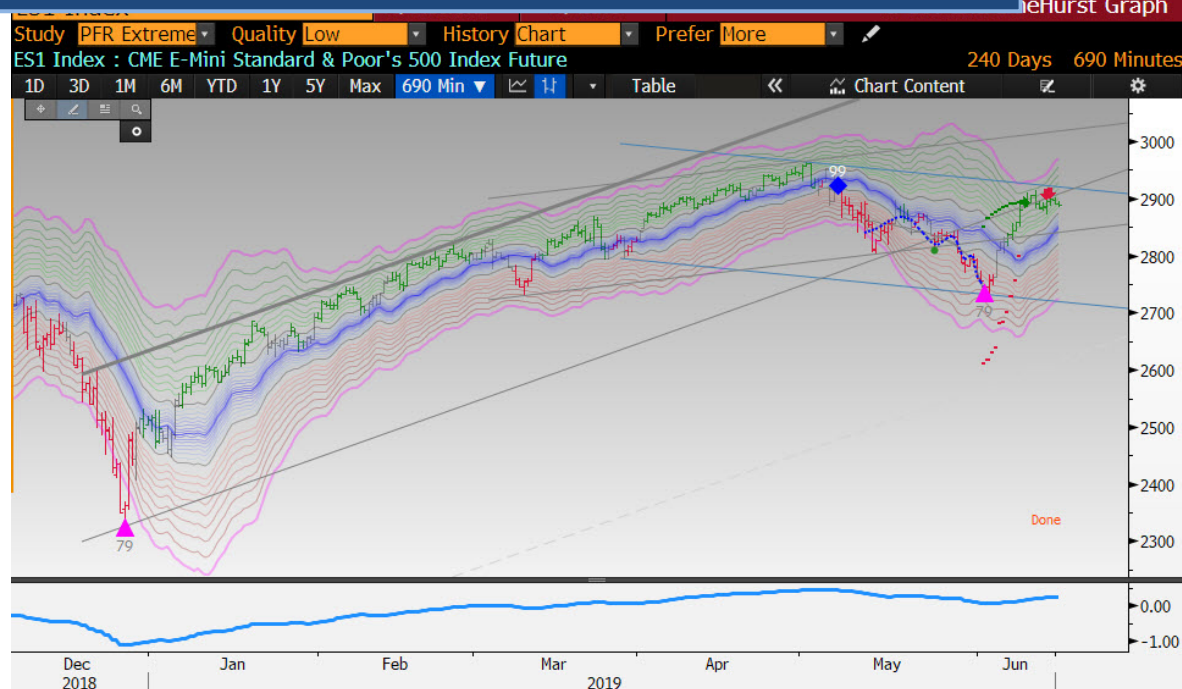


Users Guide for ExtremeHurst™, Custom Studies & EXCEL Add-In on Bloomberg



Parallax Financial Research, Inc

2/22/2022



Users Guide for ExtremeHurst™ on Bloomberg

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What is ExtremeHurst?

ExtremeHurst is a quantitative detector of extreme investor behavior that signals the end of a trend or a trendless period. Strong trend-persistent stock price movements are evidence of positive feedback (i.e., investors buying because the price is rising, driving prices higher), while extremes of mean reversion are evidence of negative feedback. Extremes of both trend persistency and mean reversion are quantified via multiple scale measurements of a band-limited Hurst exponent. Parallax found that Hurst extremes coupled with log-periodic converging cycles, signal critical market trend changes. ExtremeHurst signals are fully characterized by the presence of discrete scale invariance, accelerating price, log-periodic cycles, and volume anomalies. This App allows the user to search global markets for signals on intraday, daily, weekly, monthly, and quarterly time scales. Signals have been found to persist for up to the time it took for the signal to build. Build times average 40 bars, which in the case of weekly or higher scale data, means signal duration is a highly significant investment factor.

ExtremeHurst exploits the science of non-linear dynamics to identify unique and predictive signals occurring in freely trading auction markets. There are two types of ExtremeHurst signals that we call “**Extensions**” and “**Compressions**”. These correspond to the extreme high and low ends of the Hurst exponent distribution.



Figure 1. This is an example of a weekly scale Extension top signal.

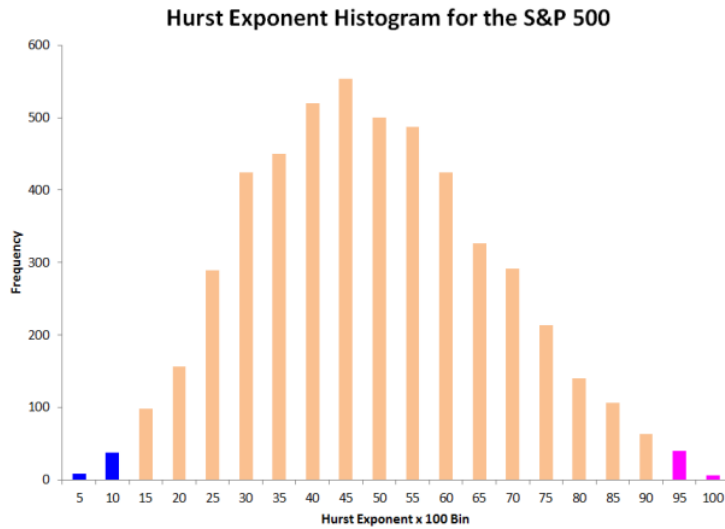


Figure 2. Histogram of band-limited Hurst exponent measurements taken from the S&P 500

The Hurst exponent, as applied to a financial series, represents the degree of randomness which is present. Deviations from random take the form of mean-reversion or trend persistency. The picture below shows five time series with different Hurst exponents. The topmost example is the most mean-reverting, while the bottom example shows the most trend persistency. The middle one is random.

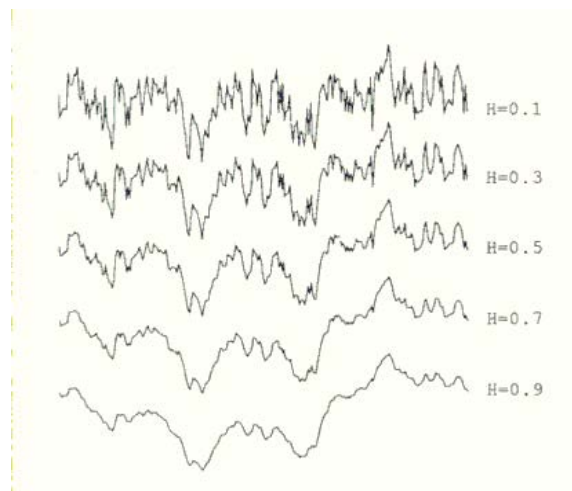


Figure 3. Time series generated with different Hurst exponents

Extensions correspond to extreme levels of trend persistency on multiple scales, and mark the end of trend persistent periods, either at market tops or bottoms. The picture below shows multiple Hurst exponent measurements for a particular security at different scales. The shortest scales are on the bottom. Red represents persistent down trends. Green represents persistent up trends. Gray shows random price movement, and blue represents mean-reverting exponents. Note the column of red at almost the exact price low.

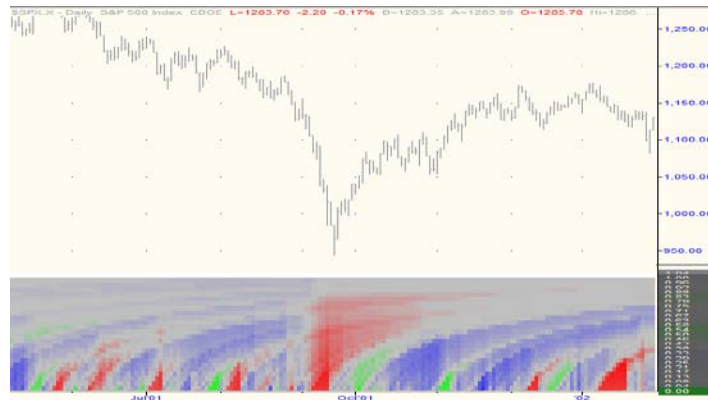
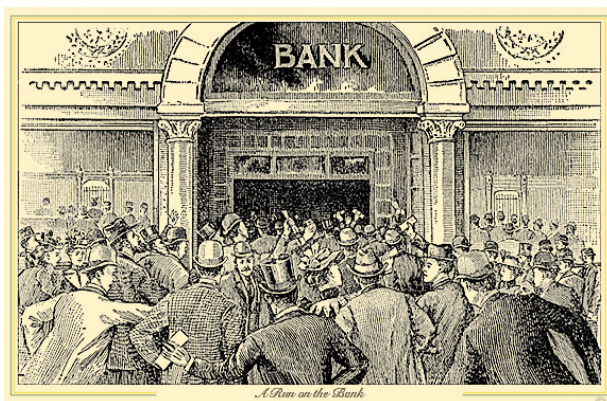


Figure 4. Color-coded Hurst exponents at multiple scales (graph not available on BB)

Many factors influence investors, but we choose to focus on the extremes of competitive or cooperative behavior from a macro perspective. Feedback is at the heart of why ExtremeHurst works. Investors sometimes behave as herds, selling because the price is dropping, or buying because it's going up. Panics and manias are large scale examples of this. However, when most investors agree that a stock is going up or down, they've probably already acted on their belief, and the buying or selling dries up, leading to a reversal.

Panic



Mania

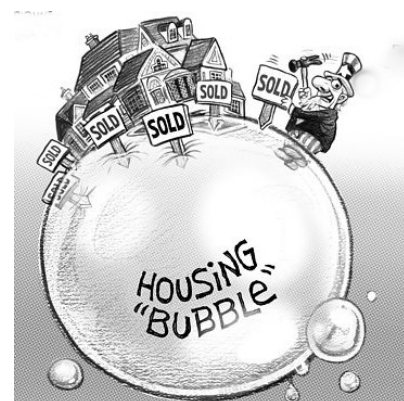


Figure 5. Extreme investor behavior.

Because these events are scientifically similar to critical failure points in materials, log periodic “foreshocks” are visible preceding most signals, as well as mirror image “aftershocks” following signals. Aftershocks are also log-periodic, but are expanding, which means the highs and lows are getting farther apart logarithmically over time. The picture below is a simulated example:

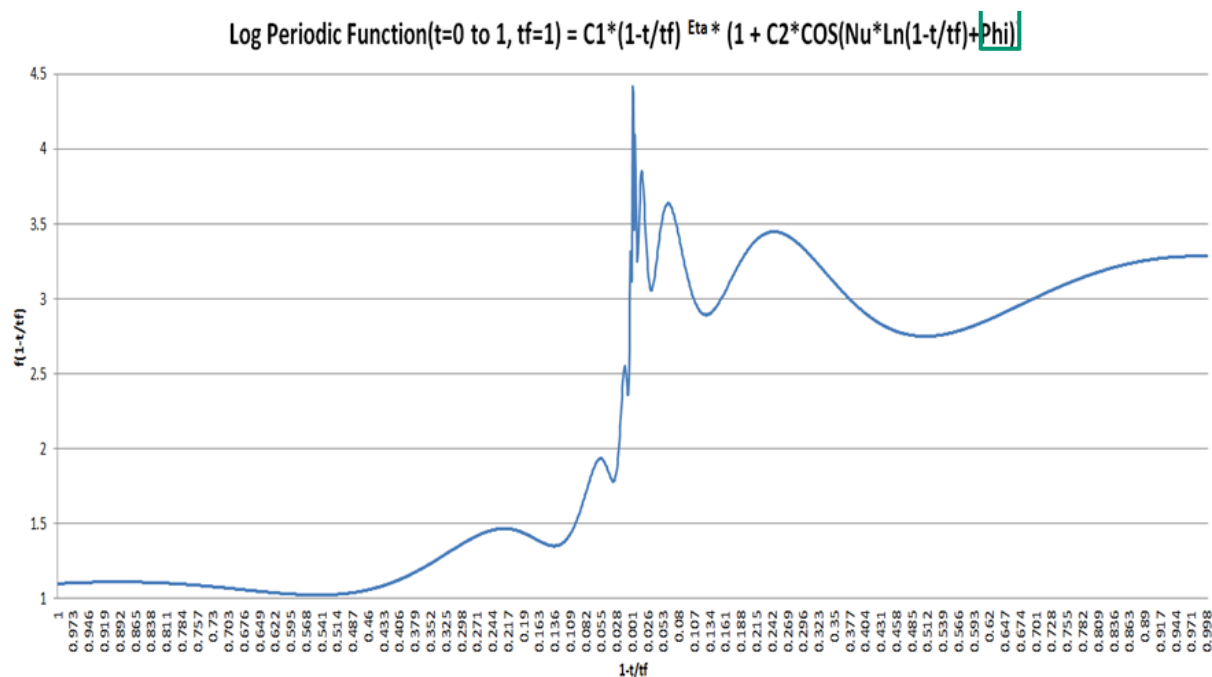


Figure 6. Simulated log-periodic oscillations culminating in a critical reversal point and then expanding away from the critical point (Top Extension). This is due to markets having a “complex numbered” fractal dimension.

Compressions correspond to extreme levels of mean-reversion, or investor competition, on multiple scales. These signals mark the end of trendless periods and the beginning of new trends by finding when the vigorous competition between supply and demand has reached a critical point. Price is expected to move very rapidly away from its current price following a compression.



Figure 7. Competition between supply and demand reaches a crescendo at compression signals

Another way to think of these signals is to envision a mass on a spring. When the spring is compressed, the system has high potential energy. When the mass is released, it will move very fast away from its starting position. In fact, it will then move too far. An extension occurs as the spring reaches its full extent, just before it settles back:

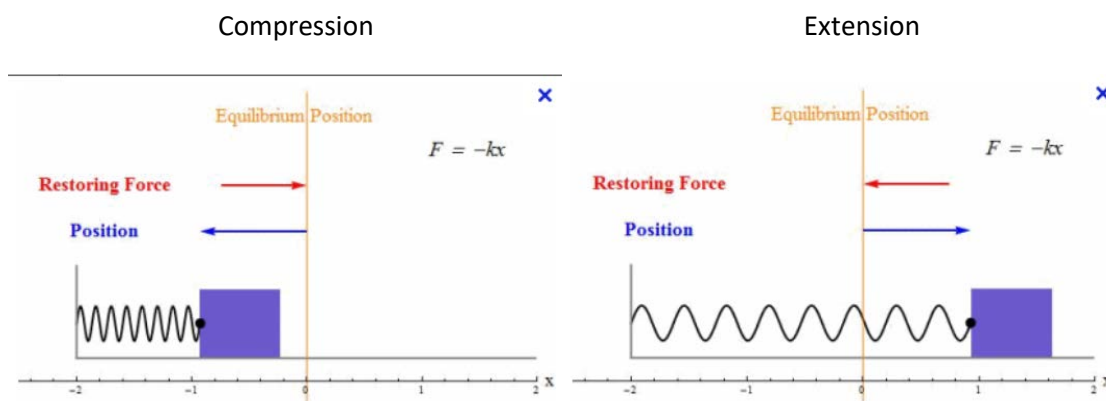


Figure 8. A harmonic oscillator is a great way to envision a compression and extension

How do I use ExtremeHurst?

The ExtremeHurst signals work on all freely traded securities and on all time scales, provided sufficient liquidity is present. For a “crowd effect” to occur, a crowd must be present.

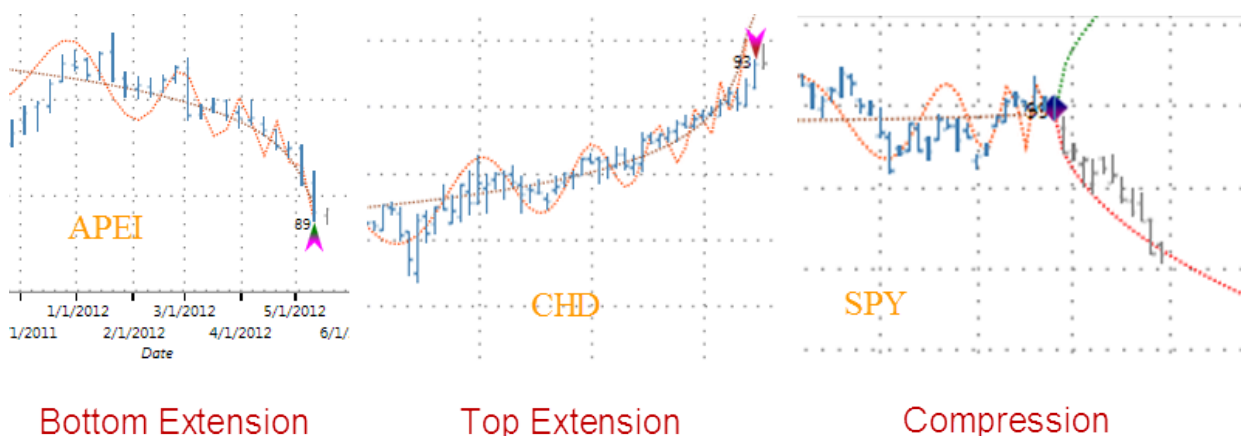


Figure 9. Examples of each ExtremeHurst signal type

The predictive edge in ExtremeHurst can be as large as 25% (See the appendix for a discussion of Edge vs Duration), and has a duration that doesn't see the edge going to zero until the “build time” is reached. On the pictures in Figure 9, the build time is the number of price bars leading into the signal which show the gray dotted line and red cycles. The point of maximum effect tends to be the first third of the duration. So in the SPY case in Figure 9, the build time is 27 bars into the Compression. That means you can expect a trend move lasting at least 9 bars.

The Extension signals predict retracement or sideways periods, so redeployment of capital may be the best strategic move. Aggressive speculators like to play the log-periodic cycles, so we have included the expected top and bottom timing marks on the charts and in the signal file.

Compressions mark the start of new trends, but we never know the direction, so a straddle or triggered L/S entry is required.

Signals have at least four important uses:

1. Trade positioning
2. Profit taking.
3. Identifying transitions from a trending to a sideways market or vice versa.
4. When the crowd runs a security too far up or down, prices can deviate significantly from a reasonable valuation and diminish portfolio performance. Having an idea about when these effects are occurring can be very valuable.

Signals are ranked from 1 to 100 depending on how closely they correspond to the ideal signal

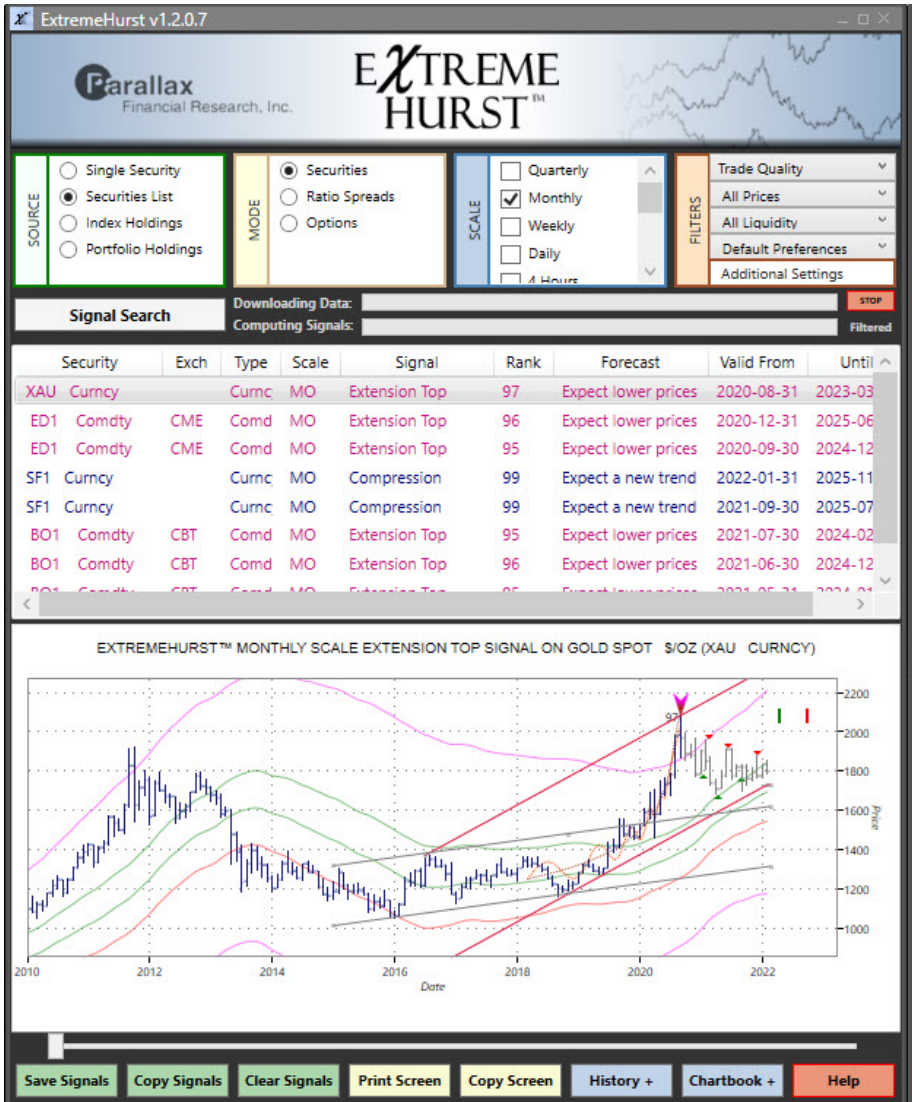
An ideal signal exhibits four characteristics:

1. A price acceleration that deviates significantly from normal Gaussian expectations
2. Extreme Hurst Exponent measurements on multiple scales
3. Log-periodic price ripples which converge to the signal date
4. Unique price and volume sequencing

We combine factors using a pre-trained neural net to produce our final signal rank

We have created the ExtremeHurst App on Bloomberg to enable users to search world markets for these predictive signals on intraday, daily, weekly, monthly, and even quarterly time scales.

The Application (on Bloomberg at APPS HURST <Go>)



The screenshot shows the ExtremeHurst v1.2.0.7 application window. The interface is divided into several sections:

- Security Group Selection:** Located at the top left, it includes radio buttons for 'Single Security', 'Securities List' (selected), 'Index Holdings', and 'Portfolio Holdings'. Below this are 'MODE' (Securities, Ratio Spreads, Options) and 'SCALE' (Quarterly, Monthly, Weekly, Daily, 4 Hours) options.
- Search Progress:** A section below the settings with 'Signal Search' and 'Downloading Data' progress bars, and a 'Computing Signals' bar.
- Signals Found:** A table listing search results with columns: Security, Exch, Type, Scale, Signal, Rank, Forecast, Valid From, and Until. The table shows several entries for Gold Spot (\$/OZ) with 'Extension Top' and 'Compression' signals.
- Selected Signal Chart:** A candlestick chart titled 'EXTREMEHURST™ MONTHLY SCALE EXTENSION TOP SIGNAL ON GOLD SPOT \$/OZ (XAU CURRENCY)' showing price movement from 2010 to 2022. The chart includes various technical indicators and a red arrow pointing to a peak.
- Zoom Output:** A horizontal slider bar below the chart for zooming in and out.
- Output:** A row of buttons at the bottom: 'Save Signals', 'Copy Signals', 'Clear Signals', 'Print Screen', 'Copy Screen', 'History +', 'Chartbook +', and 'Help'.

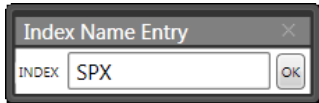
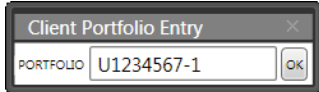
ExtremeHurst App Window	ExtremeHurst is a single Windows dialog box. It is divided into six sections from top to bottom that correspond to the workflow sequence. These sections include security and filter selection, the search progress bars, the signal list, the chart area, the zoom control, and the output options.
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CPU Usage	ExtremeHurst performs millions of complex mathematical calculations including Fast Fourier Transforms, neural network math, and trigonometry calls during each run. You will notice a sharp increase in CPU usage during searches and on occasion the processing may even appear to halt. Be patient, it will complete.
Bloomberg Data Limits	Bloomberg clients have monthly data usage limitations. We recommend that you carefully select a security universe, search <u>once</u> after the close each day for daily signals, <u>once</u> a week after the weekly close for weekly scale signals, etc., so you stay within your limits. ExtremeHurst reads 129 historical bars worth of OHLCV data for each security that passes through the filters.

Security & Filter Selection

Let's take a closer look at security and filter selection: The user can select which securities to search by either reading in a text file with one security name per line (for example "SPX INDEX" for S&P 500, "SPY US EQUITY" for S&P ETF, or "XAU CURRENCY" for silver), retrieving each security holding from an index, or by reading securities from a Bloomberg client portfolio (PRTU <Go>). The next step is to select the search mode, and time scale desired. Keep in mind that our signals remain active for about as long as it takes to build the signal, which is on average 40 bars (The biggest effect is in the first third of that time though). This means that a single quarterly signal may be predictive for years, while a daily scale event may last for weeks. The next menu has a list of filters to apply. The volume filter ensures that securities with volume actually have volume on every trading day. It also ensures a sufficient level of volume for reasonable investment. The data filter guards against spikes, excessive gaps, missing data, or improperly sequenced data. The price filter sets a minimum price level. Under "Additional Filters", you may check "New Signals Only" to see only signals that just occurred; while unchecked results in older signals that are still active. By checking "Remember Filtered", the program will remember which securities were excluded and not search them again. Three signal quality thresholds are provided. We have found that some researchers don't mind seeing less predictive signals, while others just want the few best ones. We recommend leaving this on "Trade".

SOURCE	<input type="radio"/> Single Security
	<input checked="" type="radio"/> Securities List
	<input type="radio"/> Index Holdings
	<input type="radio"/> Portfolio Holdings

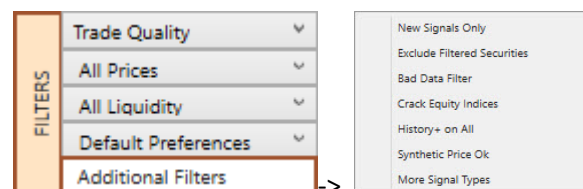
Single Security	Enter any single security, for example "MSFT US EQUITY"
Securities List	<p>A text file created using NotePad or other text editor with a list of securities, one per line, in the following format: <security name> space <exchange code> space <yellow-key>. For example:</p> <pre>AH US Equity KAR US Equity MSFT US Equity IBM US Equity EURUSD Curncy USDCAD Curncy GC1 Comdty CA1 Comdty</pre>
Index Holdings	<p>Search just the securities that make up an index by typing the Bloomberg index name at the prompt. For example, SPX for the S&P 500 index:</p> 
Client Portfolio	<p>Bloomberg offers clients the ability to keep portfolios on their system using PRTU <go>. If you wish to search only your portfolio securities then enter your portfolio name at the prompt. It should be in the following format: U1234567-1</p> 

MODE	<input checked="" type="radio"/> Securities
	<input type="radio"/> Ratio Spreads
	<input type="radio"/> Options

Securities	Search for ExtremeHurst signals on simple securities
Ratio Spreads	Search for ExtremeHurst signals on ratio spreads to a common denominator
Options	Same as "Securities" except daily in-the-money option series are also searched



Time Scale	Select which time scale to search for ExtremeHurst signals
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Liquidity Filter	With this option checked, the average daily dollar trading volume for Indices and equities must exceed a minimum limit to be considered.
Data Filter	Check this option to filter out securities with missing data, recent data spikes, inactive bars, insufficient history, excessive gapping, or improper sequencing
Price Filter	This option limits the minimum allowable price of an equity or index
New Signals Only	Check this option to search for new signals only. If it is unchecked the search will find all signals that are still active....but it will take longer.
Exclude Filtered Securities	Check this option for the program to remember all the securities that have been disqualified for signal search. This memory will persist even when the program is closed
Preferences	Certain combinations of search options can enable users to have either more signals (at the expense of compute time)
Quality	Set the minimum rank for signals, where the higher the better the performance. Max=99, Trade=95+, High=90+, Medium=80+, and Explore 0+ (unfiltered)
Crack Equity Indices	If you run an index like SPX INDEX by itself and have this checked, all the holdings will also be scanned individually
History+ on All	If this is checked then when the "History+" button is pressed, history will be added to all listed resulting charts
More Signal Types	If this is selected, more Parallax signal types will also be searched for. These include SmartChannel breakouts and reflections, and Price-Volume crosses

Signal Search and Progress

Search for Signals

Downloading Data:
 Computing Signals:

STOP
Filtered

Search for Signals

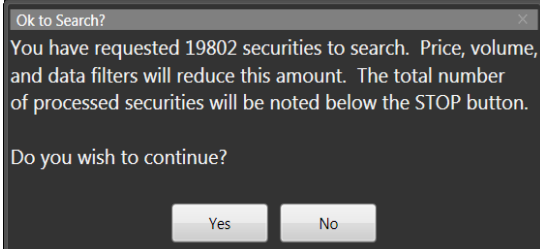
Data 275 of 500
 Calc 27 of 228

STOP
27 Total

Search for Signals	<p>Press the search button to download historical price data from Bloomberg for the selected securities and then search that data for ExtremeHurst signals. The download procedure first checks that the average daily dollar volume is greater than the limit before requesting additional data. Look at the “Filtered” section below the STOP button to find out how many securities passed all the filters and have finished being run through the ExtremeHurst signal processor. In the example above, we show the search section before and during a search of S&P 500 stocks. Note that the search button is grayed-out until all downloading and calculations are complete. As shown above, out of 275 securities downloaded, 228 had been passed to the processor, and 27 had completed so far.</p>
STOP	<p>The search procedure gathers data in chunks and then processes that data before gathering the next chunk. Press STOP to break the cycle and stop the processor from gathering additional data. It will complete the signal search using the data already downloaded however.</p>
CPU Usage	<p>ExtremeHurst performs millions of complex mathematical calculations including Fast Fourier transforms, neural network math, and trigonometry calls during each run. You will notice a sharp increase in CPU usage during searches and on occasion the processing may even appear to halt. Be patient, it will complete.</p>
Data Usage	<p>Bloomberg clients have monthly data usage limitations. We recommend that you carefully select a security universe, search for “New Signals” only, and then search once after the close each day for daily signals, once a week after the weekly close for weekly signals, etc., so you stay within your limits. ExtremeHurst reads 129 historical bars worth of OHLCV data for each security that passes through the filters. If you uncheck the New Signals button the application will take longer to run and require 15% more data. If you hit your limits you’ll see:</p> <div> <div>ExtremeHurst Message</div> <div>Bloomberg Error:Monthly limit reached. [nid:200]</div> <div>OK</div> </div>

Data Warning

If you ask for more than 1000 securities then this message comes up. As an example, In the US, the almost 20,000 listed equities are cut down to less than 2,000 by the filters. If you are unsure, press the STOP button part way through, or just make a security list in a text file and read it in.



ExtremeHurst Signal List

Signals are listed in the window as the search progresses. The list has one signal per line and is described by its symbol name, exchange, security type, time scale, signal type, quality rank, forecast, and active dates. The button marked “More” is used to find historical signals and do a statistical test on them. A yellow box indicates that insufficient data was present to do this test. Green means the test was significant, while red means the opposite. Use the scroll bars to move through the signal list.

Security	Exch	Type	Scale	Signal	Rank	Forecast	Valid From	Until
AAPL UW Equity	UW	EQ	DY	Extension Bottom	87	Expect higher prices	2012-11-08	2012-12-06
AIV UN Equity	UN	EQ	DY	Extension Bottom	93	Expect higher prices	2012-11-14	2012-12-12
APA UN Equity	UN	EQ	DY	Extension Bottom	99	Expect higher prices	2012-11-16	2012-12-14
BF/B UN Equity	UN	EQ	DY	Extension Top	86	Expect lower prices	2012-11-27	2012-12-25
BMV UN Equity	UN	EQ	DY	Extension Bottom	93	Expect higher prices	2012-11-15	2012-12-13
BXP UN Equity	UN	EQ	DY	Extension Bottom	93	Expect higher prices	2012-11-15	2012-12-13
BXP UN Equity	UN	EQ	DY	Extension Bottom	87	Expect higher prices	2012-11-14	2012-12-12
CHK UN Equity	UN	EQ	DY	Extension Bottom	94	Expect higher prices	2012-11-09	2012-12-07

Symbol	The Bloomberg symbol for this security
Exch	The Bloomberg composite exchange where the security is listed
Type	Abbreviation for the Bloomberg yellow key. EQ=Equity, CM=Commodity, CR=Currency, IN=Index, ET=Exchange traded fund
Scale	Abbreviation for the sampling frequency, DY=Daily, WK=Weekly, MO=Monthly, and QT=Quarterly

Signal	<p>There are two types of ExtremeHurst signals that we call “Extensions” and “Compressions”. These correspond to the extreme high and low ends of the Hurst Exponent distribution. There are two types of Extensions, top and bottom. Extensions mark the end of trends on that scale. Compressions are points of high potential energy that occur just before a new trend erupts.</p>	
Rank	<p>Rank varies from 0 to 100 corresponding to the signal quality. To be a high quality signal, extreme high or low consistent Hurst Exponents, log-periodic oscillations (Sornette), and expected volume behavior need to be easily distinguishable once data corrections and filters are applied. The higher the rank, the better the signals expected outcome.</p>	
Forecast	<p>Abbreviation for the behavior we expect from the three signal types.</p>	
Valid From	<p>Date from which the forecasted behavior should start to appear.</p>	
Until	<p>This is the Date after which it is unlikely that signal effects will be evident. Note here that this is set at 20 bars currently. Expect signals that had longer build-up times to have effects lasting longer, and vice versa.</p>	

You can also right click on each line to bring up a convenient Bloomberg terminal task menu:



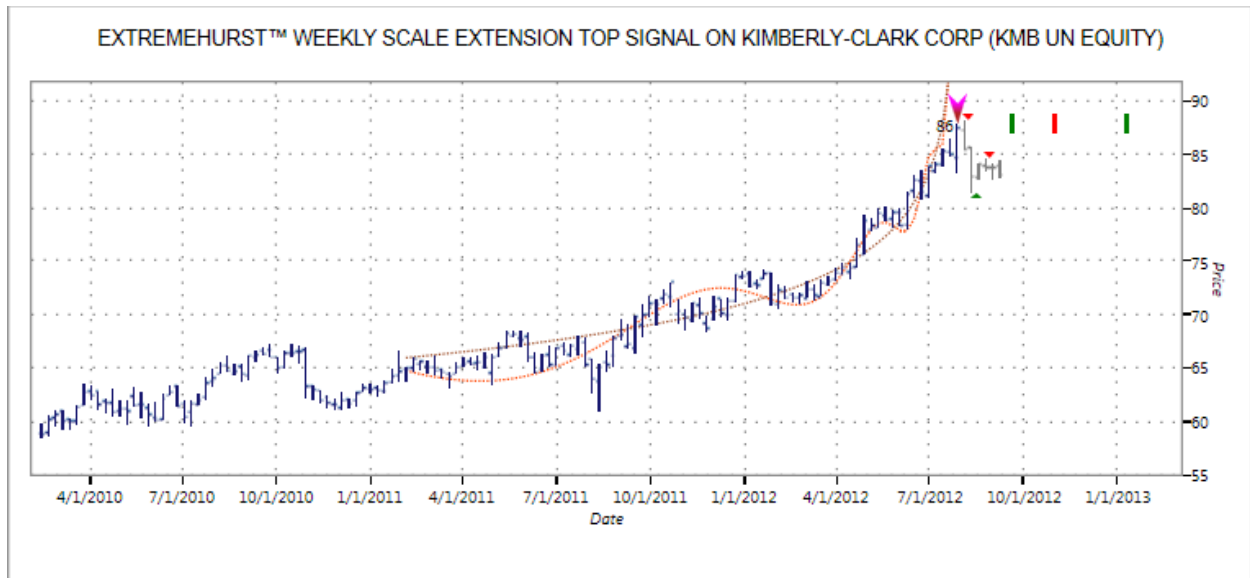
GP: Display Bloomberg Chart




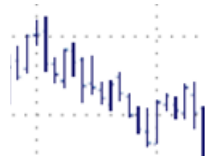
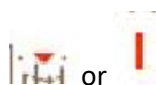



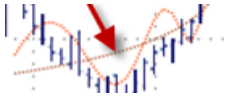
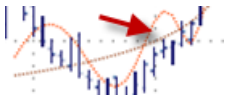
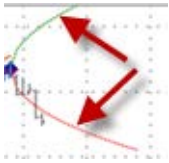


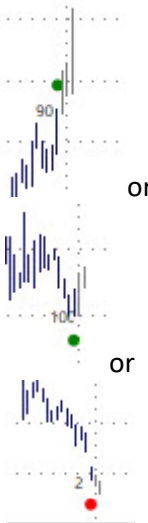
DES: Security Description


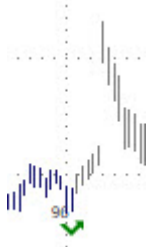


Chart of Selected Signal



Marker	Symbol	Float over
Extension Top marker		Active Signal Date: 8/28/2012 Type: Extension Top Price: 58.3 Scale: daily Rank: 86
Compression marker		Active Signal Date: 9/4/2012 Type: Compression Price: 423.61 Scale: daily Rank: 89
Extension Bottom marker		Active Signal Date: 8/10/2012 Type: Extension Bottom Price: 31.67 Scale: daily Rank: 92
Price bars		Price Data Date: 8/6/2012 Open: 32.8 High: 32.8 Low: 32.53 Close: 32.59
Marker	Symbol	Float over
Extension Cycle Top markers		Extension Cycles Date: 9/7/2012 Type: Top expected Price: 33.5 Scale: daily Rank: 92
Extension Cycle Bottom markers		Extension Cycles Date: 8/31/2012 Type: Bottom expected Price: 32.74 Scale: daily Rank: 92

Accelerating Trend (Extensions only)		Price
Log-Periodic Oscillations		Price
Average Compression trend path		<div>Average Post-Compression Uptrend Path</div> <div>or</div> <div>Average Post-Compression Downtrend Path</div>
Price Volume Cross Sell		<div>PV Cross Sell</div> <div>Date: 3/30/2012</div> <div>Type: PVX</div> <div>Price: 93.34</div> <div>Scale: daily</div> <div>Rank: -8.54</div>
Price Volume Cross Buy		<div>PV Cross Buy</div> <div>Date: 4/19/2012</div> <div>Type: PVX</div> <div>Price: 71.5</div> <div>Scale: daily</div> <div>Rank: 8.61</div>
SmartChannel Breakout Buys & Sells (upside false break sell not shown)		<div>Low Break Buy</div> <div>Date: 11/30/2021</div> <div>Time: 4:00 PM</div> <div>Type: Break</div> <div>Price: 198.74</div> <div>Scale: monthly</div> <div>Rank: 100</div>

<div><div><div>Parallax</div></div><div>Financial Research, Inc.</div></div>		<div><div>EXTREME</div><div>HURST™</div></div>	
<div>SmartChannel External Reflections</div> <div>(external reflection sell not shown)</div>			<div><div>Ext Support Buy</div><div>Date: 1/25/2022</div><div>Time: 4:00 PM</div><div>Type: Support</div><div>Price: 5.8432112689023317</div><div>Scale: daily</div><div>Rank: 96</div></div>

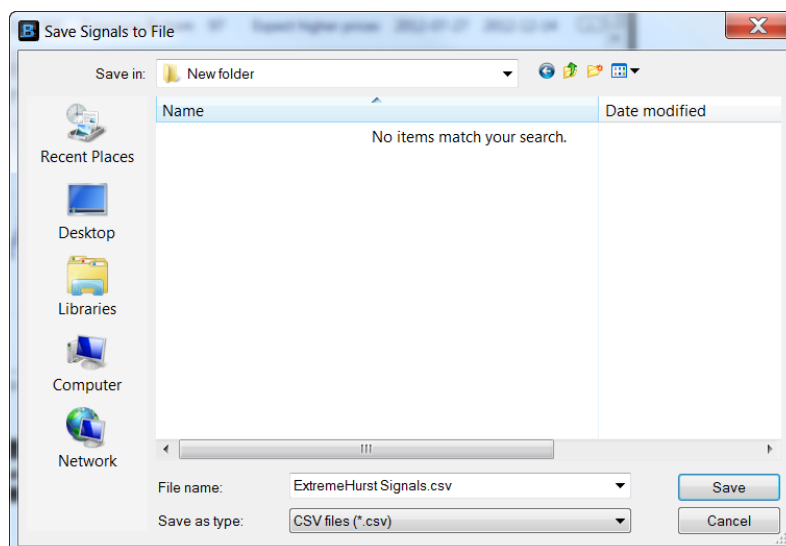
ExtremeHurst Output Options



There are seven output-related buttons across the bottom. “Save Signals” allows the user to write the signals to a CSV file. The “Copy Signals” button places the same signal data in the clipboard, so it can be pasted in a spreadsheet or other compatible document. “Clear Signals” wipes the signal list clean. The “Print Screen” button sends an image of the current dialog box to the printer. It does not save all the signals. “Copy Screen” sends an image of the current dialog box to the clipboard. The “Add History” adds historical signals and other studies to the chart. Finally, the “ChartBook+” button accumulates the user’s favorite chart images for later printing and viewing.



Press this button to save the signal list to a comma delimited text file.



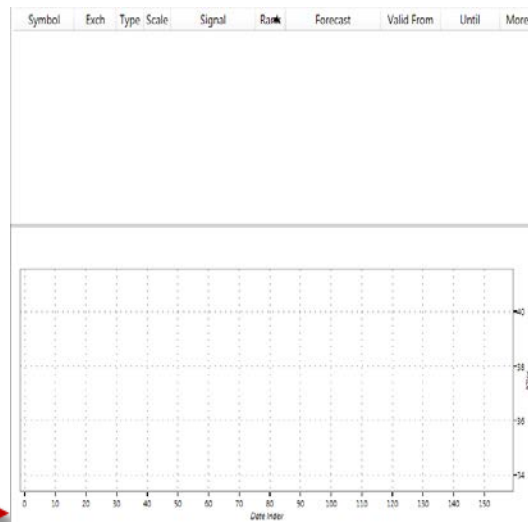
Copy Signals

Press this button to save the signal list to the Windows clipboard. Below is the signal list pasted into EXCEL.

	A	B	C	D	E	F	G	H	I	N	O	P	Q	R
1	Symbol	Region	Type	Scale	Signal	Rank	Forecast	ValidFrom	Until	Name	Sector	Industry	Cycle1_Date	Cycle1_Dir
2	DLTR	UN	EQ	WK	Extension Top	95	Expect lower prices	4/27/2012	9/14/2012	DOLLAR TREE INC	Consumer Cyclical	Retail	5/30/2012	Top
3	FTI	UN	EQ	WK	Extension Bottom	87	Expect higher prices	6/1/2012	10/19/2012	FMC TECHNOLOGIES INC	Energy	Oil&Gas Services	7/5/2012	Top
4	KMB	UN	EQ	WK	Extension Top	86	Expect lower prices	7/27/2012	12/14/2012	KIMBERLY-CLARK CORP	Consumer Non-cyclical	Household Products/Wares	8/7/2012	Top
5	LXK	UN	EQ	WK	Extension Bottom	90	Expect higher prices	7/27/2012	12/14/2012	LEXMARK INTERNATIONAL INC-A	Technology	Computers	8/7/2012	Bottom
6	ORLY	UN	EQ	WK	Extension Top	87	Expect lower prices	4/27/2012	9/14/2012	O'REILLY AUTOMOTIVE INC	Consumer Cyclical	Retail	5/14/2012	Bottom
7	RAI	UN	EQ	WK	Compression	99	Breakout w/trend	6/8/2012	10/26/2012	REYNOLDS AMERICAN INC	Consumer Non-cyclical	Agriculture	7/3/2012	Bottom
8	RAI	UN	EQ	WK	Compression	99	Breakout w/trend	6/1/2012	10/19/2012	REYNOLDS AMERICAN INC	Consumer Non-cyclical	Agriculture	6/28/2012	Top
9	ROST	UN	EQ	WK	Extension Top	89	Expect lower prices	5/4/2012	9/21/2012	ROSS STORES INC	Consumer Cyclical	Retail	5/16/2012	Top
10	SHW	UN	EQ	WK	Extension Top	96	Expect lower prices	6/8/2012	10/26/2012	SHERWIN-WILLIAMS CO/THE	Basic Materials	Chemicals	6/18/2012	Top
11	VLO	UN	EQ	WK	Extension Top	87	Expect lower prices	9/7/2012	1/25/2013	VALERO ENERGY CORP	Energy	Oil&Gas	9/21/2012	Bottom

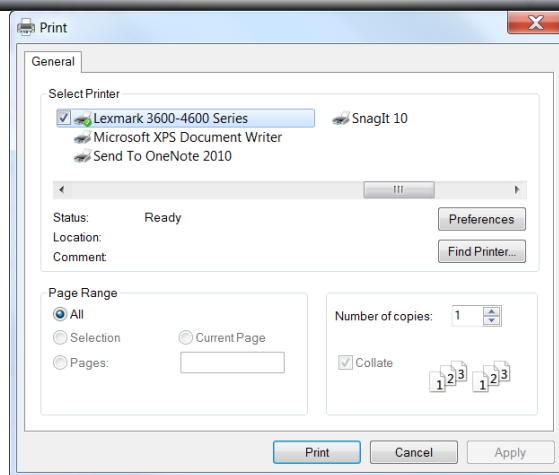
Clear Signals

Press this button to clear the signal list and chart.



Print Screen

Press this button to print a copy of the screen image.



Copy Screen

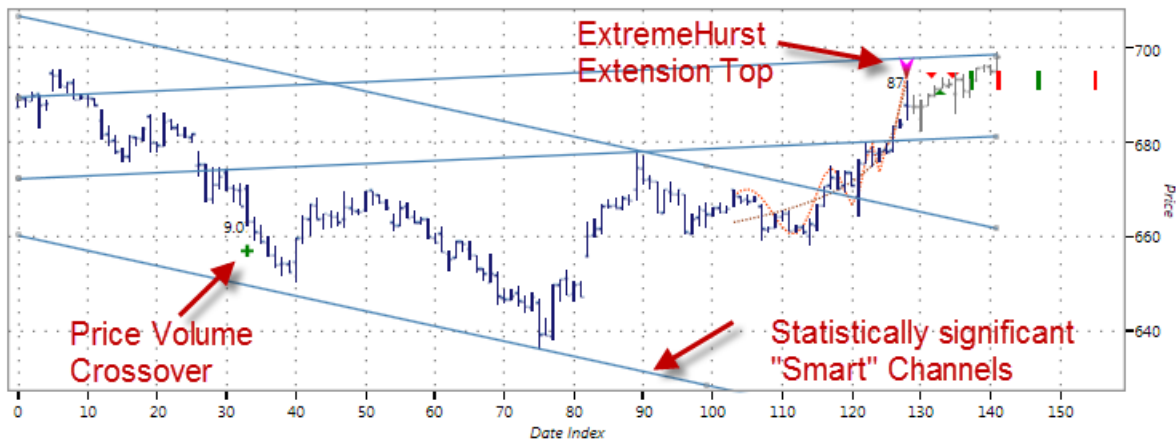
Press this button to copy an image of the screen to the windows clipboard. This allows you to paste the image in a report or email.



History +

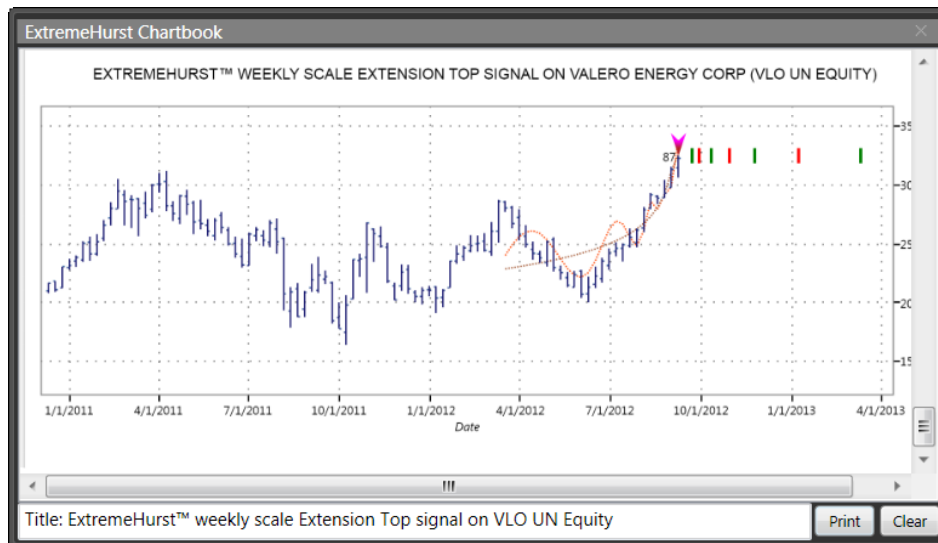
Press the "History+" button to add historical signals and additional studies to each chart. Once pressed, we gather additional data for the particular security and do a statistical calculation to see if other ExtremeHurst signals in the past behaved as expected. We also add two other signal types, SmartChannel (Custom Study "PFSC") and Price-Volume Crossovers (Custom Study "PPVC"). The Price-Volume crossover signals are useful bottom and top indications that last for about up to 6 bars.

EXTREMEHURST™ 60 MIN SCALE EXTENSION TOP SIGNAL ON GOOGLE INC-CLA (GOOG UW EQUITY)



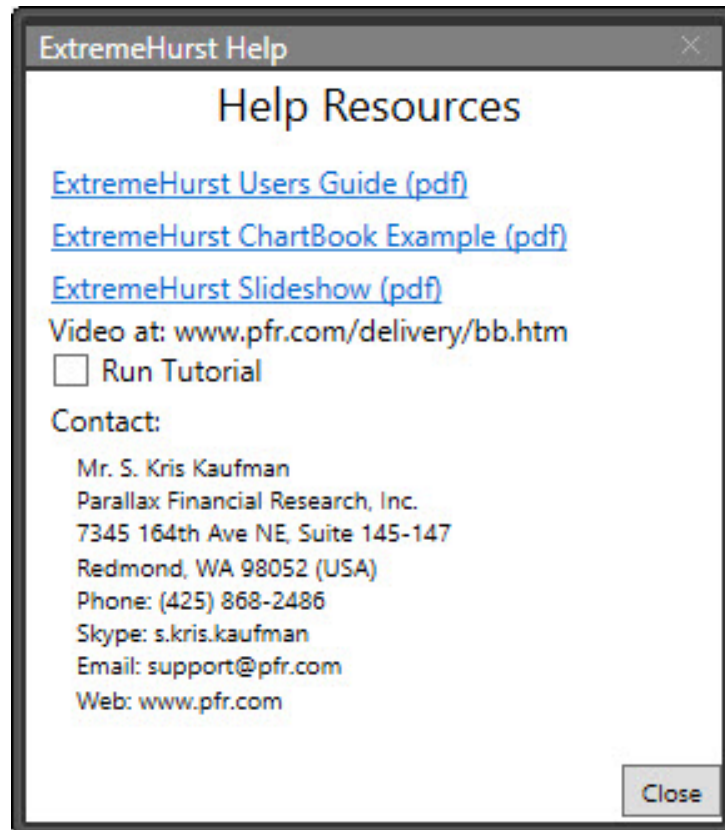
Chartbook +

Press this button to accumulate the current chart image to a book for later printing and review.



Help

Our Help screen is shown below. Our links were not allowed to be live.

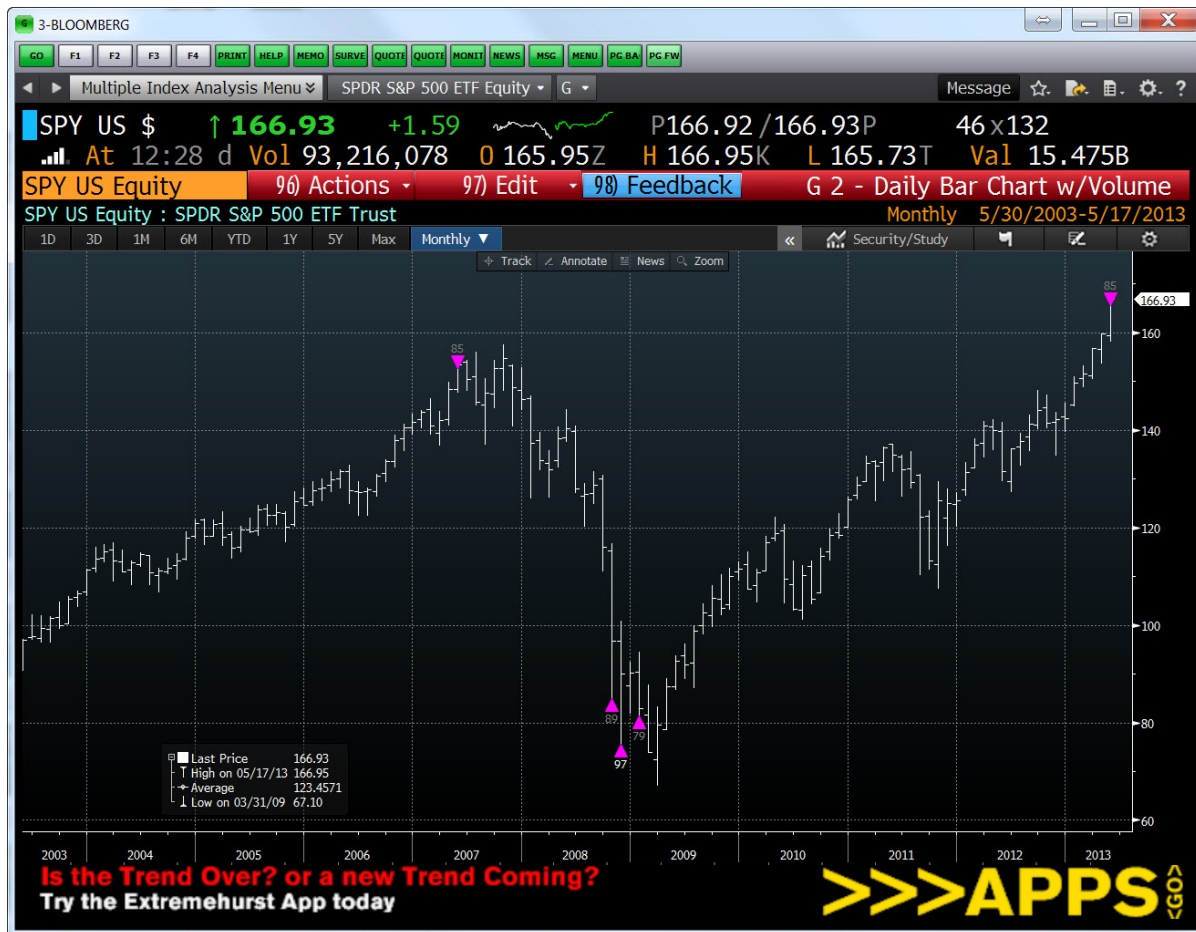


Parallax Financial Research, Inc. is a small scientific research boutique in Redmond, WA. The firm empowers professional money managers with a distinct edge through its unique fundamental and quantitative stock and commodity models. Our models are composed of individual "predictors" which are based on the financial application of both chaos and complexity theories, and presented in clear visualizations. These predictors are blended into forecasting models using genetically-enhanced neural networks. Our careful application of these mathematical modeling techniques yields unique and powerful solutions to enhance manager performance. Visit our website at www.pfr.com

The Custom Studies (APPS CS: PFR <Go>)

ExtremeHurst

The ExtremeHurst™ custom study (“PFEH”) allows the user to overlay our study on a Bloomberg chart. Once in the Bloomberg charting screen, it is easy to change time scales, look at long signal histories, or follow ExtremeHurst in real time.



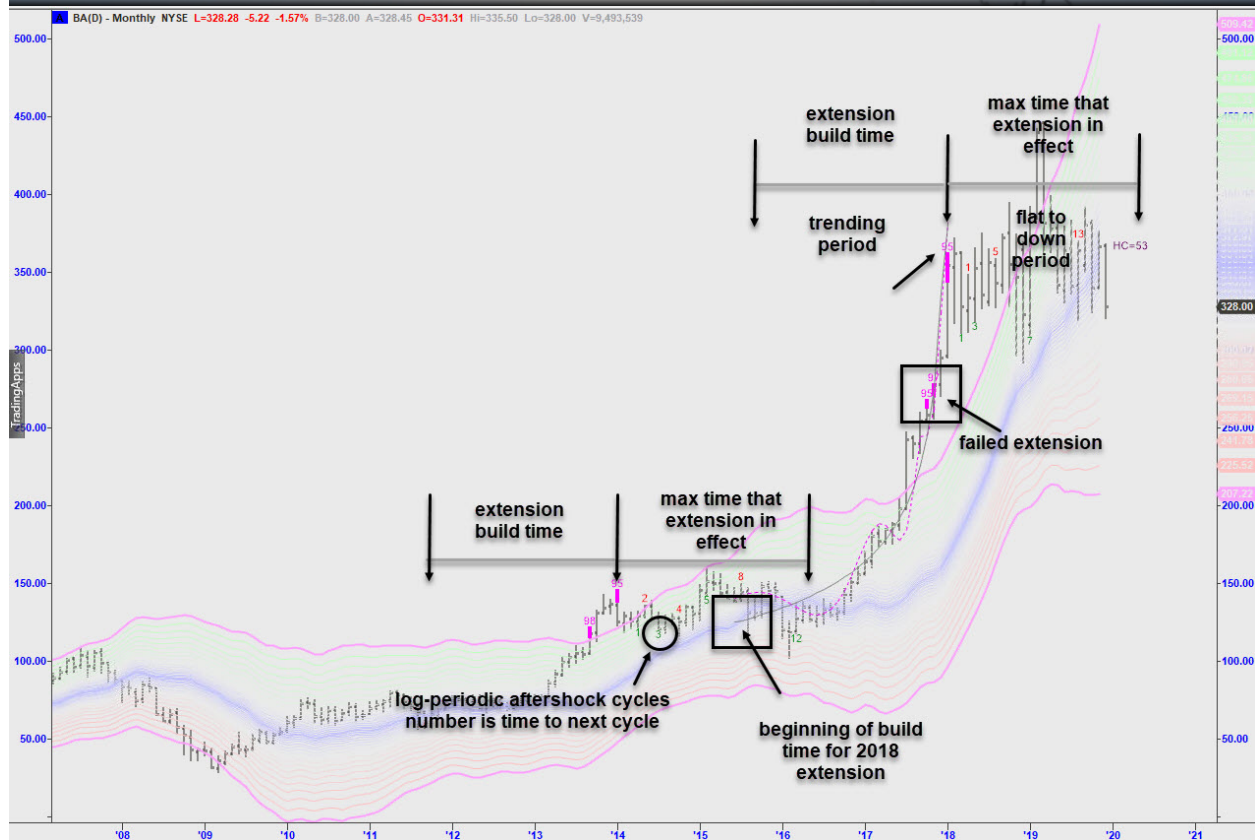
There are a few settings associated with our custom study: The signal quality varies between Explore and Maximum. “Explore” quality is unfiltered and should be used only to anticipate final tradable signals. “Medium” quality signals have ranks of 80 or higher, “High” quality signals have ranks of 90 or greater, “Trade” signals have ranks of 95 or more, and “Maximum” is for the highest rank. We recommend using signals with the highest possible rank. The History setting allows you to choose “Chart” to see historical signals, “Last” to speed up the study by choosing to just display the most recent

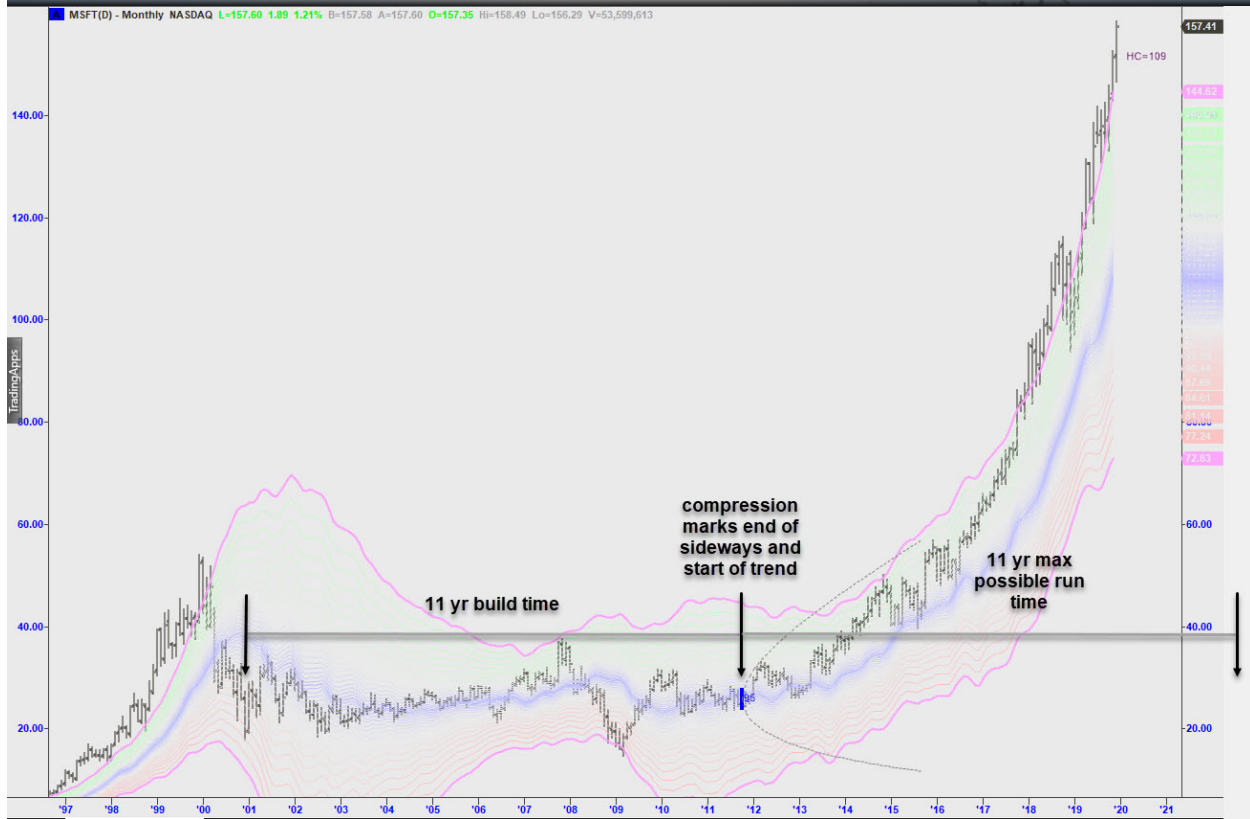
signal, or “Active” to see only signals occurring in the last 20 bars.



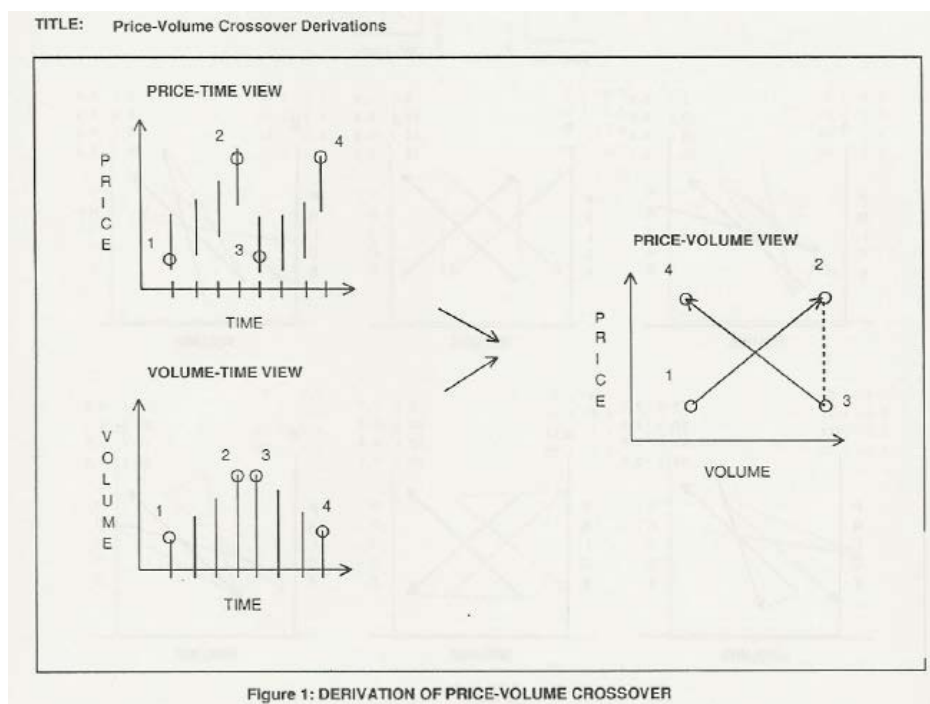
ExtremeHurst signal commentary can be accessed using the Bloomberg Commentary tool as shown below:







Price Volume Crossover (Custom Study “PFPVC”) patterns are an attempt to capture a pattern of crowd investment behavior prior to a significant rise or fall in prices. Marc Chaikin and I studied 24 of these patterns and found 4 that were significant. They are located using this indicator. The plot below shows how a price view and volume view of stocks may be combined into a “price-volume” view.



PFR Paper: *Forecasting Stock and Commodity Prices using Price-Volume Crossovers, Kaufman and Chaikin, MTA Journal, 1991*

Recommended Usage: *Best used as to identify significant upcoming directional price movement*

Output:



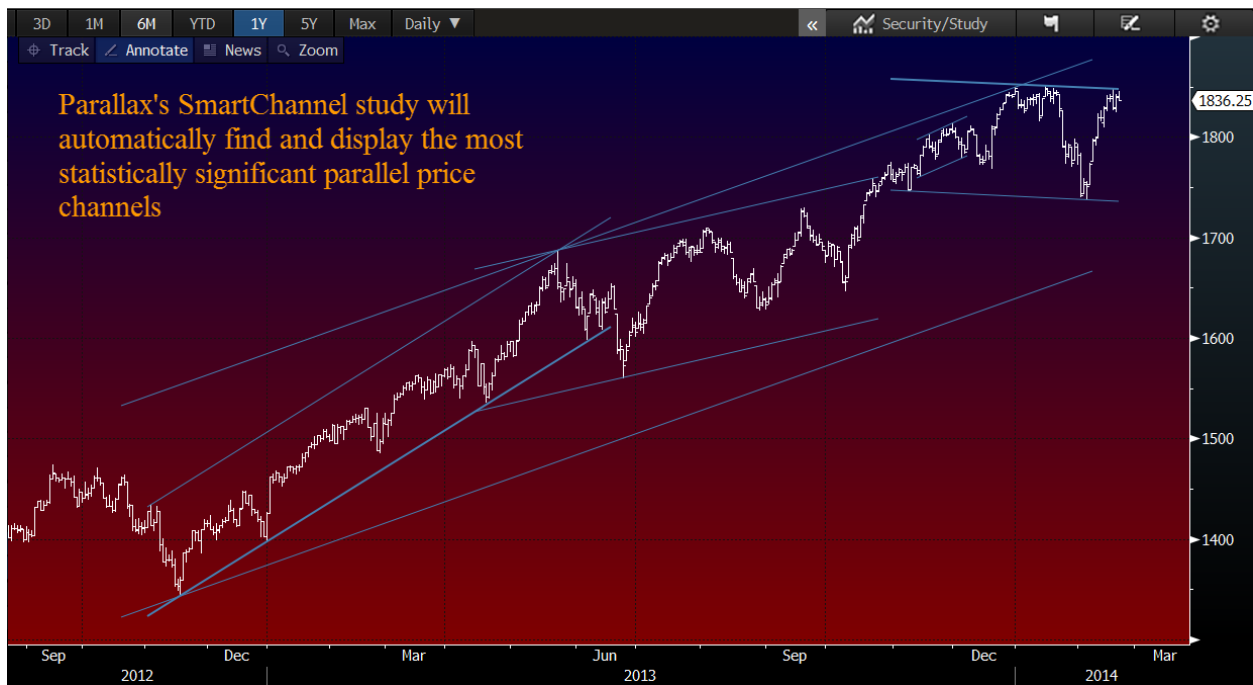
The red plus signs mark bearish predictions as of the close of the bar where they are plotted, while the green plus signs mark bullish predictions.

Performance:

Signal Name	Rank	Max Edge%	Initial Edge%	Duration	Peak%	Decay%
Bullish PV Cross	75+	15.47%	15.47%	18 bars	24%	55%
Bearish PV Cross	75+	-11.94%	-11.94%	13 bars	26%	59%

SmartChannel (Bloomberg Study “PFSC”)

Parallax’s SmartChannel study uses an advanced geometric algorithm to quickly find and display the most statistically significant parallel price channels. Users have the option to extend these channels into the past or future, and also plot offset log-periodic cycles when price breaks out of these channels.



Note the log-periodic offset projection lines

This “Settings” menu allows users to customize SmartChannel



There are a number of signals produced by SmartChannels, breakouts, internal and external reflections, log-periodic target projections, and channel exit bias.







SmartChannel Signals - Edge & Duration

Signal Name	Rank	Max Edge%	Initial Edge%	Duration	Peak%	Decay%
External Reflection Long	90	12.93%	3.10%	36 bars	40%	82%
External Reflection Short	90	-11.03%	-9.71%	14 bars	25%	50%
Breakout Long	90	18.21%	18.21%	8 bars	1%	36%
Breakout Short	90	-10.86%	10.42%	6 bars	39%	53%
Internal Reflection Long	90	3%	3%	4 bars	1%	50%
Internal Reflection Short	90	-3%	-3%	4 bars	1%	50%
Green Channel	90	10.88%	10.88%	18 bars	1%	50%
Red Channel	90	-10.57%	-10.57%	18 bars	1%	50%

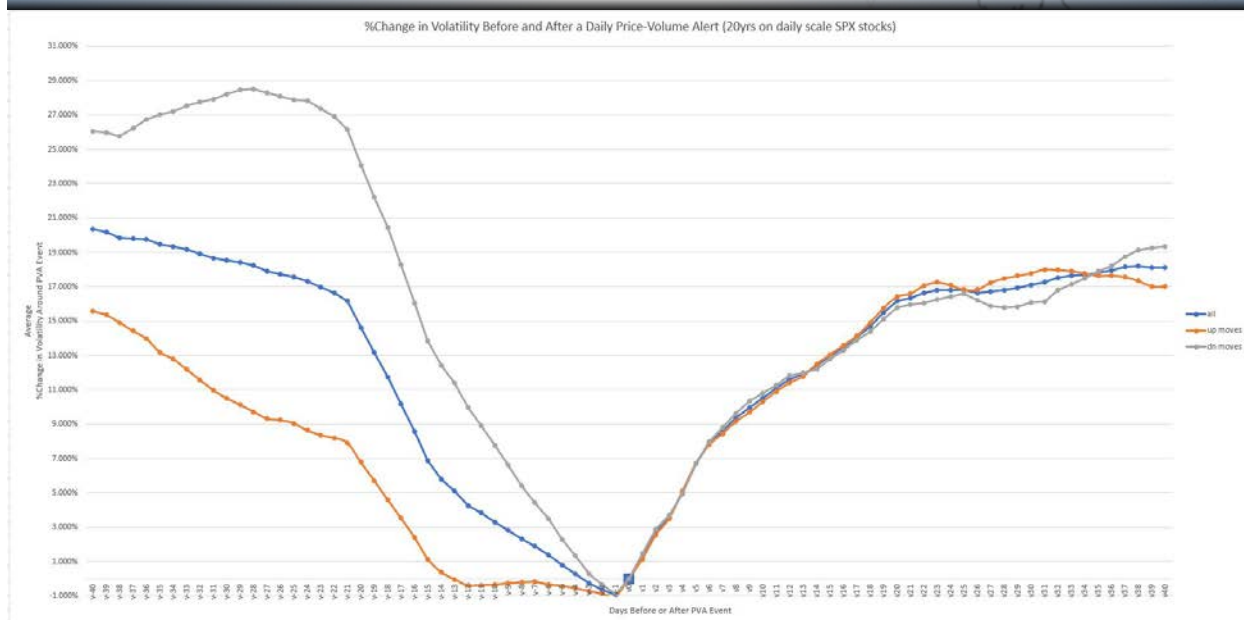
Price-Volume Alerts (included in Bloomberg Study “PFPVC”)

The psychology of market players is occasionally revealed by unusual price and volume activity. We typically see these anomalies at price extremes, just as the market is about to enter a new stage. What constitutes a price or volume anomaly? In order to identify an anomaly we first have to determine what is normal. We chose to study *relative* anomalies such as how different the most recent N-day average volume and range is from the average volume and range in the preceding N-days. A neural net was trained to recognize when the interaction of relative range and volume precedes a period of range expansion (increased volatility) either up or down.

On Bloomberg these events are shown as orange boxes painted at the midpoint of the bar on which they occurred:



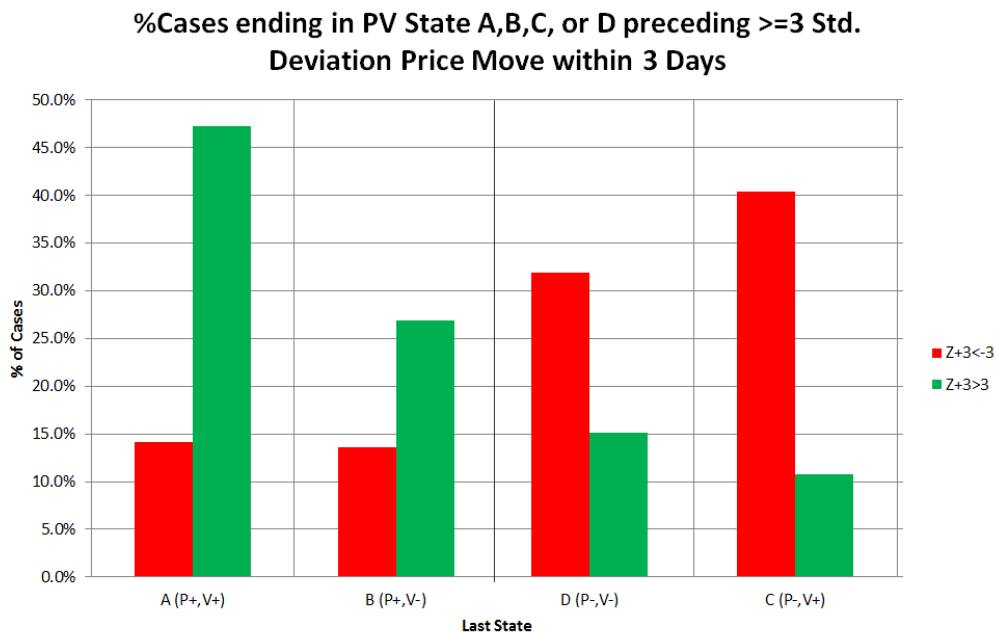
We studied thousands of these signals and found that following their occurrence, volatility increases about 17%. We also measured the case where a daily scale signal occurs within 3 days of a weekly signal, and found a 28% jump in volatility followed.



VolumeTrend (included in Bloomberg Study “PFPVC”)

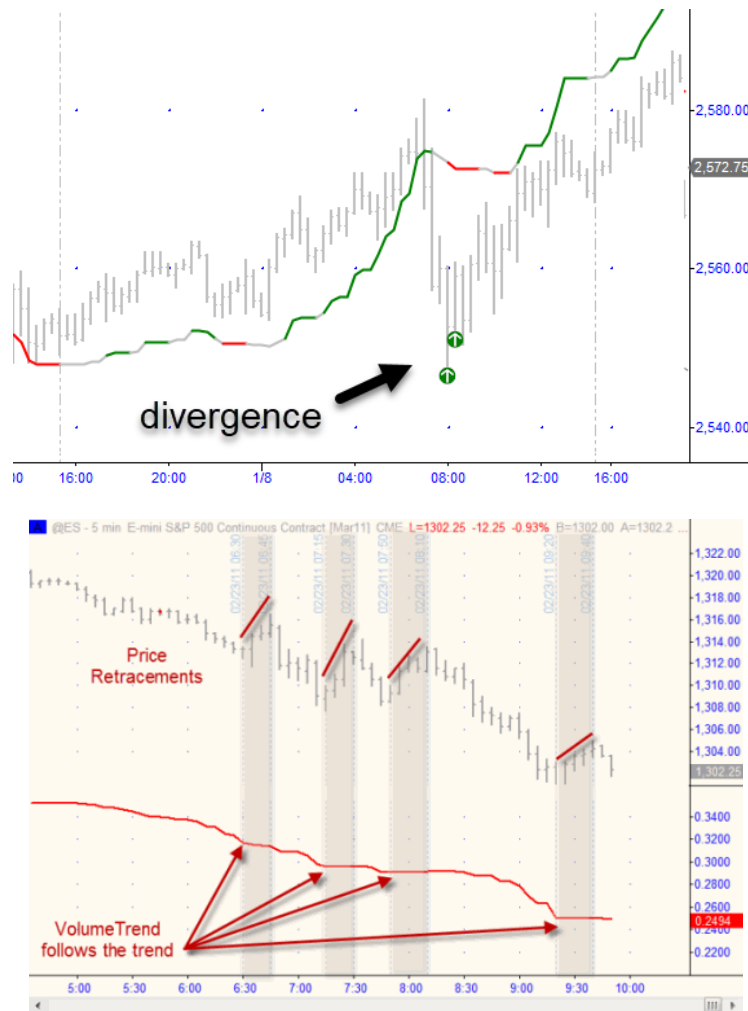
Complexity Theory tells us about the dynamics of multi-agent systems, where a few simple rules can lead to very complex-looking emergent behavior (like flocking birds). If we consider investors and traders as "agents", the simple rules are to these: 1) Pursue price trends (positive feedback), and 2) Be attracted or repulsed at prices that are related geometrically to previous prices (support/resistance). Those two rules give us the behavior cited by technical analysts.

The VolumeTrend index line is a better surrogate price series, as it has been adjusted for rule 1. When investors chase price, they will only do so in the direction they perceive there to be a trend on their scale, and when they do, volume increases. The VolumeTrend line moves only when the volume on any of several scales is increasing (cases A and C below), with the net up or down price changes being applied to form the index. If volume decreases, the line stays flat and bars are colored gray. We have found that increasing volume with increasing price leads to significant upward trends, while increasing volume and decreasing price leads to significant downward trends. Sampling on multiple scales greatly improves this effect. Note that VolumeTrend may give clues to which way a Compression may go.



When price moves up or down, but VolumeTrend does not, a divergence sets up, indicating a retracement in a trend is occurring that will likely fail if it goes too far. We display a divergence signal once this condition reaches an extreme.

The picture below shows price and the corresponding volume trend graph. Note the retracements were not matched by swings in VolumeTrend.



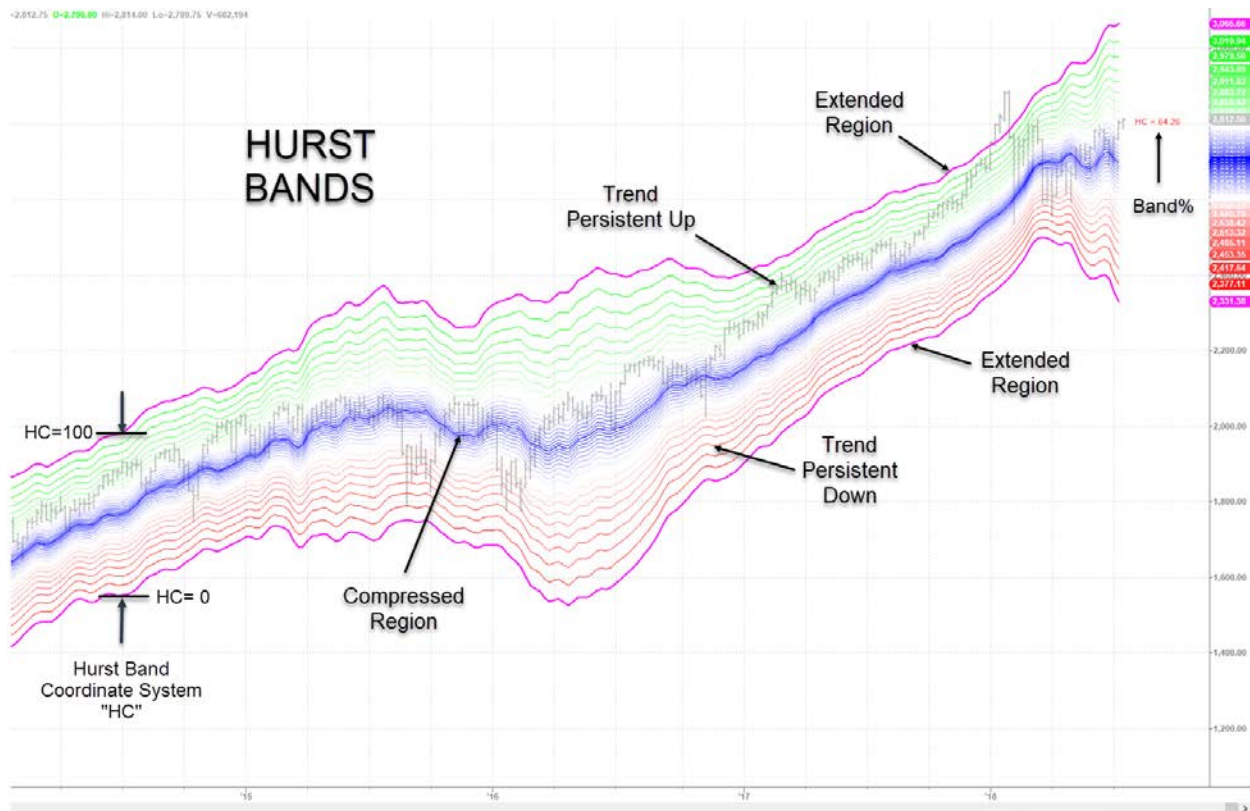
Performance Edge

Hurst Bands (included with PFEH)

We have designed a band system that actually means something. We draw bands at levels corresponding to Hurst Exponent levels at intervals of 0.05 from 0.05 to 0.95. Hurst is a simple way to judge the strength of short-term trend or tightness of trading range. When the reading gets above 0.95, an extension signal and reversal is likely, while compression signals are likely for small readings below 0.05. Strong trend persistent periods up or down occur roughly between 0.52 and 0.72.

Red or Green- expect trend to continue

Magenta – expect transition to sideways or retracement



ExtremeHurst Science

This section covers the basic science and the empirical results from our ExtremeHurst™ market predictor model. Our research started in the late 80's with the observation that market series appeared to have no unique trend. An uptrend on a 5 minute chart might be embedded in a daily scale downtrend, and a monthly scale up trend, etc. It also made intuitive sense that no unique trend exists. After all, if it did, then all investors would quickly exploit it for profit. So following this line of thought, we wondered what would happen next if a financial series simultaneously showed a measurably strong trend on at least two adjacent time scales, or even three. This is a deceptively simple question, but how is trend measured? How much trend is a strong trend? Are there preferred time scales? How much data is needed to evaluate trend? The answers to these questions led eventually to the discovery that elements of chaos theory, namely self-organized criticality [13, 30] and discrete scale invariance [25-27, 30] (discovered independently and named by Didier Sornette), have a statistically significant predictive power in financial markets and elsewhere. Here are the highlights of the journey.

Most scientists and engineers graduating in the 80's or earlier were trained that experimental data usually approximated some smooth function, but with a bit of random measurement error. To the untrained eye, stock price data looks very similar to a smoothly trending signal covered up by a large amount of random noise. Even the price returns appear to resemble a Gaussian distribution, which often implies a random process. The standard engineering approach in cases like this would be to fit a regression curve to the market series and write off the remainder to random noise [1]. Once a smooth curve was found that fit prices well enough, one would just find the slope ("trend") at each point. The trend would be unique by definition, and its direction would dictate the trade direction.

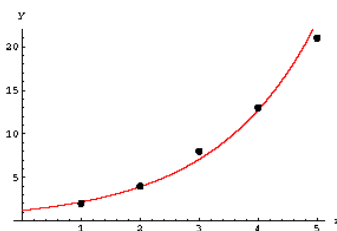


Figure 10. Typical regression curve fitted to data with the remainder attributed to random sources

If this sounds too simple to be true, you have graduated to the rest of the story.

Chaos theory covers the dynamics of feedback systems [3, 8, 12, 18, 22, 30, 31]. Generally, feedback means that the outputs of the system are fed back into the system as new inputs to produce more outputs....and then this process continues until the loop is broken. Feedback can be negative, like in the case of a thermostat, or positive, as seen by placing a microphone near a speaker. In the financial markets we can imagine that price movement, news, or possibly influential people produce investment bias “output” that is fed into the brains of the investor community, who then produce new outputs in the form of buy and sell decisions. If this bias is positive, buying occurs, which leads to higher prices and more positive bias, etc. Feedback systems exhibit certain characteristics, which strangely enough, seem to match the kinds of phenomena that market technical analysts have attributed to markets over the last 100 years. Self-similarity is the primary example.

Financial series appear to have the same “look” on many different time scales. This is called self-similarity, and it happens to be one of the best ways to confirm that a series is governed by the rules of chaos theory. Put another way, the market is what Mandelbrot [14] called a “fractal.” Not quite like a fern or a snowflake, but more of a statistical fractal like a shoreline. We chose a fractal function developed by Weierstrass to model a market series [8]. Weierstrass functions are continuous, meaning you can draw one without lifting your pencil, but they have no unique slope. They look like a cycle inside a cycle inside a cycle as shown in the next figure. Market technicians call this effect the “Elliot Wave”, but self-similarity has a much deeper theoretical meaning firmly based in non-linear dynamics.

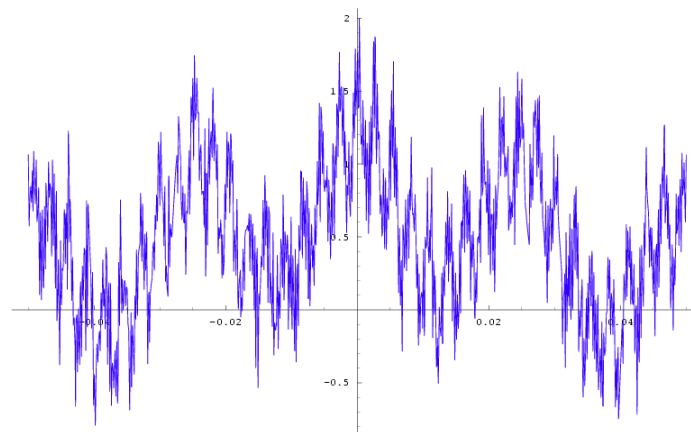


Figure 11. Weierstrass functions[8] show nested cycle patterns. It has no unique slope at any point.

Equation:

$$f(t) = \sum_{k=1}^{\infty} \lambda^{(s-2)k} \sin(\lambda^k t), \quad 1 < s < 2, \lambda > 1$$

According to our model, a 5 minute chart will exhibit a different slope at a given moment than the same

chart viewed on a 60 minute, daily, weekly, or monthly scale. It all depends on the length of your time sampling. Again, this is nothing new to traders, but it represents a radical shift for scientists and engineers. Faced with a non-unique trend, we decided to make multiple measures of trend on different scales. This naturally led to the research question of what might happen if they all agreed. To measure trend we used a special local form of the Hurst exponent [35]. The Hurst exponent has a simple formula and ranges in value between 0 and 1. Values above ½ indicate that there is a trend to events, with very high values (towards 1) corresponding to strong trends, with a marked tendency to persist. Values below ½ correspond to mean-reverting behavior, which becomes more and more tightly constrained as the exponent approaches 0. The formula for the exponent is:

$$\left(\frac{R}{S} \right)_N = (cN)^H$$

Where $(R/S)_N$ is the range of the cumulative deviations from the mean divided by the standard deviation, c is a constant and H is the Hurst exponent. The following picture shows the Hurst exponent placed on a percentile rank scale of our choosing. Note that Parallax uses a special band-limited Hurst.

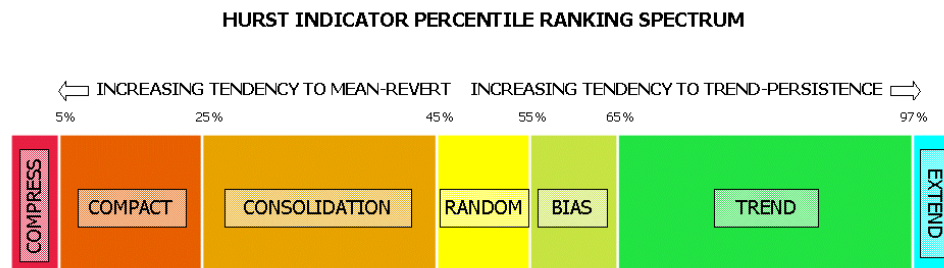
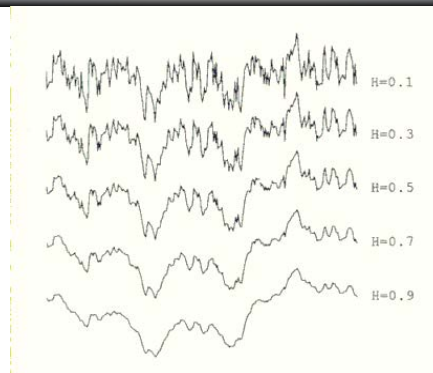
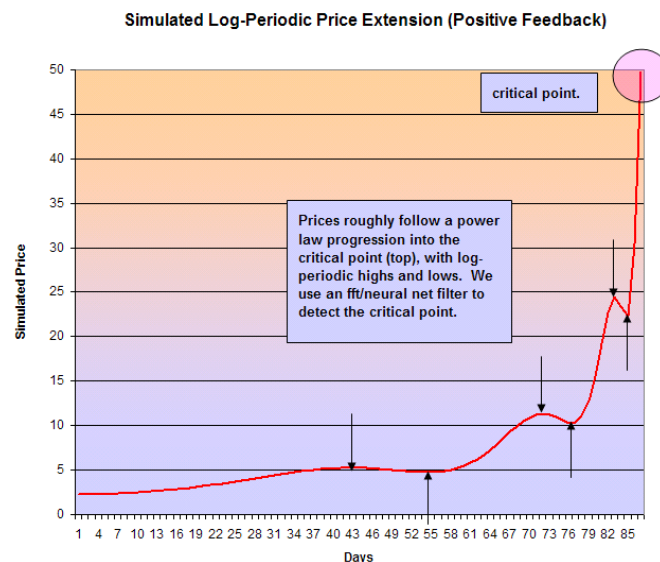


Figure 12. This shows the Hurst exponent percentiles and our interpretation of the various domains.

The following picture is an example of what a time series might look like using different Hurst exponents [34]:



Using the Hurst exponent, we are able to identify price swings which have high autocorrelation and resemble power law upswings or downswings such as the one shown in the following picture [30]:



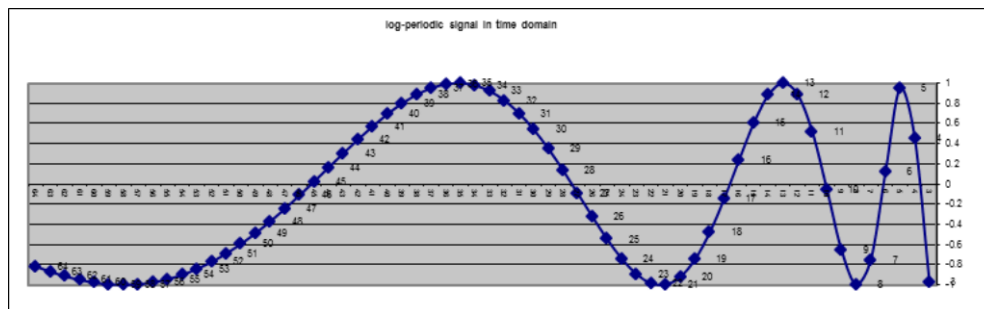
There was another key timing factor in addition to the parabolic price move which we literally stumbled upon while trying to limit our Hurst sampling look back periods. Cycles were present during these parabolic moves, and by exploiting them, we were better able to time the critical point. The next section discusses log periodic cycles and the science that ties it all together.

Extremes of investor behavior are most evident in large scale market manias or crashes, but like earthquakes, significantly more low magnitude events occur than large ones. It is our contention that markets set themselves up in critical states through feedback, like earthquakes, and then we see

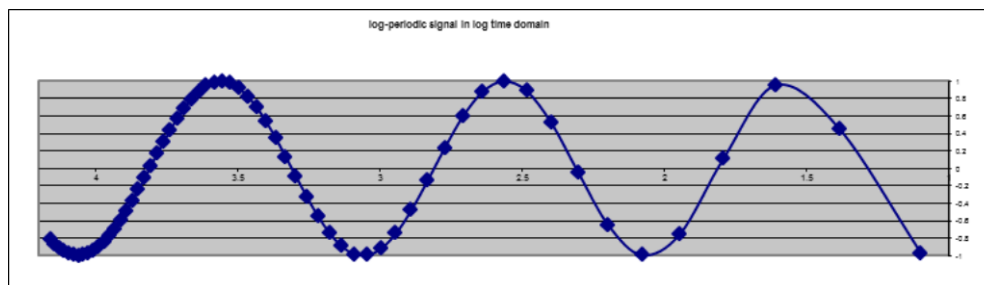
tremor-like activity of all sizes and scales at both highs and lows. This area of scientific research is called “Self-Organized Criticality” or SOC for short. Bak, Tang, and Weisenfeld (BTW) first introduced SOC in 1987 by studying the occurrences of avalanches in sand pile models. It was their contention that large systems with many constituent parts, organize themselves into states that resemble systems in equilibrium at critical points.

In the case of the markets, investors are influenced by news, price changes, and other investors within their local social network. This influence conditions their willingness to buy or sell, which in turn affects price and influences others, and so on. One of the methods used to understand the dynamics of large critical systems is called the Renormalization Group Method this method uses scaling to make sense of complex systems. We have applied this method to learn some basic principles about markets: First, it takes very few net buyers or sellers to trigger a buying or selling trend, or end one. Second, the buildup to a critical point resembles the power law function $C1 \cdot (1 - t/t_c)^x$, where $C1$ is a constant, x is a negative power, t is time, and t_c is the time of the critical point. Thirdly, there is often a log-periodic ripple in price that converges to the critical point that has the form: $1 + C2 \cdot \cos[p \cdot \ln(1 - t/t_c) + q]$, where $\ln(x)$ is the natural log function, $\cos(x)$ is the cosine function, and $C2$, p , and q are real constants[30].

In the time domain the small ripple signal we search for looks like this:



While in the log time domain it becomes a sine wave:



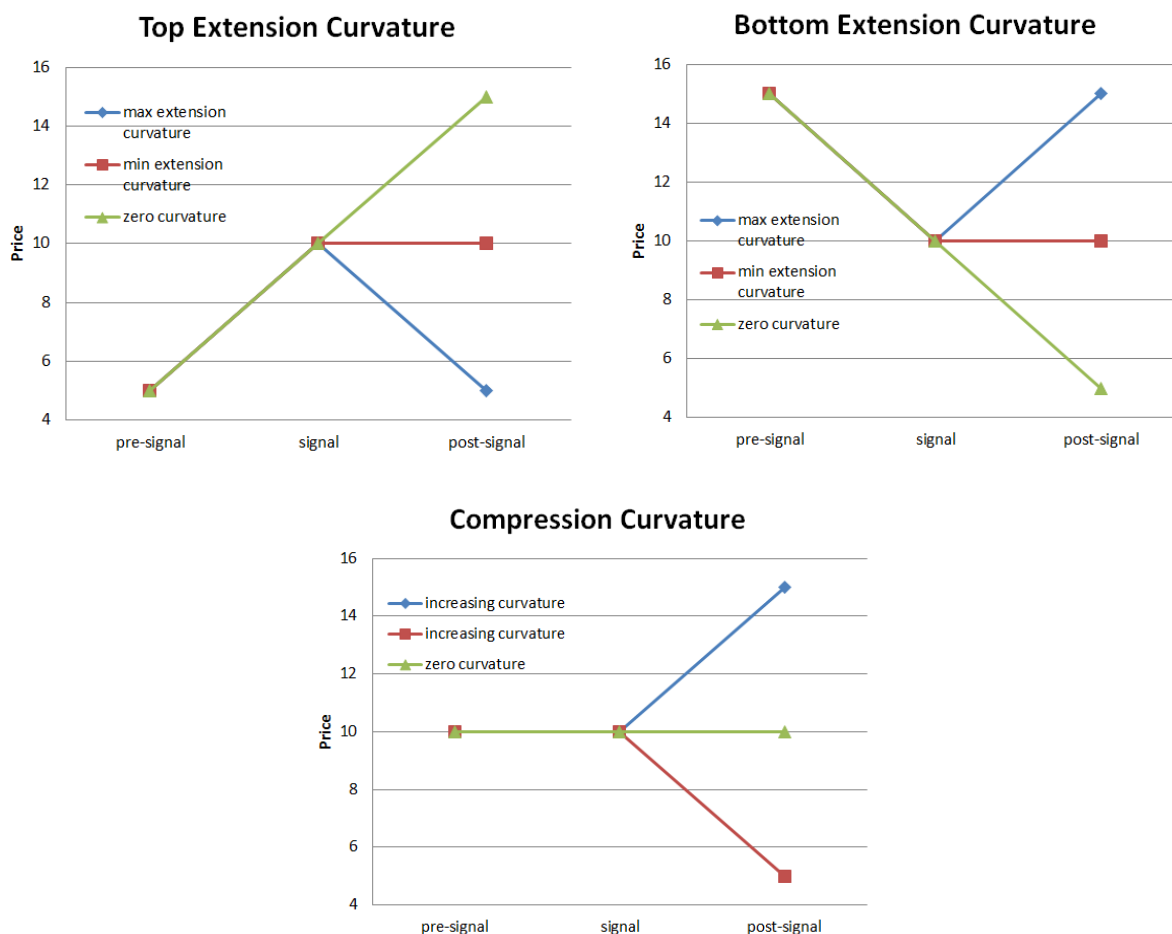
Sornette attributes this ripple to what he has called “discrete scale invariance” which means that the price series is only scale invariant at certain discrete times. He attributes this effect to fractal dimensions being complex numbers instead of real numbers. Translation: Discrete scale invariance

occurs when all trend measurements at all scales agree with each other. Our filter is designed to find these critical points.

The filter we have created finds these critical points at the end of power law advances and declines. These we call “extensions.” There is another critical point not yet written about in the literature that we call “compressions.” A compression has the same log periodic behavior shown above, but without the power law advance or decline. A compression occurs at points of extreme mean reversion, and is followed by the start of a new trend, usually with a volatile breakout.

Turn Measurement Index

ExtremeHurst signals predict market critical points which mark a change in trend, or in mathematical terms, increasing price curvature. There are three types of ExtremeHurst signals: Top and Bottom Extensions and Compressions. The predicted price behavior following a top extension is for price to cease moving up. Likewise, for bottom extensions we expect price to cease moving down. Compressions are preceded by flat periods, so the post-signal period must see price move away from current price and begin to trend:



These charts show the simulated periods before and after each of our signal types. The green lines show no trend change across the signal. We have created a tool to measure curvature called the Turn Measurement Index (TMI) which is an approximation to the second derivative of a series using the following differential formula from Calculus:

2nd Order Central

$$f''(x) \approx \frac{\delta_h^2[f](x)}{h^2} = \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}.$$

We have manipulated the formula to work with financial data on all scales using a “random walk” assumption. The final form looks like this (Taken from a Parallax research document):

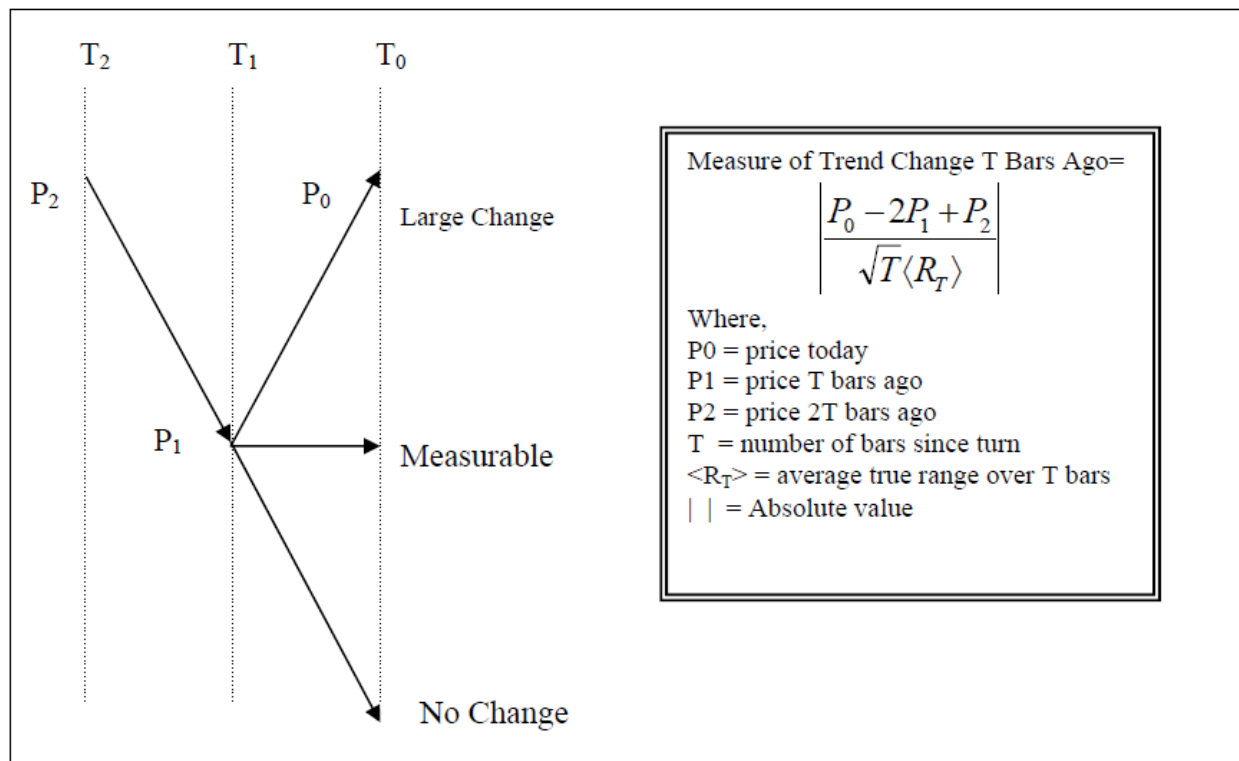


Figure 1. The Turn Measurement Index (“TMI”)

The graphic in Figure 1 illustrates how the **TMI** is calculated. When prices form a straight line, then the numerator goes to zero, meaning that there is no change in trend between the P2 to P1 segment, and the P1 to P0 segment. The $\langle R_T \rangle$ factor refers to the average true range over the whole period. Regular range is simply the change in price between today's high and low. The "true" range fills any gaps from the prior day. If yesterday's close is higher than the high today, then it is used in place of the high, likewise yesterday's close is used if it's lower than today's low. The length of time for this measurement can be varied, and different **TMI**s be compared with each other.

The next picture is an example of the TMI formula applied to Microsoft stock prices over lengths of 7 and 15 days:

TMI Calculation Example: Microsoft Price Series

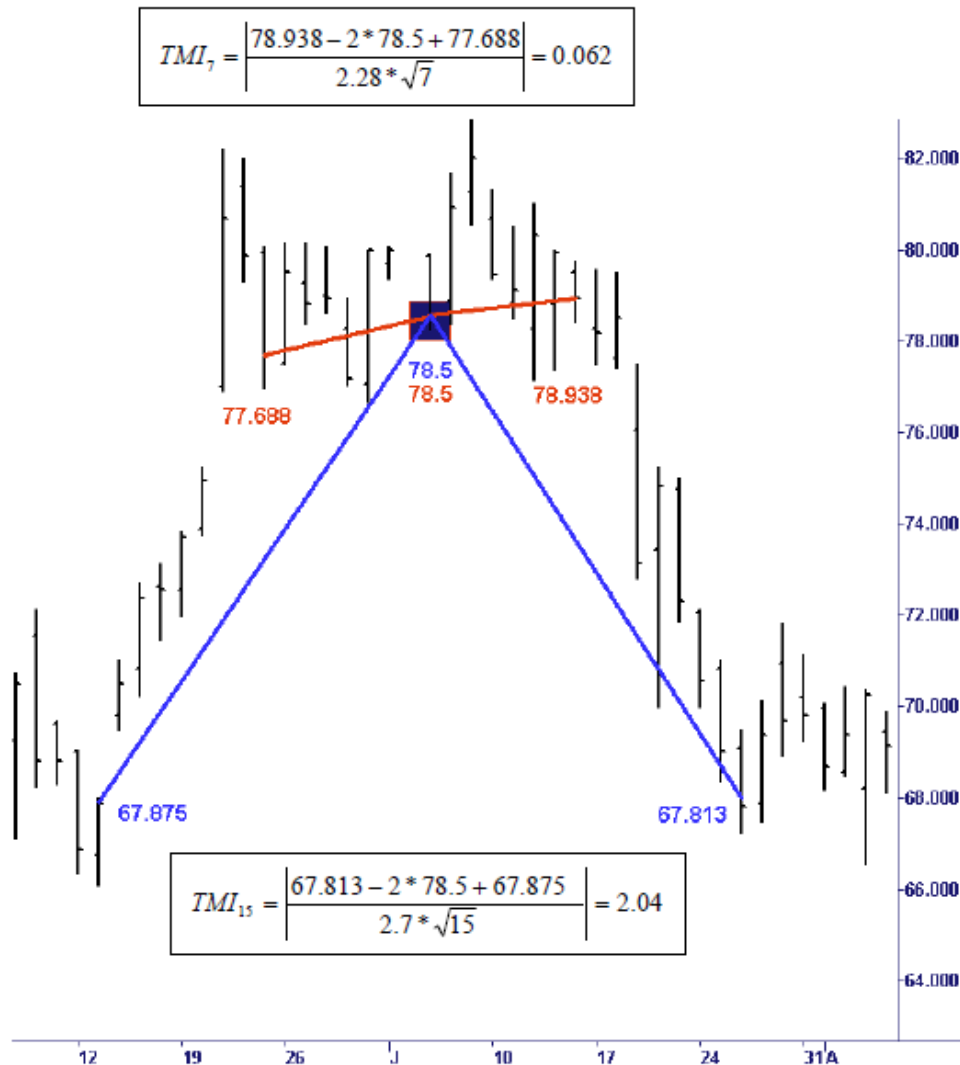


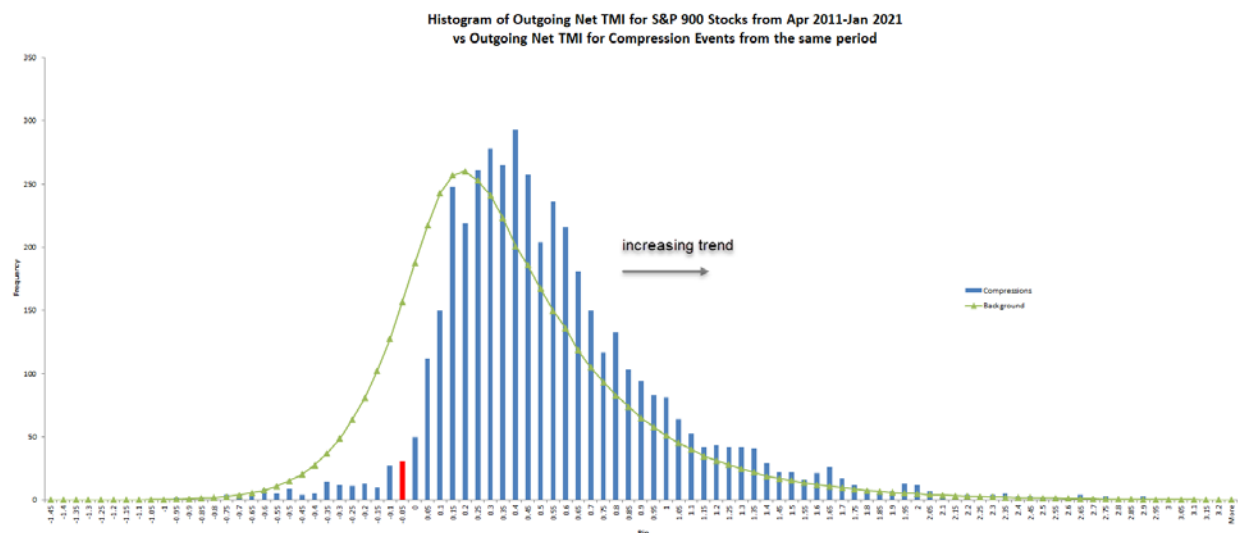
Figure 2. The TMI calculation for two different time intervals (7 and 15 days) surrounding the price of Microsoft stock on July 5, 2000 yields very different answers. We will use the maximum number to express “how much” trend-change occurred that day.

ExtremeHurst Testing Using the Turn Measurement Index (TMI)

Our ExtremeHurst product produces two signal types, Extensions, which mark the end of trends and the beginning of consolidations, and Compressions, that mark the end of consolidations and the beginning of new trends. In either case there is change in market price behavior. In order to better see the significance of that change we use the TMI indicator, which is a scale-independent measure of price curvature (absolute value of the 2nd derivative of price). To do these tests, we seek to measure the curvature contribution following a signal, both as an absolute number, and as a percentage of total curvature, and then compare these measures to a background of all bars (days in this case).

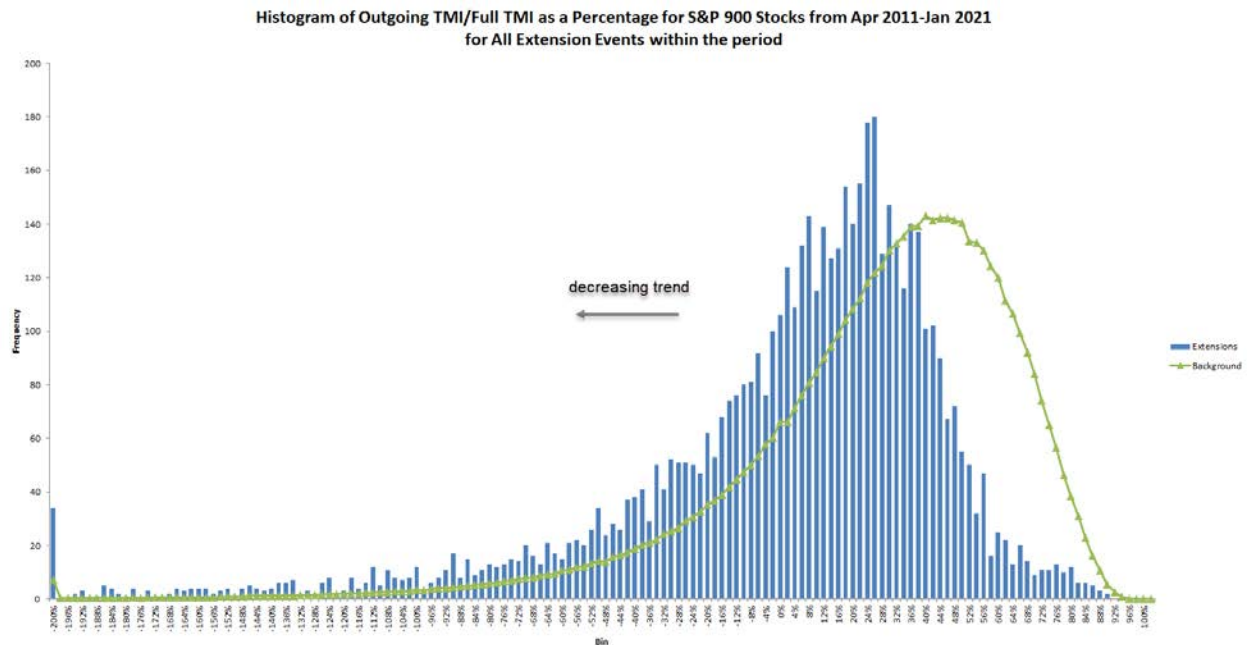
TMI numbers were calculated on daily scale S&P 900 (500 + 400) stocks from April 2011 through Jan 2021. ExtremeHurst events were generated using the latest distributed software on TradeStation with the default parameter settings (ranks \geq 95). Overall more than 25k signals were found to study.

In the case of Compression events, our contention is that absolute curvature significantly increases immediately following signal. The histogram below shows this to be true and significant compared to the background of all days:



The green line shows the background distribution normalized to our signal count, while the blue bars show the distribution of our signals. The bins represent the net curvature following the signal. A number greater than zero (red bar) indicates a net increase in curvature. Clearly a significant (Chi-squared $p < 1.27 \times 10^{-177}$) increase in trend follows the compression signal.

Testing Extensions is a bit harder using TMI, as they mark the end of a trend period and the beginning of a consolidation. During the consolidation, expanding log-periodic cycles will be present, and there should be a significant reduction in overall trend. We therefore examine the curvature following the signal as a percentage of the overall curvature using the (TMI outgoing/full TMI) ratio for both types of Extensions.



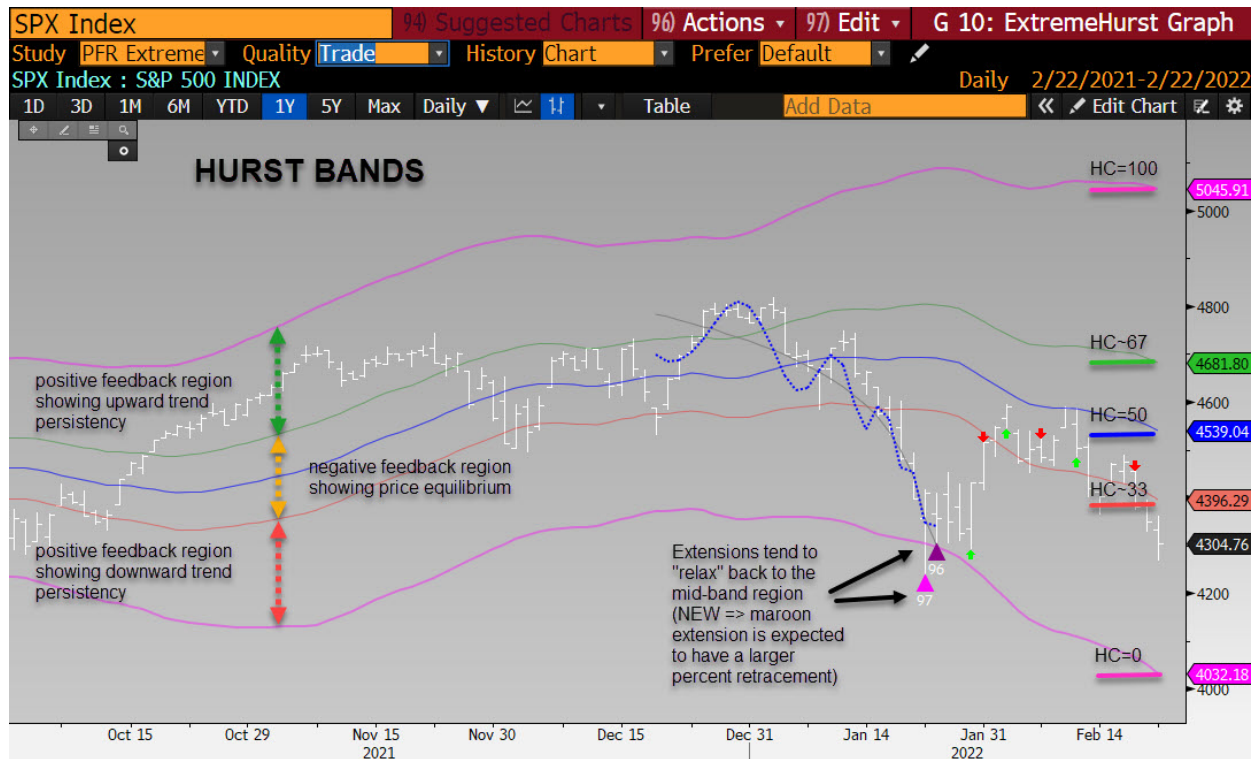
Clearly, the overall curvature is significantly reduced following an Extension signal as compared with the background expectation that peaks at half (green curve normalized by the total Extension signal count).

ExtremeHurst Extension “Excitation-Relaxation” Behavior

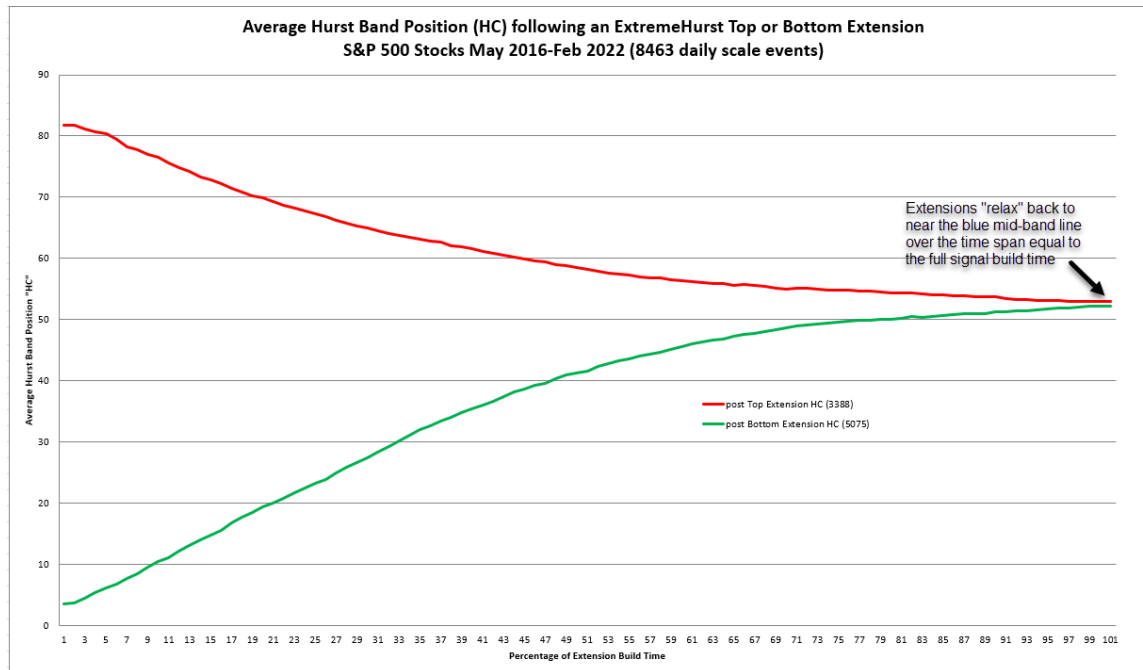
ExtremeHurst extension events occur because of extreme positive feedback on multiple scales with an associated converging log-periodic cycle. The associated investor excitement leads to what is called self-organized criticality (SOC), as the rapid price movement inadvertently leaves the security in a critical state where everyone who wanted to participate has already done so. It’s primed for a sudden reversal.

In psychology, there is a limit to how long humans can remain in an excited state before they need to relax. If we similarly identify extensions as excited states, then where does price have to go for us to say that the group is now “relaxed”?

The Hurst Bands provide an answer. The inner blue band region is the center of stability, where equilibrium is re-established. Using our Hurst Band coordinate system, where the magenta bands span 0 to 100, the mid-band blue line is at 50, the first green line at ~67, and the first red line at ~33, we found that following an extension, price tends to consistently move back to the mid-band over the build full time.



Signal Name	HC	Max Edge%	Initial Edge%	Duration	Peak%	Decay%
Upper Magenta Band	100	-6.84%	-1.84%	43 bars	40%	50%
Lower Magenta Band	0	4.41%	1.70%	37 bars	24%	50%

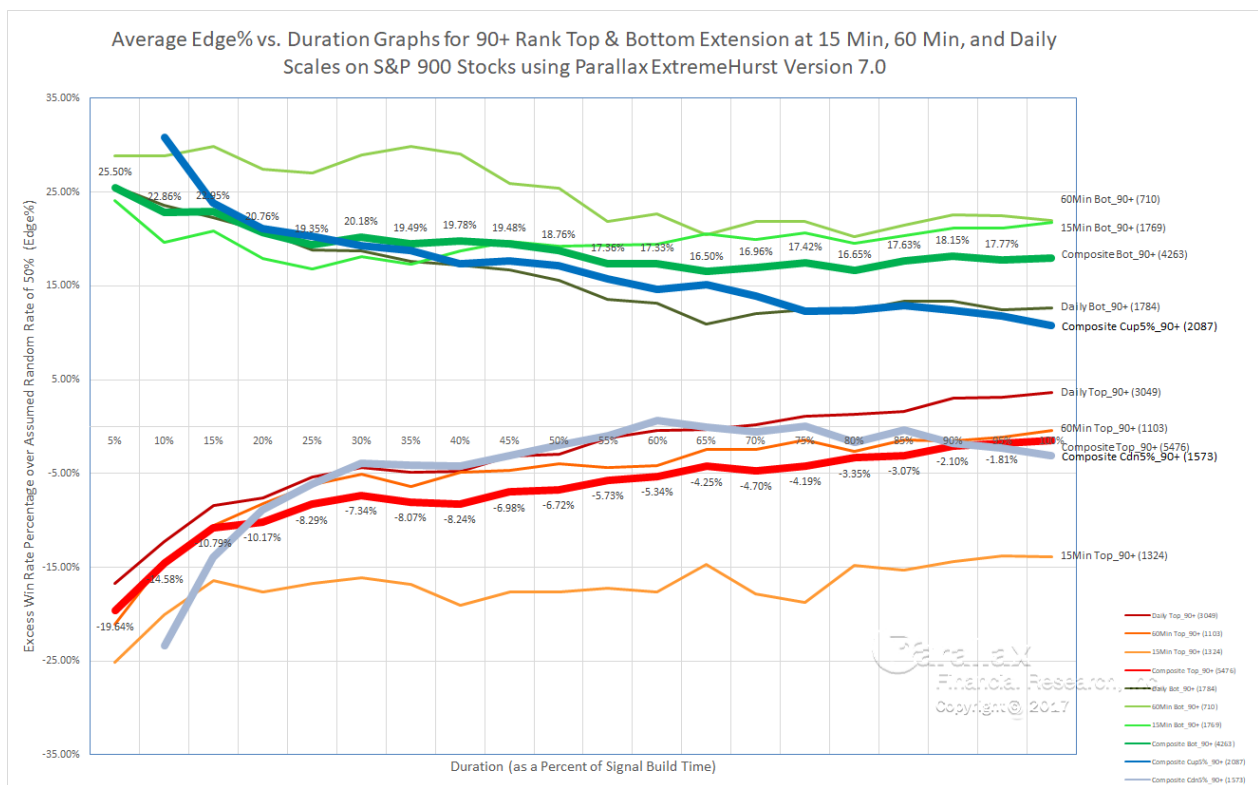


This is very important because the Hurst band lines may now be used for profit take targeting. In addition, we have also discovered that the mid-band's rate of change is a determining factor in selecting which extensions will be the most profitable

ExtremeHurst – Predictive Edge & Duration

There are three types of ExtremeHurst signals, top and bottom Extensions, and Compressions. Extensions mark the end of trends, while Compression mark the end of sideways, mean-reverting periods. Version 7.0 will be introduced in 2018 and represents the biggest performance gain yet. To recap, we measure the performance of our predictors by tracking whether the subsequent market prices were above or below the event by more than a random background drawn from the same time period and scale. We call that difference the “Edge%”.

Our time scale is often proportional to the time over which the signal is formed (“build-time”). That is the case with ExtremeHurst. The X-Axis below varies from 5% to 100% of the build-time. The edge usually diminishes as we move away from the event, where a timely signal has a maximum edge at or near the beginning. The Y-Axis is the edge, and to make them easier to read, sell signals will be shown with negative edges.



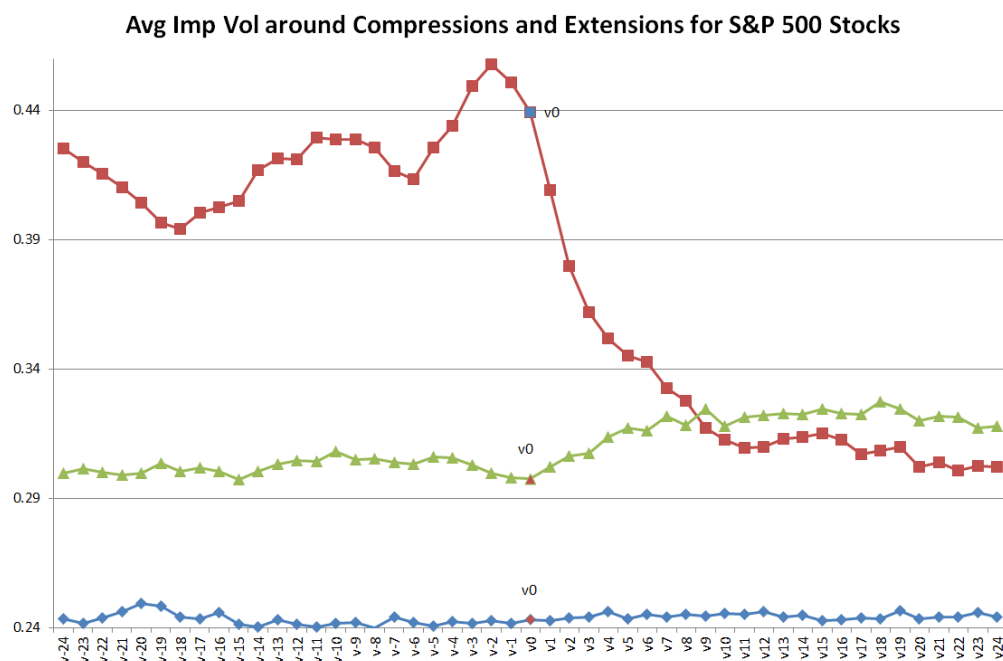
The edge results shown in the graph represent tests done on three different scales, 15 minute, 60 minute, and daily. A composite of all three is also shown with a thick line. The green lines are for bottom extensions, red for top extensions, and blue for compression long and short triggered trades (direction is established by market position relative to the compression midpoint at the 5% mark)

There are a few things to note about the results. First, we did not remove any background edge because 15 and 60 minute don't require this step. The dailies are going to be biased upward by about 1% per month (23 trading days). The average build-time was 54 days, so the daily edges should be adjusted downward using between 0% at the signal and 2.3% at the Duration=100% end.

It is interesting also that the 15min scale results were excellent. It should be mentioned that ExtremeHurst should work better if the bar interval divides evenly into the day. Then each bar is "filled" with trading activity.

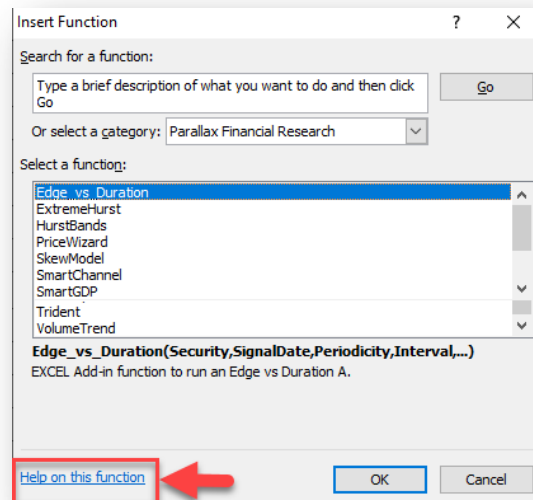
The overall results are phenomenal, with edges beyond 20%, long durations, and scalability. Most quantitative signals show edges well below 10%, have short durations, and can be quite unstable across timeframes. This further supports the hypothesis that ExtremeHurst is measuring a real crowd feedback effect in markets. We think it is likely at the very core of what market practitioners have referred to as Technical Analysis.

The next plot shows average implied volatility (from options) before and after the three signal types. The red line is due to extension bottoms, and shows that volatility drops 32% following a bottom signal. The green line is the average volatility before and after a top extension. In this case we see a 10% increase after a top. There is no change at all in volatility around a compression signal, and volatility is also relatively low.




EXCEL Add-In APPS PFEX <Go>


In order to help our EXCEL users simultaneously examine many symbols at once, we have created an EXCEL Add-in with our best tools...including a few new ones:



The tools come with an extensive help file that can be accessed using the button marked in red above:



Parallax
Financial Research, Inc.



ParallaxLibrary
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 Github

PriceWizard function

Description

EXCEL Add-in function to run Price Wizard™ from Parallax Financial Research, Inc. Price Wizard™ is our worldwide multi-factor equity-pricing model that uses pre-trained sector neural networks to convert corporate fundamentals into an estimated market price. This product has been used by money managers since 1991. Traditional factors such as earnings, book value, debt, margins, cash flow, industry classification, and dividends were used to train our network. No analyst estimates or price derivatives such as momentum were used. Price residuals are predictive. We have found that residual difference between our estimated price and market prices are predictive of average future price trends as to twelve months in the future. We support that claim by exceptional performance compared to conventional discounted cash flow models. Price Wizard price estimates lead to improved stock screening, aggregate sector and industry estimates, asset class estimates, and overall better risk management.

Syntax

```
PriceWizard(Security, MostRecentDate, LeastRecentDate, Periodicity, ExpirationPeriodicity, HedgeDays, UseGrossEdge, OutputLocation)
```

Arguments

Name	Type	Description
Security	text string	The full Bloomberg security name (e.g., "BM US Equity" or "SPX Index").
MostRecentDate	date/time	The start or most recent date to process...blank means today
LeastRecentDate	date/time	The end date...blank means today
Periodicity	text string	The periodicity as "QUARTERLY", "MONTHLY", "WEEKLY", "DAILY"...blank means MONTHLY
ExpirationPeriodicity	text string	Expiration date periodicity for option trading (Default="MONTHLY" or "WEEKLY")
HedgeDays	integral number (int)	Minimum days to Expiration for option trading (default=7)
UseGrossEdge	true/false	true if the edge calculation includes the stock market background (default is true)
OutputLocation	text string	(optional) The cell to which the output will be directed.

Returns

Price Wizard Valuation outputs include the valuation, %change difference for price to reach value, valuation HurstExponent (good to measure persistency), and the valuation growth rate.

(Output 1) Security Symbol on Bloomberg
 (Output 2) Run Date
 (Output 3) Run Time
 (Output 4) Market Capitalization
 (Output 5) Company Name
 (Output 6) Company Sector
 (Output 7) Company Industry
 (Output 8) Last Market Price
 (Output 9) Estimated Price
 (Output 10) +/- Pricing Error (1 standard deviation)
 (Output 11) % Change needed for market price to reach our valuation
 (Output 12) Valuation growth rate over last 3 years using linear regression fit
 (Output 13) Valuation series Hurst exponent - used to judge whether valuations are trend persistent
 (Output 14) Overall valuation attractiveness from 0 to 100
 (Output 15) Target date in the future to evaluate the predictive edge
 (Output 16) Predictive edge remaining at some future date

One of the great things clients can do now is check ExtremeHurst on multiple scales:

Security= <div>SPY US EQUITY</div> Within Past <div>100</div> Bars										ExtremeHurst™ Multiscale Signals								
Scale	Interval	Security	Run Date	Run Time (UTC)	Periodicity	Interval (min)	Last Price	Signal Type	Signal Date	Signal Rank	Signal Edge%	Signal Duration	Expected Max Gain%	+/- Std Deviation%	Target Date	Edge% at Target	Duration at Target	
MONTHLY	1	SPY US EQUITY	9/23/2019	12:00 AM	MONTHLY	1	\$ 298.21	Top Extension	01/23/2018 00:00	90	-19.64%	112.00	-6.95%	-28.59%	10/4/2019	-17.52%	85.56%	
WEEKLY	1	SPY US EQUITY	9/23/2019	12:00 AM	WEEKLY	1	\$ 298.21	Top Extension	01/29/2018 00:00	96	-19.64%	24.00	-1.57%	-6.62%	10/4/2019	-0.04%	0.00%	
DAILY	1	SPY US EQUITY	9/23/2019	12:00 AM	DAILY	1	\$ 298.21	Compression	08/30/2019 00:00	98	18.96%	32.30	0.83%	5.77%	10/4/2019	15.27%	44.27%	
MINUTE	240	SPY US EQUITY	9/23/2019	5:30 PM	MINUTE	240	\$ 298.63	Bottom Extension	08/05/2019 13:30	90	25.50%	26.00	0.50%	2.16%	10/4/2019	5.83%	0.00%	
MINUTE	120	SPY US EQUITY	9/23/2019	5:30 PM				No Signal										
MINUTE	60	SPY US EQUITY	9/23/2019	6:30 PM	MINUTE	60	\$ 298.63	Top Extension	09/05/2019 17:30	98	-19.64%	47.00	-0.17%	-0.86%	10/4/2019	-0.04%	0.00%	
MINUTE	30	SPY US EQUITY	9/23/2019	6:30 PM	MINUTE	30	\$ 298.63	Bottom Extension	09/20/2019 17:30	98	25.50%	24.00	0.19%	0.59%	10/4/2019	5.83%	0.00%	
MINUTE	20	SPY US EQUITY	9/23/2019	6:30 PM	MINUTE	20	\$ 298.63	Bottom Extension	09/20/2019 17:10	96	25.50%	24.00	0.17%	0.64%	10/4/2019	5.83%	0.00%	
MINUTE	15	SPY US EQUITY	9/23/2019	6:45 PM	MINUTE	15	\$ 298.63	Bottom Extension	09/20/2019 17:45	98	25.50%	24.00	0.11%	0.45%	10/4/2019	5.83%	0.00%	
MINUTE	10	SPY US EQUITY	9/23/2019	6:40 PM	MINUTE	10	\$ 298.63	Bottom Extension	09/20/2019 17:20	93	25.50%	40.00	0.08%	0.54%	10/4/2019	5.83%	0.00%	
MINUTE	5	SPY US EQUITY	9/23/2019	6:45 PM	MINUTE	5	\$ 298.63	Bottom Extension	09/20/2019 17:30	95	25.50%	26.00	0.03%	0.11%	10/4/2019	5.83%	0.00%	

We also have a separate Add-in (<https://www.pfr.com/products/moreproducts.htm>) available on our website that enables users to send emails/text messages from a spreadsheet. Users can also get a list of historical signals:

ExtremeHurst™ History

Symbol=	SPY US EQUITY							
Scale=	MINUTE							
Interval=	15							
From Date=	7/1/2019							
To Date=	9/23/2019							
Security	Run Date	Run Time (UTC)	Periodicity	Interval(min)	Last Price	Signal Type	Signal Date	Signal Rank
SPY US EQUITY	9/12/2019	1:30 PM	MINUTE	15	\$ 300.87	Top Extension	09/12/2019 13:30	95
SPY US EQUITY	9/5/2019	2:30 PM	MINUTE	15	\$ 298.33	Top Extension	09/05/2019 14:30	97
SPY US EQUITY	8/20/2019	2:00 PM	MINUTE	15	\$ 291.12	Bottom Extension	08/20/2019 14:00	95
SPY US EQUITY	8/8/2019	3:45 PM	MINUTE	15	\$ 292.14	Top Extension	08/08/2019 15:45	96
SPY US EQUITY	8/1/2019	6:00 PM	MINUTE	15	\$ 295.99	Bottom Extension	08/01/2019 18:00	97
SPY US EQUITY	7/31/2019	7:45 PM	MINUTE	15	\$ 297.23	Bottom Extension	07/31/2019 19:45	96
SPY US EQUITY	7/31/2019	7:00 PM	MINUTE	15	\$ 298.24	Bottom Extension	07/31/2019 19:00	95
SPY US EQUITY	7/31/2019	6:45 PM	MINUTE	15	\$ 297.52	Bottom Extension	07/31/2019 18:45	99
SPY US EQUITY	7/29/2019	7:30 PM	MINUTE	15	\$ 301.67	Compression	07/29/2019 19:30	98
SPY US EQUITY	7/24/2019	7:30 PM	MINUTE	15	\$ 301.24	Top Extension	07/24/2019 19:30	97
SPY US EQUITY	7/17/2019	2:45 PM	MINUTE	15	\$ 298.70	Bottom Extension	07/17/2019 14:45	95
SPY US EQUITY	7/16/2019	4:15 PM	MINUTE	15	\$ 299.77	Bottom Extension	07/16/2019 16:15	95
SPY US EQUITY	7/10/2019	2:15 PM	MINUTE	15	\$ 298.66	Top Extension	07/10/2019 14:15	97
SPY US EQUITY	7/10/2019	2:00 PM	MINUTE	15	\$ 299.09	Top Extension	07/10/2019 14:00	98
SPY US EQUITY	7/3/2019	3:30 PM	MINUTE	15	\$ 298.21	Top Extension	07/03/2019 15:30	97
SPY US EQUITY	7/3/2019	3:00 PM	MINUTE	15	\$ 297.77	Top Extension	07/03/2019 15:00	97
SPY US EQUITY	7/3/2019	2:45 PM	MINUTE	15	\$ 297.92	Top Extension	07/03/2019 14:45	96
SPY US EQUITY	7/1/2019	2:15 PM	MINUTE	15	\$ 295.72	Top Extension	07/01/2019 14:15	96
SPY US EQUITY	7/1/2019	2:15 PM	MINUTE	15	\$ 295.72	Top Extension	07/01/2019 14:15	96

Our EXCEL tools are only available to existing clients of our Bloomberg applications. Just type APPS PFEX <go> and Run for a trial.

Edge_vs_Duration function

Description

EXCEL Add-in function to run an Edge vs Duration Analysis from Parallax Financial Research, Inc. Edge is determined by taking half the average of wins (+1) and losses (-1) over each bar for many repetitions of the same signal type. Duration is the number of bars it takes for the edge to return to near zero

Syntax

Edge_vs_Duration (Security, SignalDate, Periodicity, Interval, EstDurationBars, SignalBasis, EdgeSamplingInterval[, OutputLocation])

Arguments

Name	Type	Description
Security	text string	The full Bloomberg security name (e.g., "IBM US Equity" or "SPX Index").
SignalDate	date/time	The exact date and time of the signal to process
Periodicity	text string	The periodicity as "YEARLY", "QUARTERLY", "MONTHLY", "WEEKLY", "DAILY", or "MINUTE" for intraday
Interval	integral number (int)	The intraday minute bar interval (240, 120, 60, 30, 20, 15, 10, 5, 3, 2, 1).
EstDurationBars	integral number (int)	The estimated maximum number of bars corresponding to 100% of signal duration.
SignalBasis	text string	The price to use as the basis for the signal "HIGH", "LOW", "MIDPOINT", or "CLOSE", default="CLOSE".
EdgeSamplingInterval	integral number (int)	The number of edge samples to generate
OutputLocation	text string	(optional) The cell to which the output will be directed.

Returns

The Edge vs Duration modeling tool returns a series of +/-1's representing being above or below the starting price. To develop an edge chart, apply this tool to many examples of the same signal type, and then take half the average of each column. The edge% for each row is also computed and returned as the last output.

(Output 1) Security Symbol on Bloomberg

(Output 2) Series of +1, -1, or blanks representing if the market was above (=1), below (-1), or equal (blank) to the signal price

(Output 3) Cumulative Edge% for that particular signal event. To get the edge for any generic signal, run hundreds of signal examples on subsequent rows, and then at the bottom of each column, calculate the column average divided by 2. This is the average edge at each bar following the signal. We are looking for stable edges above 5% to confirm a signal that is likely to yield significant returns.

ExtremeHurst function

Description

Add-in EXCEL function to run ExtremeHurst(tm) from Parallax Financial Research, Inc ExtremeHurst is a quantitative detector of extreme investor behavior that signals the beginnings or ends of a trends. Signals persist for about as long as it takes to build the signal. This Excel add-in enables the user to find the most recent signal on any time scale and on any security. Strong trend-persistent stock price movements are evidence of positive feedback (i.e., investors buying because the price is rising, driving prices higher), while extremes of mean reversion are evidence of negative feedback. Extremes of both trend persistency and mean reversion are quantified via multiple measurements of the Hurst exponent. Signals are fully characterized by the presence of discrete scale invariance (DSI), accelerating price (PL), log-periodic cycles (LP), and volume anomalies.

Syntax

ExtremeHurst (Security, MostRecentDate, LeastRecentDate, Periodicity, Interval, History, Quality, Preferences, ExpirationPeriodicity, MinExpDays, FillWithHeaders, OnlyShowSignals, SpreadSecurity[, OutputLocation])

Arguments

Name	Type	Description
Security	text string	The full Bloomberg security name (e.g., "IBM US Equity" or "SPX Index").
MostRecentDate	date/time	The start or most recent date to process...blank means today
LeastRecentDate	date/time	The end or least recent date to process...blank means today
Periodicity	text string	The periodicity as "YEARLY", "QUARTERLY", "MONTHLY", "WEEKLY", "DAILY", "MINUTE"
Interval	integral number (int)	For intraday data, this is the bar interval in minutes (240, 120, 60, 30, 20, 15, 10, 5, 3, 2, 1).
History	integral number (int)	If History is greater than 0, it is the number of bars back to the first search date - The program uses this number if LeastRecentDate is blank (default is 1 bar). If History is less than zero, then the most recent signal within the specified range (where History is used for range setting) is displayed on only a single line
Quality	integral number (int)	The minimum rank to accept (0=99+, 1=95+, 2=90+, 3=80+, 4=70+, and 5=0+(any)).

Preferences	integral number (int)	Signal search preferences (0=Recommended, 1=More).
ExpirationPeriodicity	text string	Expiration date periodicity to set an option date for option trading (default="MONTHLY" or "WEEKLY")
MinExpDays	integral number (int)	Minimum days to Expiration to set a target date for option trading (default=7)
FillWithHeaders	true/false	Set this to true if you want to label non-signalling rows with the column headers, (default is false)
OnlyShowSignals	true/false	Set to true if you wish to just list the dates that had fresh new signals (default is false)
SpreadSecurity	text string	Optional ratio spread denominator security name such as "SPX INDEX". Default is blank
OutputLocation	text string	(optional) The cell to which the output will be directed.

Returns

ExtremeHurst Signal Key: Compressions mark the end of a sideways mean-reverting period and the onset of a trend period Extensions mark the end of a trend period and the onset of an unstable retracement or sideways period Signal edge and duration describe the probability of success (above random) and time frame Signal rank determines the quality, where ≥ 90 is considered superior Three future log-periodic peaks and troughs are also listed

- (Output 1) Security Symbol on Bloomberg
- (Output 2) Run Date
- (Output 3) Run Time
- (Output 4) Run Price
- (Output 5) Periodicity
- (Output 6) Time Interval in minutes if intraday (Periodicity="MINUTE")
- (Output 7) Signal Type
- (Output 8) Signal Date
- (Output 9) Signal Price
- (Output 10) Signal Rank
- (Output 11) Signal Edge% (1% edge means the win rate is 51%)
- (Output 12) Signal Duration in bars
- (Output 13) Max Expected Gain%
- (Output 14) Standard Deviation around the Max Expected Gain
- (Output 15) Target Date to evaluate the remaining signal edge
- (Output 16) Remaining Edge% at Target Date
- (Output 17) Remaining Duration at Target Date in bars
- (Output 18,19, and 20) Date of next 3 Log-periodic Price Cycles
- (Output 21,22, and 23) Expected LP Cycle - H for a Price High, or L for a Price Low
- (Output 24,25, and 26) Expected Max LP Cycle Price %Change

HurstBands function

Description

EXCEL Add-in function to run Hurst Bands(tm) from Parallax Financial Research, Inc. The Hurst exponent approximation we use indicates whether price is experiencing trend persistent (red or green), mean-reverting (blue), or random (white) movement. The area beyond the magenta bands is often where ExtremeHurst extensions occur, indicating an impending reversal.

Syntax

HurstBands(Security, Periodicity, Interval, MostRecentDate, LeastRecentDate, ExpirationPeriodicity, MinExpDays, SpreadSecurity[, OutputLocation])

Arguments

Name	Type	Description
Security	text string	The full Bloomberg security name (e.g., "IBM US Equity" or "SPX Index").
Periodicity	text string	The periodicity as "YEARLY", "QUARTERLY", "MONTHLY", "WEEKLY", "DAILY", "MINUTE"
Interval	integral number (int)	For intraday data, this is the bar interval in minutes (240, 120, 60, 30, 20, 15, 10, 5, 3, 2, 1).
MostRecentDate	date/time	The most recent date to process in double quotes (e.g., "1/23/2021")...blank means today
LeastRecentDate	date/time	The end date...blank means today
ExpirationPeriodicity	text string	Option Expiration date periodicity to set a target date for edge evaluation. (default="MONTHLY", "WEEKLY", "HISTORICAL_MONTHLY", or "HISTORICAL_WEEKLY")
MinExpDays	integral number (int)	Minimum days to Option Expiration (default=0)
SpreadSecurity	text string	Optional ratio spread denominator security name such as "SPX INDEX". Default is blank
TargetDateOverride	date/time	Alternate target date to evaluate remaining signal edge and duration
UseSyntheticPrices	true/false	Set to true if synthetic weeks or months are allowed (default is false)
OutputLocation	text string	(optional) The cell to which the output will be directed.

Returns

(Output 1) Security Symbol on Bloomberg

(Output 2) Run Date

(Output 3) Run Time

(Output 4) Price

(Output 5) Hurst Exponent

(Output 6) Hurst Coordinate - This is a convenient measure of where price is within the bands. HC=0 on the lower band and HC=100 on the upper band

(Output 7) Signal Edge% (0.01=1% edge means the expected win rate is 51%)

(Output 8) Signal Duration (The number of bars until the signal edge is zero)

(Output 9) Target Date to evaluate the remaining signal edge

(Output 10) Remaining Edge% at Target Date

(Output 11) Remaining Duration at Target Date in bars

(Output 12) Price at the low band line

(Output 13) Price at the downtrend band line

(Output 14) Price at the mid band line

(Output 15) Price at the uptrend band line

(Output 16) Price at the high band line

PrecisionTurn function

Description

EXCEL Add-in function to run the Precision Turn cycle analysis from Parallax Financial Research, Inc. The function only works with daily scale price data and produces a list of future expected market trend change dates based on the quasi-periodic oscillator model from Chaos Theory

Syntax

```
PrecisionTurn(Security, Scale, NextTurnOnly[, OutputLocation])
```

Arguments

Name	Type	Description
Security	text string	The full Bloomberg security name (e.g., "IBM US Equity" or "SPX Index").
Scale	text string	The bar scale. Only "INTRADAY", "DAILY" or "WEEKLY" accepted, (Default is DAILY).
NextTurnOnly	true/false	To just list the next turn date only, set to true. If false, all dates will be listed.
OutputLocation	text string	(optional) The cell to which the output will be directed.

Returns

The Precision Turn tool returns the date of projected and past cycle dates with their ranks

(Output 1) Security Symbol on Bloomberg

(Output 2) Run Date

(Output 3) Run Time

(Output 4) Scale

(Output 5) Forecast Cycle Date

(Output 6) Forecast Local Cycle Rank (Local Ranks is produced by rescaling the global ranks found during the forecast period)

(Output 7) Forecast Global Cycle Rank (Global Ranks are based on all training data)

Performance:

Signal Name	Rank	Max Edge%	Initial Edge%	Duration	Peak%	Decay%
Single Turn at Low	90	3%	0%	10 bars	30%	50%
Single Turn at High	90	-1.5%	0%	10 bars	30%	50%
Cluster Turns at Low	90	12%	0%	9 bars	22%	50%
Cluster Turns at High	90	-4%	0%	9 bars	22%	50%

RSIz function

Description

EXCEL Add-in function to run RSIz™ from Parallax Financial Research, Inc. This version of relative strength simply counts the number of up and down bars within the most recent N bars and performs a simple statistical test on the result. It assumes that up and down bars have equal probabilities of occurrence. A reading above $z=+/-2$ (std. deviations) indicate a statistically significant deviation from random has occurred

Syntax

```
RSIz(Security, Periodicity, Interval, MostRecentDate, LeastRecentDate, SampleLength, SignalRate, UseSyntheticPrices[, OutputLocation])
```

Arguments

Name	Type	Description
Security	text string	The full Bloomberg security name (e.g., "IBM US Equity" or "SPX Index").
Periodicity	text string	The periodicity as "YEARLY", "QUARTERLY", "MONTHLY", "WEEKLY", "DAILY", "MINUTE"
Interval	integral number (int)	For intraday data, this is the bar interval in minutes (240, 120, 60, 30, 20, 15, 10, 5, 3, 2, 1).
MostRecentDate	date/time	The most recent date to process in double quotes (e.g., "1/23/2021")...blank means today
LeastRecentDate	date/time	The end date...blank means today
SampleLength	integral number (int)	The sample length for analysis, default=14 if blank
SignalRate	floating point number (double)	The probability of seeing a signal in percent, default is 3% if blank, entered as 0.03
UseSyntheticPrices	true/false	Set to true if synthetic weeks or months are allowed (default is false)
OutputLocation	text string	(optional) The cell to which the output will be directed.

Returns

VolumeTrend output data:

- (Output 1) Security Symbol on Bloomberg
- (Output 2) Run Date
- (Output 3) Run Time
- (Output 4) Periodicity
- (Output 5) Time Interval in minutes if intraday (Periodicity="MINUTE")
- (Output 6) Sample Length
- (Output 7) Signal Rate%
- (Output 8) Last Price
- (Output 9) RSIz
- (Output 10) Signal
- (Output 11) Signal Edge
- (Output 12) Signal Duration (The number of bars until the signal edge is zero)
- (Output 13) Target Date to evaluate the remaining signal edge
- (Output 14) Remaining Edge% at Target Date
- (Output 15) Remaining Duration at Target Date in bars

ExtremeHurst Users

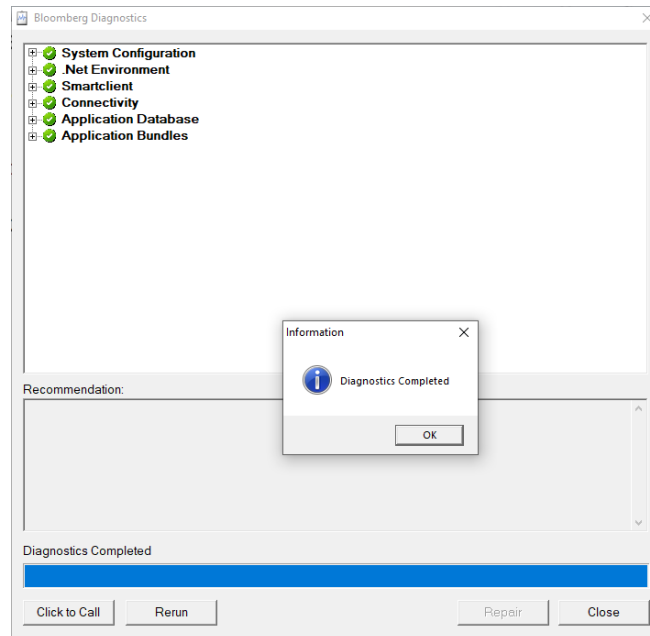
Several money managers are using or have used the ExtremeHurst product as a part of their management business and have consented to be listed as references for potential users:

1. **BILLY BRANDENBERGER**
RBC
EMAIL: Billy.brandenberger@rbc.com
2. **JEAN-PAUL LAGARDE**
FAUBOURG
EMAIL: jp@fpwa.com
3. **TONY GALLEA**
MORGAN STANLEY
EMAIL: Anthony.M.Gallea@morganstanley.com
4. **MARK ASTLEY**
MILLENNIUM GLOBAL INVESTMENTS LTD.
EMAIL: mastley@millenniumglobal.com
5. **RAJPAL ARULPRAGASAM**
ARCHETYPE RISK ADVISORS, INC.
EMAIL: rajpal@ARAPortfolio.com

Bloomberg Terminal Settings

MAKE SURE ALL OF YOUR WINDOWS UPDATES ARE INSTALLED ! (Start->Settings->Windows Update)
MAKE SURE ALL OF YOUR DEVICEDRIVERS ARE CURRENT ! (I recommend lobit's "Driver Booster")
Bloomberg terminals need to be configured correctly for our software. To check that your terminal is ready:

1. Type DNET DIAG <go> and you should see all green:



If yours is not all green, either use the Repair button if available or type Help Help to get the Bloomberg help desk

2. Type UPGR <go> and you should see all green here too:

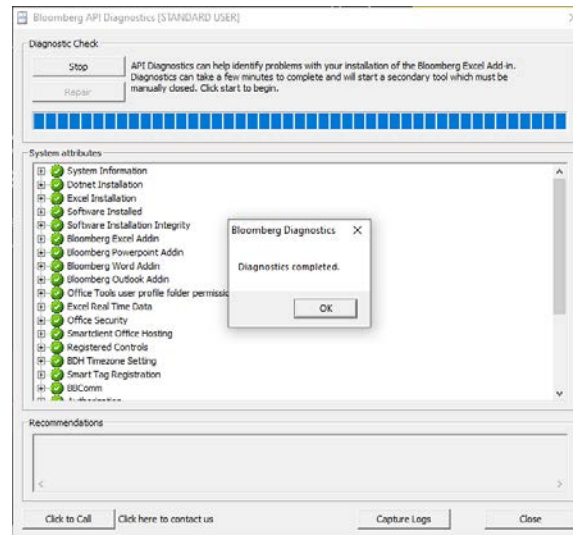
The screenshot shows the Bloomberg UPGR screen. At the top, it says 'Click on row below for more information' and '99 Refresh'. Below this, it displays 'UUID 8751979 S KRIS KAUFMAN'. A table follows with the following data:

Software Component	Current Version	Rated Version	Status
11) Bloomberg Application	09/08/19	09/08/19	Up To Date
12) BBComm	09/22/19	09/22/19	Up To Date
13) API Data Dictionary	01/19/12	01/19/12	Up To Date
14) Keyboard Driver	10/07/13	10/07/13	Up To Date
15) Webview	10/03/19	10/03/19	Up To Date
16) Bloomberg Voice Fonts	12/07/13	12/07/13	Up To Date
17) Supplemental Fonts	02/07/10	02/07/10	Up To Date
18) Bloomberg Silverlight	09/11/11	01/01/96	Up To Date

If yours is not all green, then go to www.bloombergsoftware.com and download/install

the latest terminal software.

3. Next, On your PC, go to the Start Button and then Bloomberg->API Environment Diagnostics



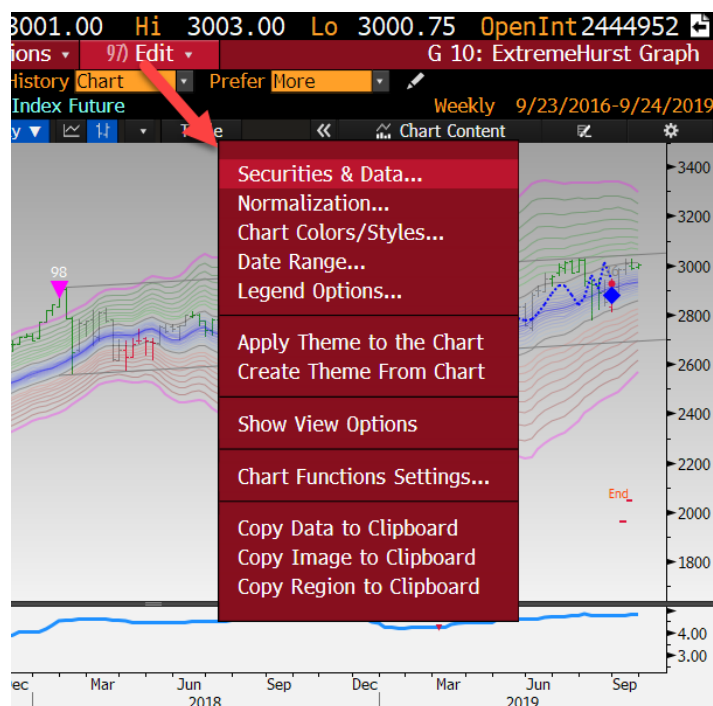
If yours is not all green, then go to www.bloombergssoftware.com and download/install the latest terminal software.

4. All of our tools require long data histories, so if you use futures, be sure and use the continuous contracts like ES1 and TY1. To set the futures rollover method, type GFUT<go>. This is what I recommend:

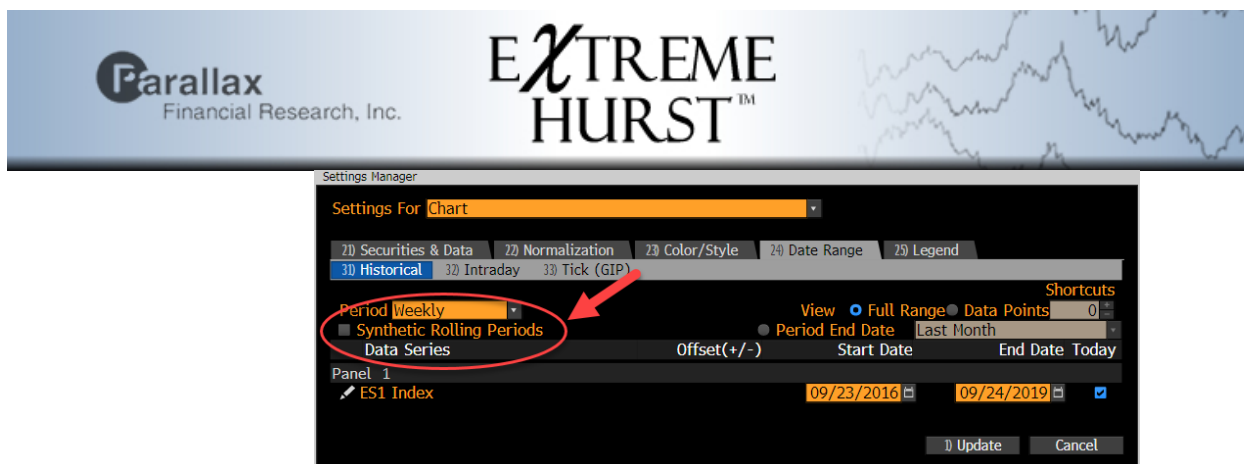


- Finally, the Bloomberg “G” charts have an option buried inside for creating synthetic rolling periods (for example, weeks that end on Wednesdays). We recommend disabling this:

Go to a G Chart and Select “Edit” and then “Securities & Data”



Uncheck “Synthetic Rolling Periods”



How to Fix Common Bloomberg Issues

The Bloomberg APP store products generally run fine and require no user interventions, but there are times when they do. In general, the main thing to keep in mind is that these programs automatically download and run on YOUR PC, not on some Bloomberg cloud device, so the faster your machine, the faster they run.

My Checklist if something is not working:

- 1) Always try a simple reboot first
- 2) Make sure all your Windows Updates are done
- 3) Make sure your Windows PC language is set to English. It just doesn't work right otherwise.
- 4) type DNET DIAG and make sure the test comes back all green, work with the Help desk if the Repair button is grayed out
- 5) type UPGR and make sure all are up to date. If not, go to www.bloombergsoftware.com and re-install the Terminal and Office Tools
- 6) Press Windows Start>>Bloomberg and select API Environment Diagnostics and run it. All should also be all green. Work with the Help desk if any are not and no Repair option is offered.
- 7) Additionally, If you are using the EXCEL add-in, and it is giving NA or not filling in results, then close EXCEL, go to the task manager and end the task (if its there) listed as Bloomberg Addin Host (blpaddinhost.exe), and then go back to APPS PFEX <go> and press Run again to reload
- 8) If all else fails, resetting the Bloomberg terminal defaults might work (save work first). Select a Bloomberg Terminal window by clicking on it, then Press Alt+D and the Setup tab will appear. Choose "Legacy Terminal Defaults", and then when the dialog comes up, choose the Setup tab and press Restore Default Settings

Also, helpful:

- 1) Refrain from using synthetic rolling periods in G charts
- 2) Do use enough bars for ExtremeHurst and other studies, which is generally the middle selection in the G chart timeframe dialog
- 3) Do use continuous contracts instead of front months (see my GFUT recommended settings)
- 4) Don't blow your data quota by using the scanner on thousands of securities...instead, build a securities list in Notepad and run it instead
- 5) If ExtremeHurst is running slow in the scanner app (EHURST), then go to Additional Settings and select "New Signals Only". In the G Charts, select the "Active" option for History. This will only look backwards 20 bars for signals
- 6) I recommend an i9 PC for running our tools, as they are extremely CPU intensive