The Time Fractals

Mukul Pal

Founder & CEO, Tralio
email: mukul@tralio.ai

April 8, 2010

ABSTRACT

Ralph N. Elliott[1] wrote the wave principle in 1938. In 1975 Benoit B Mandelbrot[2] coined the term fractal[3] and in 1982 published his ideas in 'The Fractal Geometry of Nature'. The book brought fractals into the mainstream of professional and popular mathematics. In February 1999, Benoit Mandelbrot submitted an article to Scientific American called "A Multifractal Walk down Wall Street." In the article, he discussed how fractal geometry can be used to model the stock market curves. The enclosed research reworks the Mandelbrot Multifractal from a time cycle rather than trend perspective to prove that time fractal is more proportionate than the price fractal and is the real law of nature, which drives everything in nature. The case is validated by illustrating power law curves in time cycle periodicities. Power law[4] is seen across nature and in a diverse social trends. The power law in prices is a subject of extended study, but there has been no research attempt made to prove power law in time cycle periodicities. Testing cycle periodicity needs large historical data. Long term time series are difficult to obtain and many emerging markets have seen stock market trading activity only start a decade back. The continued prosperity after 1980's was a reason why time fractals did not get researchers attention, unlike price fractal which was actively studied and researched. The fact that what we can see is what we can relate too more also made researchers focus more on price than time, which is less visible. Cycles are not conventionally believed to be patterns. Patterns are understood either conventionally or as Elliott wave fractals. Even few Elliott wave practitioners have admitted the limitation of the Elliott Wave structure as being more sharp on form than on time. These were few reasons why time time fractals remained unproven. This study further connects its findings with the existing research on various economic cycles finally extending the proof to a long – short intermarket strategy on an asset pair.

The structure of the paper will be in following steps **.**

1: Cycles underlie fractals and Mandelbrot's multifractals can be redrawn from a cycle perspective. This suggests that time cycles are fractals that showcase self similarity with a factor of 3. They are also more proportionate than price fractals.

2: The above mathematical proportion X, X/3, X/9, X/27…. can also be seen in the economic group of cycles (Fig. 1) viz. William Strauss and Neil Howe[5], Brian Berry[6], Clement Juglar[7] and Joseph Kitchin[8], which are also connected by 3. This hence is not a chance event but owing to time fractal nature. This means that if we isolate the Kitchin (K) cycle of 40-44 months, which is widely witnessed, we could identify lower hierarchies i.e. K/3, K/9, K/27 etc. We kept in mind the cycle characteristics before isolating the K factor.

- - -K/9-K/3-'K' KITCHIN-JUGLAR-BERRY-STRAUSS- - -

-- -K/9-K/3-K-3K-9K- - -

ECONOMIC CYCLES	PERIOD (YEARS)	AVERAGE	FACTOR
KITCHIN	3-5	3.33	K
JUGLAR	7-11	10	3K
BERRY	25-35	30	9K
STRAUSS	85-99	90	30K

Fig. 1 Economic cycles ruled by a factor of 3.

3: Now if we assume that time fractals can be isolated, similar cycle periodicities can even be witnessed and isolated in intermarket ratio lines, which are independent of price.

4: We tabulate the cycle periodicity and test it for power law distributions.

5: We test the K/9 time fractal periodicities on intermarket[9] ratio line on two assets though a long-short strategy.

TIME FRACTALS VS. PRICE FRACTALS

The term fractal, as Mandelbrot defined it, refers to a curve in which distinct parts are smaller scales of the whole curve. A multifractal is formed by a curve pattern being repeated at smaller and smaller time scales. Mandelbrot used a 3 wave pattern, the first and last being in the direction of the general trend, the middle against the general trend. A picture of his example from the article “A multifractal walk down wall street” is illustrated in Fig 2. Mandelbrot multifractals focused on the price and not the time. This is the reason why price fractals and time fractals seem disconnected. We as a society can relate more to what we can see and feel. Time is an underlying variable, which is tougher to relate compared to price. This is one reason why the debate regarding who saw it first, Elliott or Mandelbrot is inappropriate when we realize that time fractals are more proportionate than price fractals. If one redraws Mandelbrot's multifractals from a time cycle (up leg and down leg) rather than from a price trend (up leg - down leg - up leg) perspective, the same multifractals emerge out as time fractals Fig 3. Not only the iterations break up in the same proportion X, X/3, X/9, X/27 but the time fractals also are more homogeneous that the price multifractals in Fig.2.

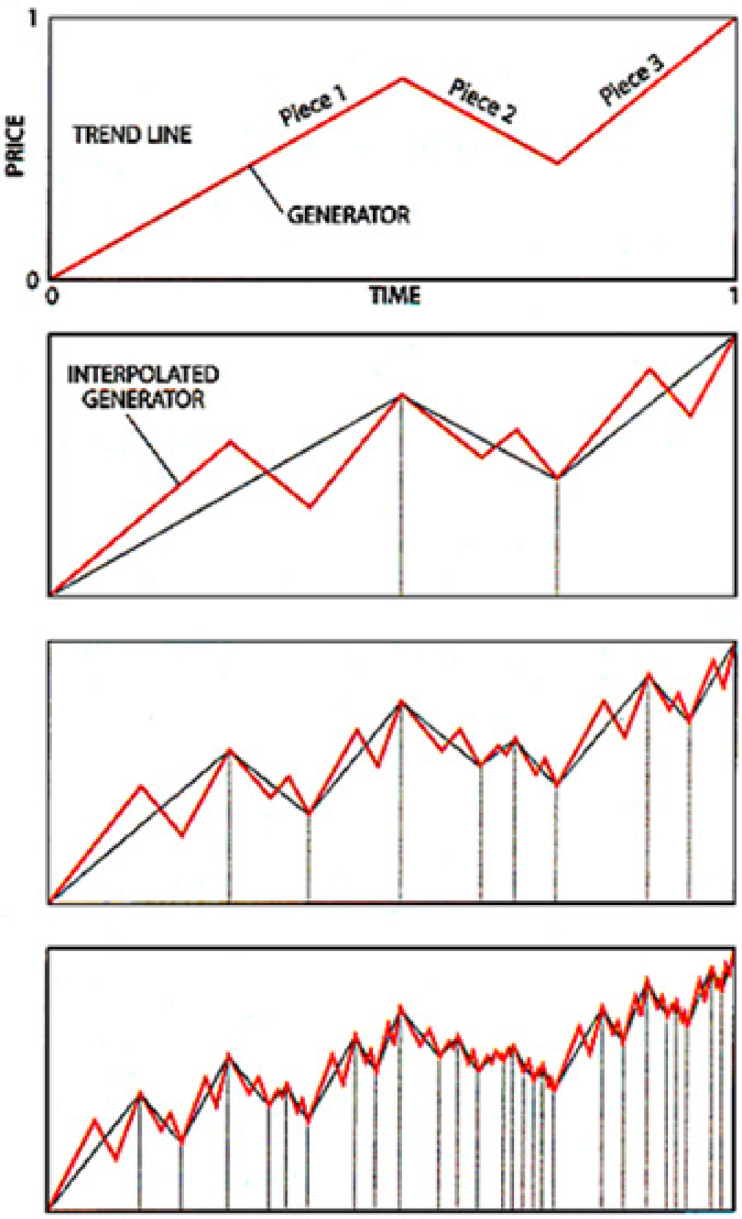

Fig. 2 Mandelbrot's Multifractal based on price.

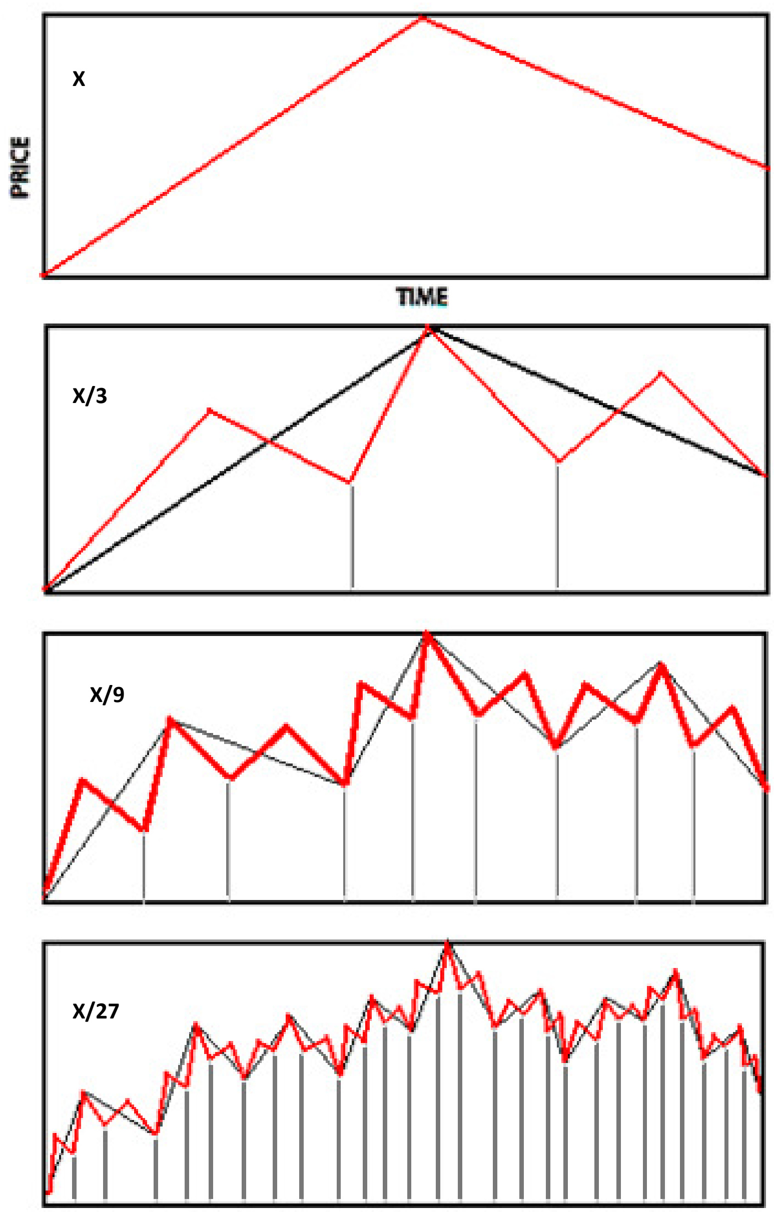

Fig. 3 Author’s interpretation from a time fractal perspective

THE KITCHIN CYCLE (THE K FACTOR)

Tony Plummer[10] in his book ‘Forecasting financial markets’ does give reference to time cycles as a triad of patterns[11]. Though Plummer comes close to the idea of a power law and self similarity in cycles, he does not give a proof for the same. He mentions that “if the triad theory is correct, then the pattern should repeat themselves in a fractal like fashion across all genuine cyclical time”. Plummer also talks about the time aspect of the cycle along with the cycle pattern (Fig.4). The cycle pattern is represented by the move from 0 to C i.e.., 1–2–3 up and A–B–C down. It then consists of three lower-level (sub-) cycles, each of which itself contains the archetypal six-wave pattern. According to Plummer, each of these lower-level cycles will itself consist of three cycles. In other words, the cycles are nested within each other. In all cases, significant lows can be expected to occur one-third and two-thirds along the time elapse of the next higher cycle that contains it. Similarly, important highs occur at one-sixth, one-half and five-sixths along the time elapse of that higher-level cycle.

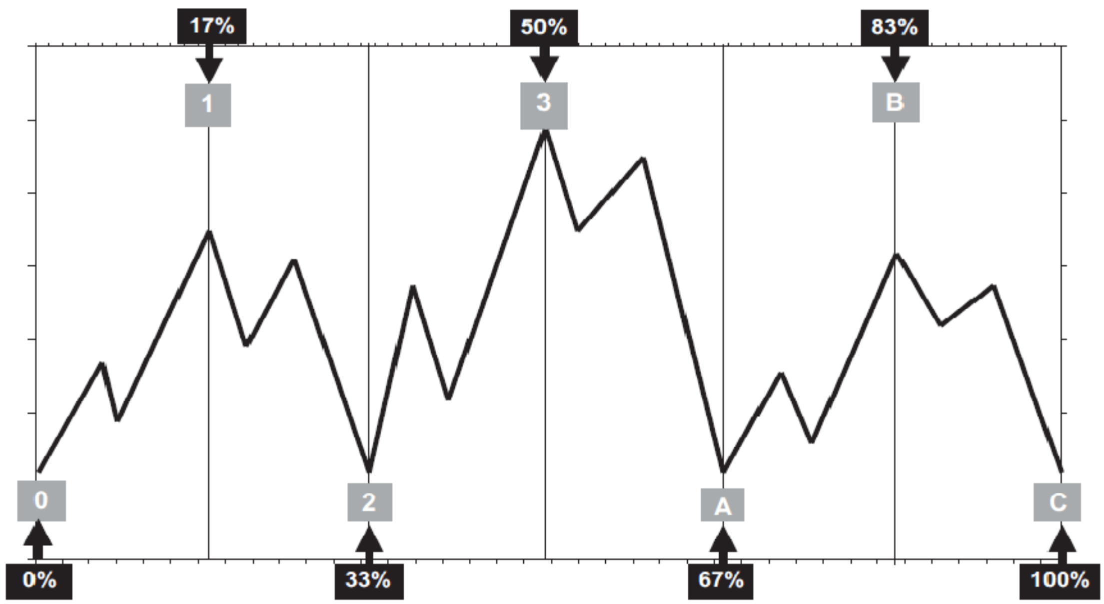

Fig. 4 Tony Plummer’s triad pattern

In 1923, Joseph Kitchin reported a short-term, three- to five-year, business cycle. There is a huge amount of evidence that the central periodicity of the short-term Kitchin cycle is somewhere between 40 and 44 months that is, somewhere between 3.33 and 3.67 years. These periodicities can be found in prices.

So if we now replace the X factor witnessed from time fractals (derived from redrawing Mandelbrot’s multifractals) with the K cycle factor, which is widely seen and accepted, then the K factor should subdivide in a similar proportion as the X factor (X. X/3, X/9, X/27 ….). And we should see it across assets, and across any time series irrespective of the Y axis. Lack of long term data and the need for a workable investment strategy was another reason why we chose the K cycle as a workable time frame to break down. Moreover economic cycles research did not go below Kitchin, the very reason this study focused sub K level. The rate of change oscillator was used to illustrate the K cycle and the other K factors.

ISOLATING THE K FACTOR

CYCLE TRANSLATION AND PATTERN DISTORTION

Cycles are about pattern and periodicity. Pattern being the stronger of the two cycle characters. The focus was on identifying self similar nesting structures (Fig. 5), three smaller cycles nesting under the larger cycle. Care was also taken to identify cycle pattern distortions (Fig. 7), to illustrate potential improper cycle isolation and identification. Just like price fractals, smaller time fractals are effected by larger time fractals which drive them. The very reason for translation (Fig. 6) when the peak of a cycle shifts owing to the larger cycle above it causing cycle pattern distortion.

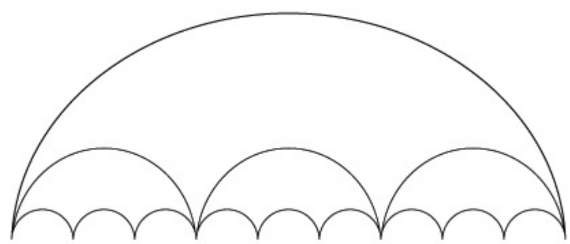

Fig. 5 Cycle hierarchy

Once cycles have been properly categorized in the K factor and sub K factors, the cycle periodicities can be used for forecasting purposes[12].

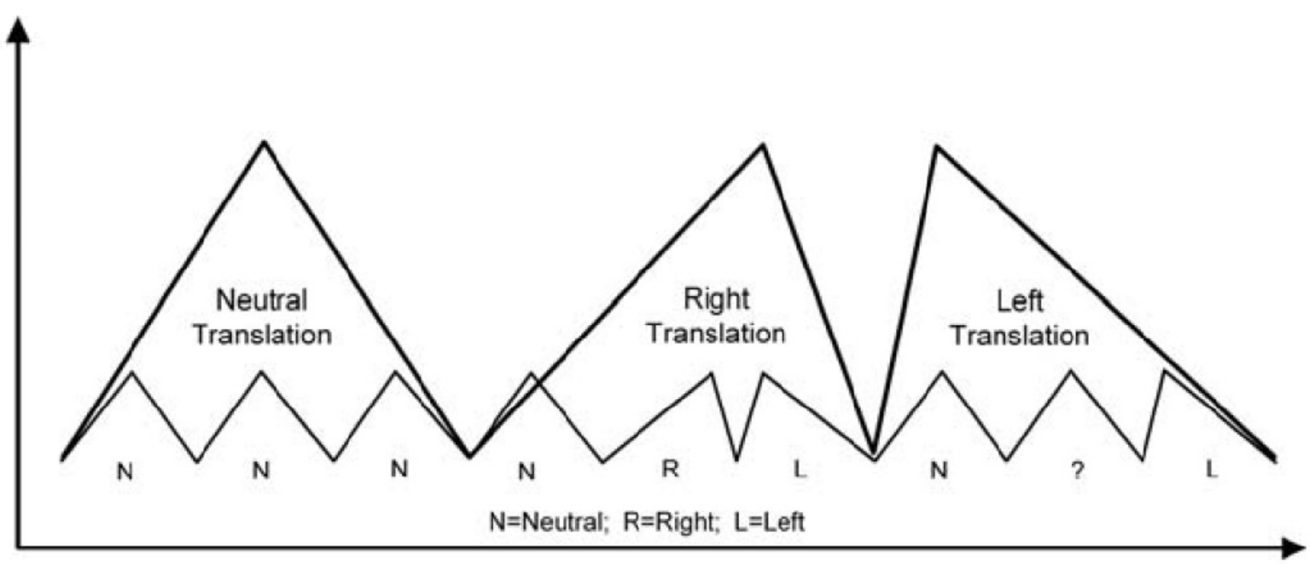

Fig. 6 Cycle translation

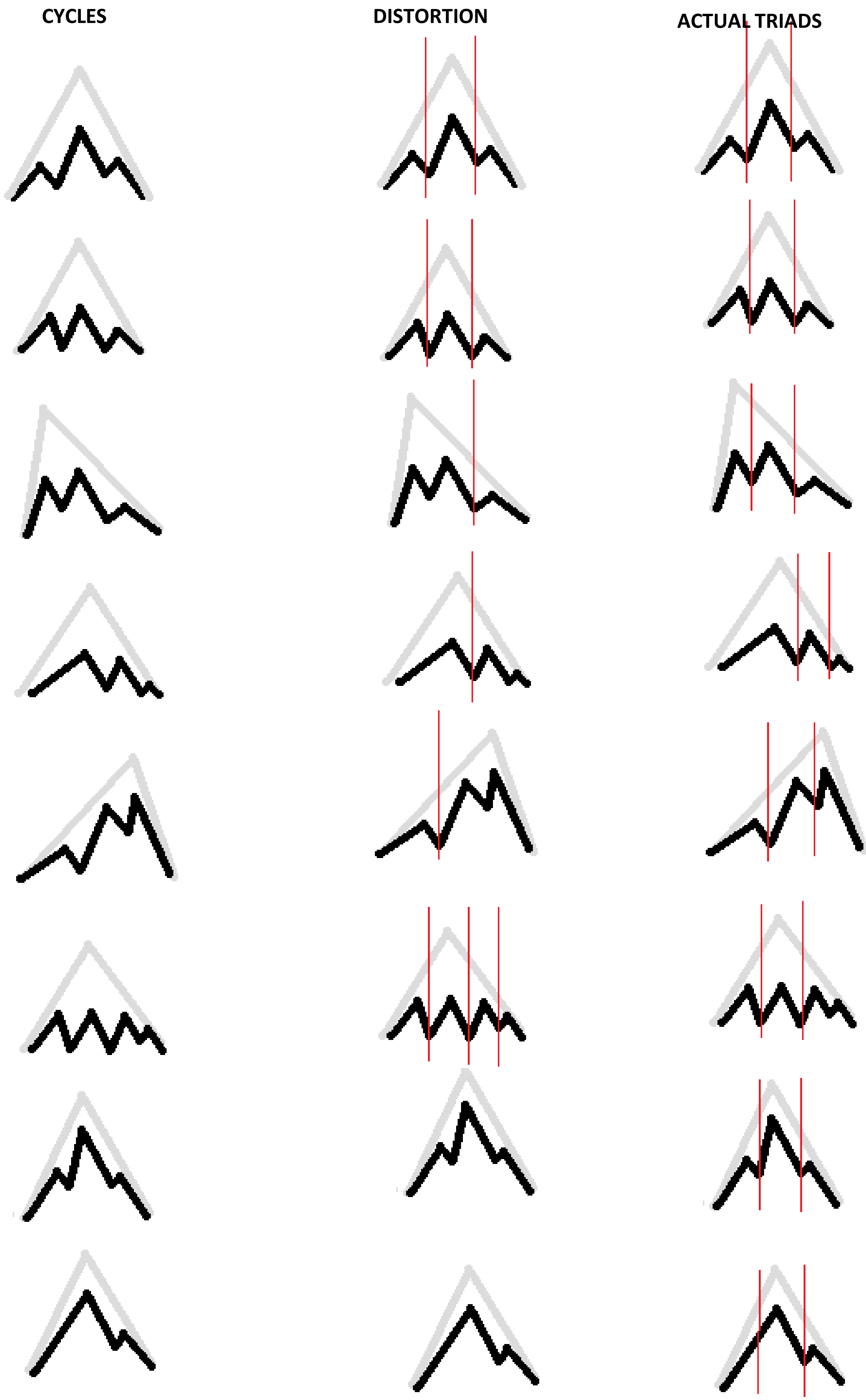

Fig. 7 Cycle distortions cause visual identification error instead of actual triads.

INTERMARKET STRATEGY

Owing to the easier access to information, global markets have seen an increasing interest in instruments and assets. This on one side has seen a rise in trading volume, but at the same time made market relationships harder to understand. Intermarket analysis coined by John Murphy[13] has an increasing relevance in these times. The subject's main hypothesis is that technical analysts need to broaden their chart focus to take these intermarket correlations into consideration. Analysis of the stock market for example without consideration of existing trends in the dollar, bond and commodity markets are simply incomplete. Murphy suggests that financial markets can be used as a leading indicators of other markets and, at times, confirming indicators of related markets.

The writer of the study wanted to test time fractals on intermarket ratio between two assets, specially because they worked independent of price and were a good proxy to demonstrate fractal nature of time. Murphy's Intermarket analysis also illustrated the nature of performance cyclicality irrespective of the intermarket ratio between two asset prices. Murphy also talked about cyclicality between large asset classes like commodities and equities. This was nothing but larger time fractal K factors under action.

However, intermarket analysis (Fig. 8) owing to its focus on trend over time just like the Elliott Wave theory fails to quantify the time element in the investment approach. The perspective signals mentioned in Murphy's intermarket analysis rely on conventional tools like breaking of a trendline and indicative patterns on the intermarket ratios.

The Fig. 8 depicts the price of asset A, asset B and the ratio between them. The K factor is identified from the respective ratio line. This addition of the time fractal to the intermarket ratio line gives the intermarket strategy. (Fig .9)

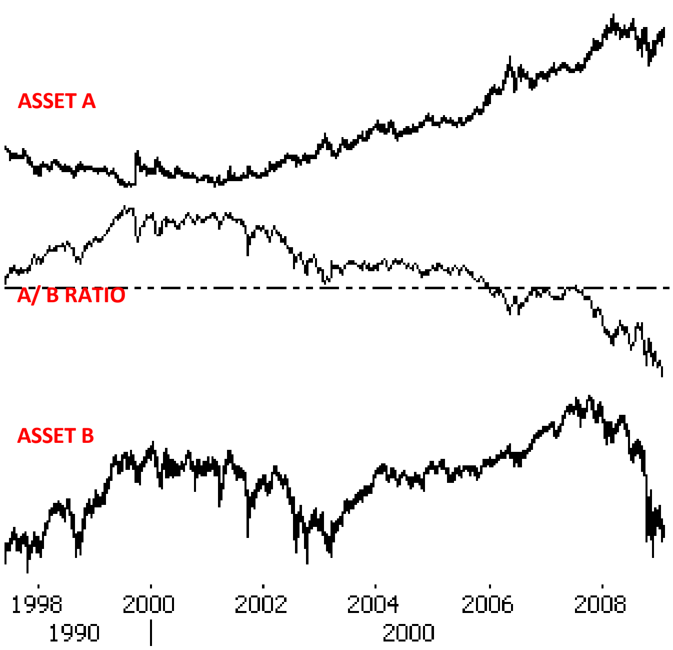

Fig. 8 Intermarket Analysis

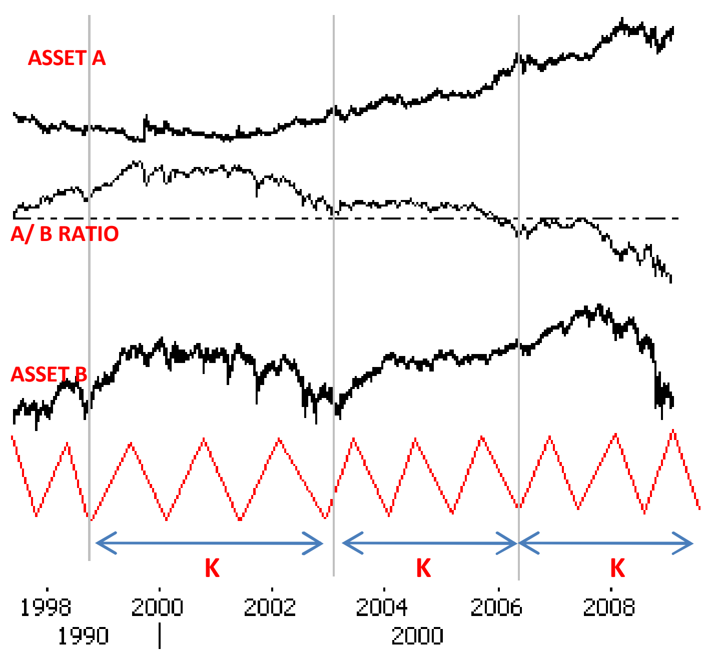

Fig. 9 Intermarket strategy

POWER LAW

A power law is a mathematical formula which states that as a phenomenon increases in scale, it also decreases in frequency. Time cycles also reduce in number as the time scale increase (K/9 to K/3 to K). Power laws appear widely in physics, biology, earth and planetary sciences, economics and finance, computer science, demography and the social sciences. For instance, the distributions of the sizes of cities, earthquakes, solar flares, moon craters, wars and people's personal fortunes, stock indices and prices all appear to follow power laws.

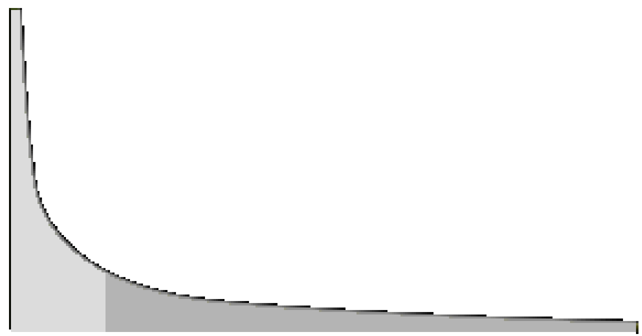

Fig. 10 Power law distribution

A power-law distribution is also sometimes called a scale-free distribution. Because a power law is the only distribution that is the same irrespective of the scale. This is also called as scale invariance. A closely related concept to scale invariance is self-similarity. In mathematics, a self-similar object is exactly or approximately similar to a part of itself (i.e. K= 3*K/3). The whole has the same shape as one or more of the parts. Self-similarity also means that any magnification would lead to a smaller piece of the object that is similar to the whole. Many objects in the real world, such as coastlines, are statistically self-similar with all parts of them showing the same statistical properties at many scales. Self-similarity is a typical property of fractals. Self similarity also appears in time cycles, as a large cycle encompasses smaller cycles, which in turn have smaller cycles nesting under them.

The power law can be described as…$P(x)= cx^{-\alpha}$

Here, α is the scaling exponent. The distribution is an exponential function, which takes a straight line form when we move on a logarithmic scale. $\ln P(x)= \ln c-\alpha \ln x$

Formally, this sharing of dynamics is referred to as universality, and systems with precisely the same critical exponents are said to belong to the same universality class. Working on the assumptions that time cycles belonged to the same universality class and were self similar fractals, we pulled out the k factor intermarket ratio cycle periodicities to test for power law distribution.

THE K TREE

Many emerging market index pairs and top Dow Jones components were paired to isolate the K factor for cycle periodicities. The self similarity appeared in most cases. About 3 Kitchin cycles, nearing a decade of daily data was tested for the study. The author has illustrated the detailed workings of the following three intermarket ratio lines.

BRENT vs. WTM (Brent vs. Midland)
GE vs. CAT (General Electric vs. Caterpillar)
XOM vs. CVX (Exxon vs. Chevron)

The above pairs were purposely chosen owing to their high and poor correlation. BRT-WTM correlation was 0.99, XOM-CVX correlation was 0.97 and GE – CAT correlation was at 0.12 for the period under study. All of the pair cycle periodicities depicted the underlying K factor hierarchy.

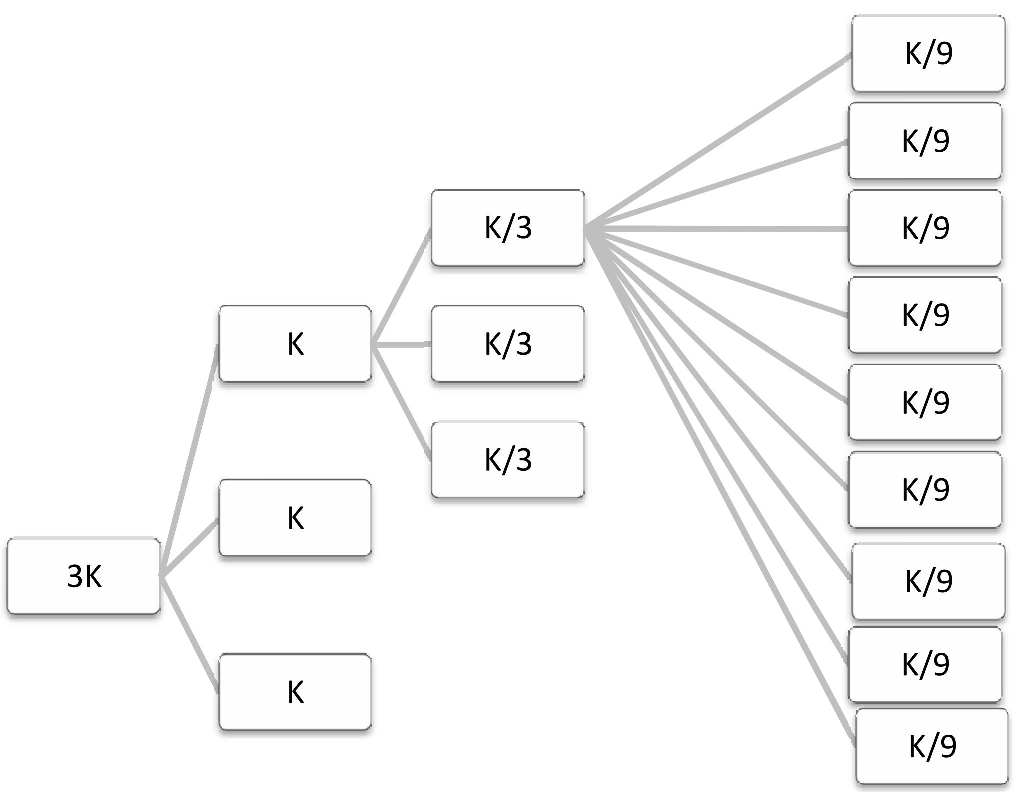

Fig. 11 - K tree

INTERMARKET STRATEGY

The strategy has three parts. First the author has carried a visual of three iterations of the K factor on the intermarket ratio line (Fig 12, Fig. 14, Fig. 16).

Second part includes the distribution and tabulation of the time cycle periodicity of the respective pair.
The tables (Table 1, Table 3, Table 5) carries the periodicities in days in column A. The calculations for B and C are enclosed.

B = Periodicity in days*STDEV + Mean
C= NORMDIST (B,STDEV, MEAN, FALSE)

Where STDEV is standard deviation and NORMDIST is the normal distribution functions.

Third part (Table 2, Table 4, Table 6) is the working of the long short strategy, where the author goes long on numerator A of the intermarket ratio under study while simultaneously selling the denominator B from the pair. The entry number of days is the same as the time cycle periodicities carried on the second part of each working. The exit number of days are taken as half of the K/9 cycle. The author has tested the strategies for an average 3 Kitchin cycles. Underlying spot prices on the two assets making the pair are used. There is also a stop factor of 10% put to see how many times the pairs lose more than 10%. The strategy assumes a leverage factor of 1. The last column is the net annualized returns.

A few important aspects linked with time fractals based strategies is that the fractal illustrates the performance cyclicality clearly. For example the GE-CAT conventionally showcased a secular underperformance of GE against CAT. This was for all the time period under study. However, despite such an underperformance of GE against CAT, the K factor allowed us to trade long GE vs. Short CAT strategy successfully over the K/9 time frame (102-131 days) with exits on an average of 54 days. Even the other two pairs viz. BRT-WTM, and XOM-CVX are highly correlated pairs that even from a conventional long short strategy are not easy to trade. The time fractals based intermarket strategy delivers consistent returns on both the pairs. This proves that even a conventional underperformer or highly correlated assets can be traded against its sector leader (performer) or sector peers respectively, if the time fractal is isolated well. This reinforces the idea of time fractal being better than the price fractal.

All the three pair cycle periodicities show power law distributions.

The average entry number of days for the three pairs were 111, 102, 131 for GE-CAT, BRT-WTM and XOM-CVX respectively. The exit number of days for the three pairs were 54, 50 and 66 in the same order. The stop loss of 10% was hit twice in 80 readings, once on both GE-CAT and XOM-CVX pair. The average annualized non leveraged return was at 54%.

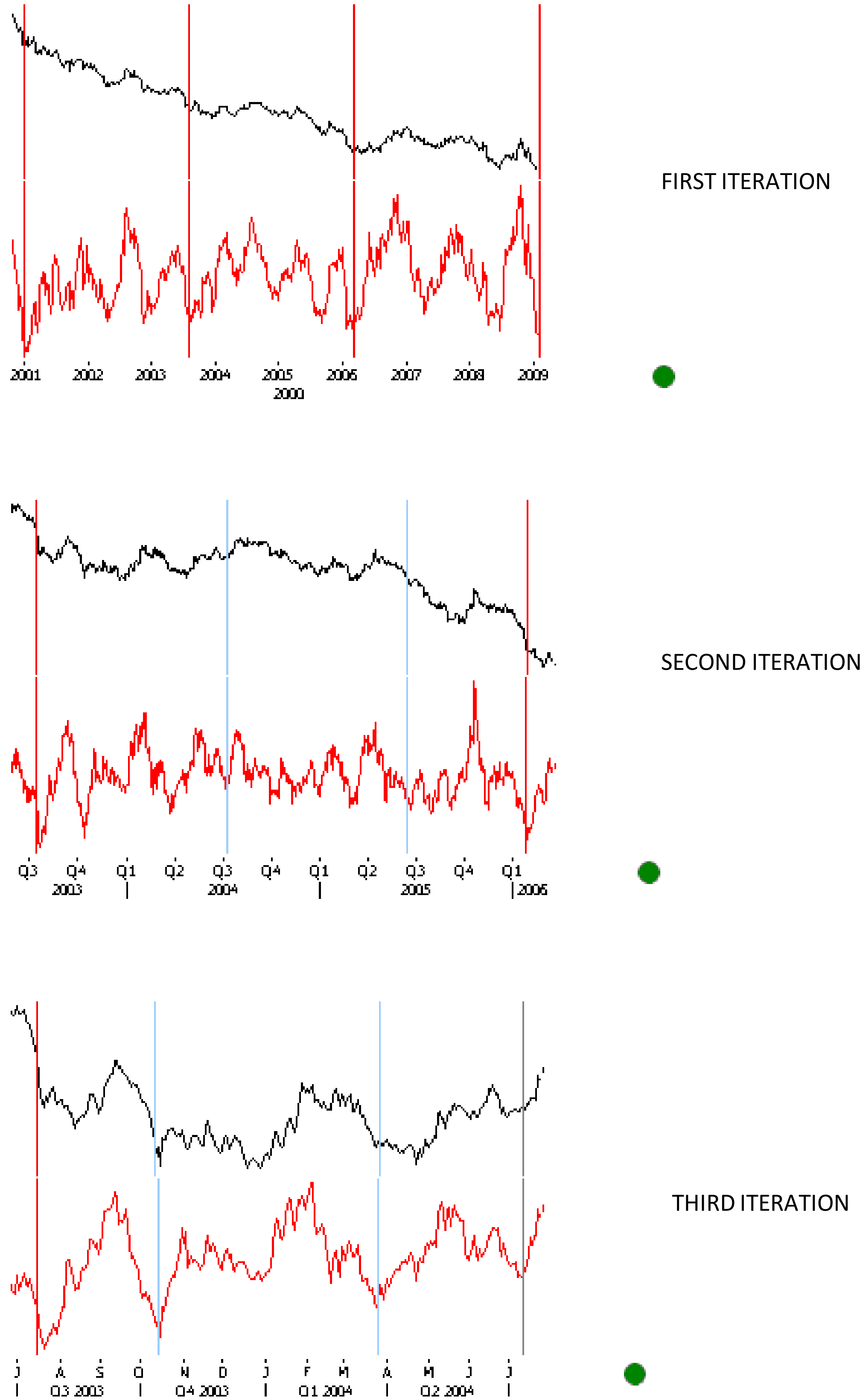

Fig. 12 - GE VS CAT intermarket ratio line vs. the K factor

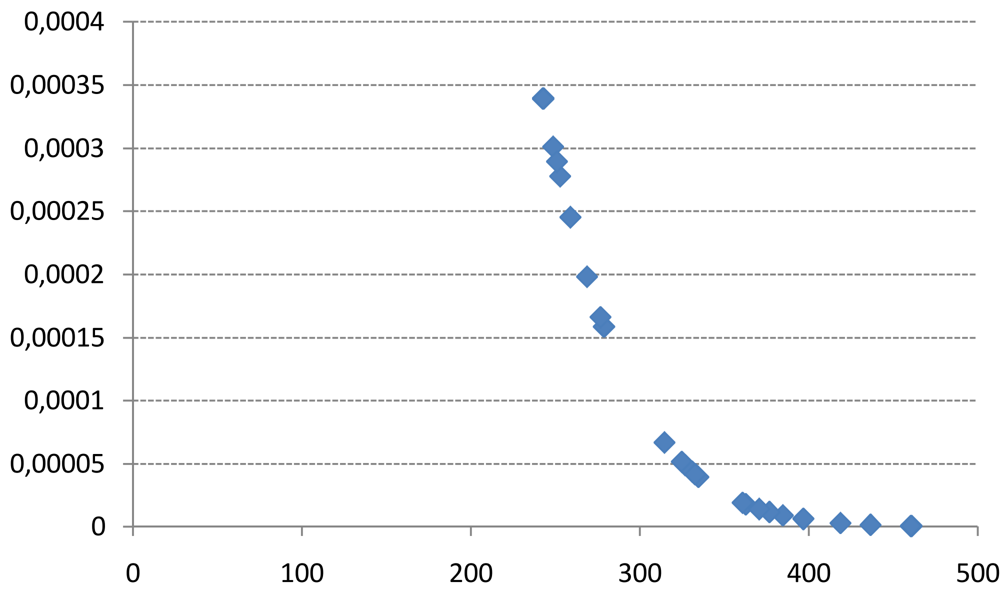

Fig. 13 - GE vs. CAT cycle periodicity distribution

A	B	C
69	248.7308	0.000301
143	396.7308	6.27E-06
126	362.7308	1.79E-05
130	370.7308	1.41E-05
143	396.7308	6.27E-06
71	252.7308	0.000278
108	326.7308	4.89E-05
74	258.7308	0.000245
66	242.7308	0.000339
84	278.7308	0.000159
163	436.7308	1.62E-06
107	324.7308	5.15E-05
125	360.7308	1.89E-05
110	330.7308	4.39E-05
112	334.7308	3.94E-05
79	268.7308	0.000198
70	250.7308	0.000289
74	258.7308	0.000245
154	418.7308	3.03E-06
102	314.7308	6.68E-05
111	332.7308	4.16E-05
137	384.7308	9.17E-06
175	460.7308	6.76E-07
133	376.7308	1.17E-05
130	370.7308	1.41E-05
83	276.7308	0.000166
110.7308	MEAN	
2	STDEV	

Table 1 - GE vs. CAT cycle periodicity distribution calculation

	Date (GMT)	ENTRY IN DAYS	EXIT IN DAYS	LONG GE	NET PROFIT/LOSS	SHORT CAT	NET PROFIT/LOSS	NET SPOT RETURN	FILTERED FOR 10% STOP	ANNUALISED
ENTRY	1/2/2001			43.75		23.15625				
EXIT	2/5/2001		34	47.85	9.4%	21.885	5.81%	15.2%	15.2%	163%
ENTRY	3/12/2001	69		39.6		22.48				
EXIT	5/22/2001		71	52.68	33.0%	28.1	-20.00%	13.0%	13.0%	67%
ENTRY	8/2/2001	143		42.2		27.3				
EXIT	10/4/2001		63	37.39	-11.4%	23.715	15.12%	3.7%	3.7%	22%
ENTRY	12/6/2001	126		37.76		25.255				
EXIT	2/8/2002		64	37.25	-1.4%	24.25	4.14%	2.8%	2.8%	16%
ENTRY	4/15/2002	130		31.85		28.995				
EXIT	6/25/2002		71	28.9	-9.3%	24.1	20.31%	11.0%	11.0%	57%
ENTRY	9/5/2002	143		28		21.28				
EXIT	10/10/2002		35	22.6	-19.3%	17.535	21.36%	2.1%	2.1%	22%
ENTRY	11/15/2002	71		23.86		22.54				
EXIT	1/8/2003		54	25.5	6.9%	23.2	-2.84%	4.0%	4.0%	27%
ENTRY	3/3/2003	108		23.9		23.54				
EXIT	4/9/2003		37	27.3	14.2%	25.855	-8.95%	5.3%	5.3%	52%
ENTRY	5/16/2003	74		27.85		26.485				
EXIT	6/18/2003		33	30.73	10.3%	28.51	-7.10%	3.2%	3.2%	36%
ENTRY	7/21/2003	66		27.18		32.66				
EXIT	9/2/2003		43	30.44	12.0%	36.23	-9.85%	2.1%	2.1%	18%
ENTRY	10/13/2003	84		28.93		38.45				
EXIT	1/2/2004		81	31.12	7.6%	41.325	-6.96%	0.6%	0.6%	3%
ENTRY	3/24/2004	163		29.18		38.165				
EXIT	5/17/2004		54	29.97	2.7%	36.77	3.79%	6.5%	6.5%	44%
ENTRY	7/9/2004	107		32.17		38.54				
EXIT	9/9/2004		62	33.86	5.3%	37.435	2.95%	8.2%	8.2%	48%
ENTRY	11/11/2004	125		35.8		44.925				
EXIT	1/5/2005		55	35.93	0.4%	46.11	-2.57%	-2.2%	-2.2%	-15%
ENTRY	3/1/2005	110		35.22		48.685				
EXIT	4/26/2005		56	36.18	2.7%	44.43	9.58%	12.3%	12.3%	80%
ENTRY	6/21/2005	112		36.15		51.1				
EXIT	7/29/2005		38	34.5	-4.6%	53.91	-5.21%	-9.8%	-9.8%	-94%
ENTRY	9/8/2005	79		33.85		58.35				
EXIT	10/13/2005		35	34.02	0.5%	54	8.06%	8.6%	8.6%	89%
ENTRY	11/17/2005	70		34.66		57.47				
EXIT	12/23/2005		36	35.42	2.2%	58.51	-1.78%	0.4%	0.4%	4%
ENTRY	1/30/2006	74		32.93		67.01				
EXIT	4/17/2006		77	33.29	1.1%	76.45	-12.35%	-11.3%	-10.0%	-53%
ENTRY	7/3/2006	154		33.33		74.77				
EXIT	8/23/2006		51	33.79	1.4%	67.21	11.25%	12.6%	12.6%	90%
ENTRY	10/13/2006	102		35.98		69.08				
EXIT	12/7/2006		55	35.16	-2.3%	63	9.65%	7.4%	7.4%	49%
ENTRY	2/1/2007	111		36.23		64.99				
EXIT	4/10/2007		68	34.88	-3.7%	66.95	-2.93%	-6.7%	-6.7%	-36%
ENTRY	6/18/2007	137		38.07		81.85				
EXIT	9/13/2007		87	40.51	6.4%	72.99	12.14%	18.5%	18.5%	78%
ENTRY	12/10/2007	175		37.41		76.58				
EXIT	2/14/2008		66	34.39	-8.1%	70.44	8.72%	0.6%	0.6%	4%
ENTRY	4/21/2008	133		32.46		83.33				
EXIT	6/25/2008		65	27.99	-13.8%	76.58	8.81%	-5.0%	-5.0%	-28%
ENTRY	8/29/2008	130		28.1		70.73				
EXIT	10/9/2008		41	19.01	-32.3%	44.8	57.88%	25.5%	25.5%	227%
ENTRY	11/20/2008	83		12.84		32.84				
EXIT	12/29/2008		39	15.66	22.0%	42.34	-22.44%	-0.5%	-0.5%	-4%
AVERAGE		111	54		1.18%		3.58%	4.8%	4.8%	35%

Table 2 - GE vs. CAT long short pair strategy

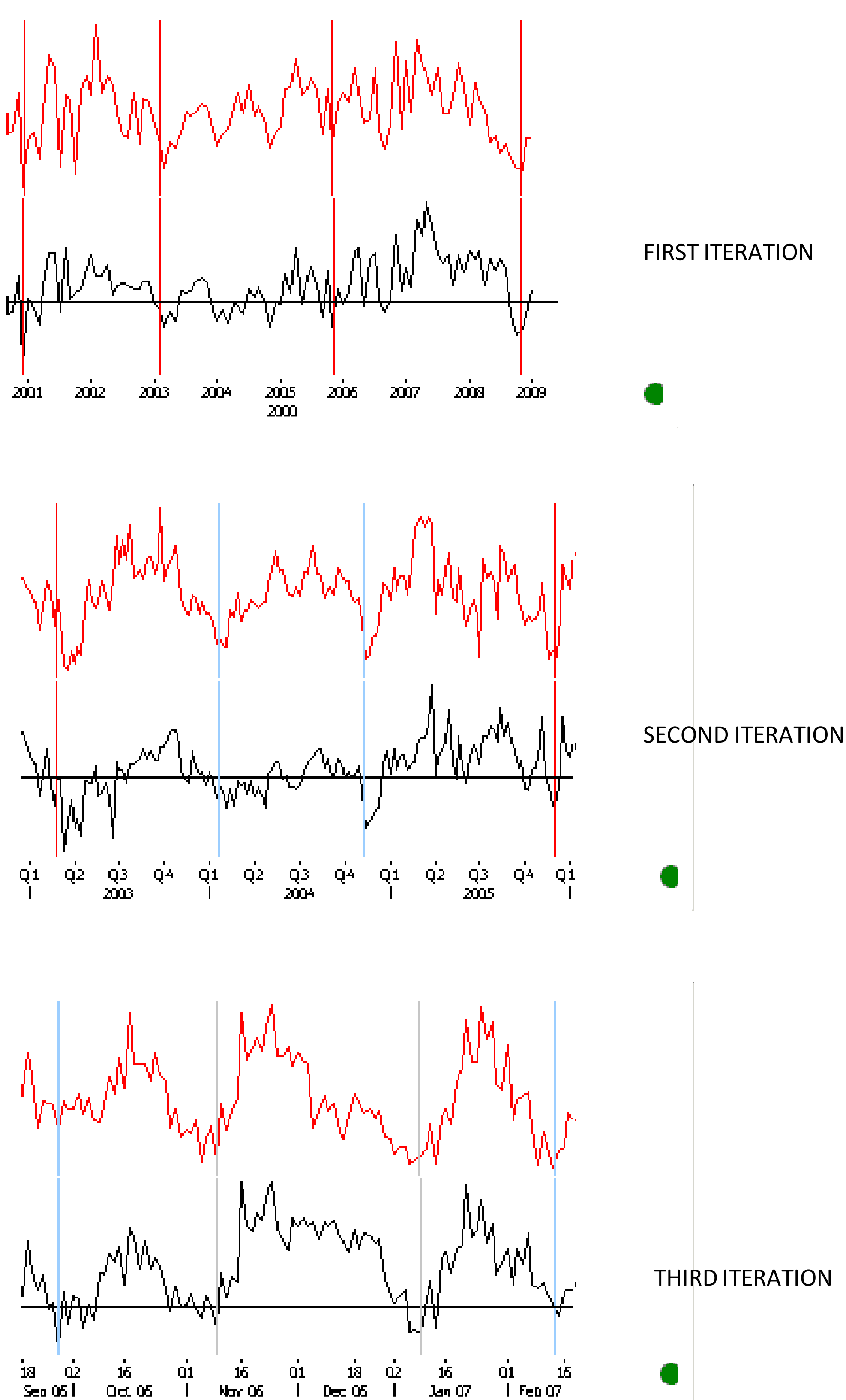

Fig. 14 – BRT vs. WTM intermarket ratio line vs. the K factor

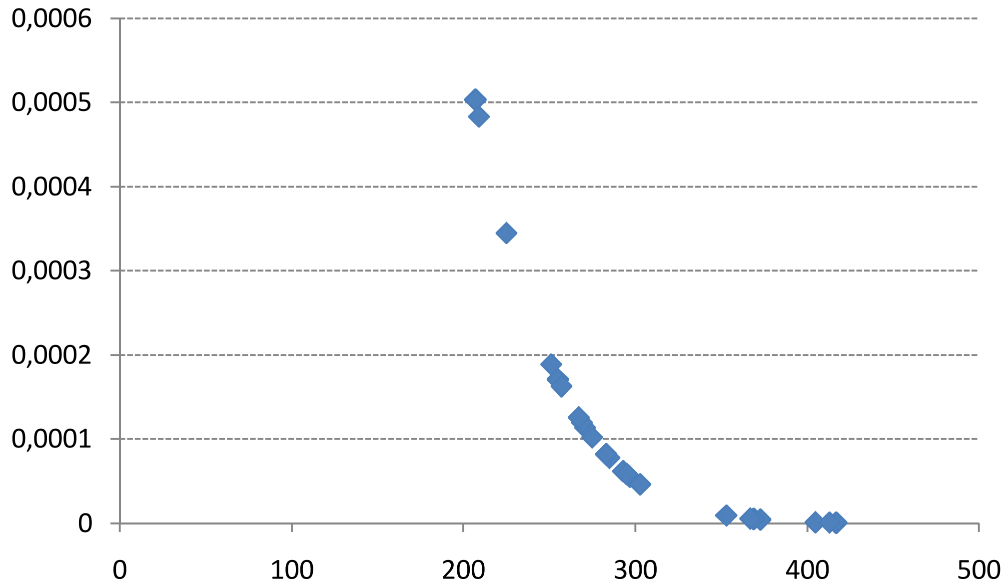

Fig. 15 - BRT vs. WTM cycle periodicity distribution

A	B	C	
	91	282.9259	8.21E-05
	98	296.9259	5.53E-05
	85	270.9259	0.000114
	152	404.9259	1.37E-06
	158	416.9259	8.45E-07
	101	302.9259	4.64E-05
	53	206.9259	0.000503
	96	292.9259	6.2E-05
	97	294.9259	5.86E-05
	62	224.9259	0.000345
	136	372.9259	4.61E-06
	84	268.9259	0.00012
	83	266.9259	0.000126
	54	208.9259	0.000483
	92	284.9259	7.77E-05
	91	282.9259	8.21E-05
	91	282.9259	8.21E-05
	126	352.9259	9.37E-06
	87	274.9259	0.000102
	152	404.9259	1.37E-06
	77	254.9259	0.000171
	78	256.9259	0.000163
	134	368.9259	5.33E-06
	75	250.9259	0.000189
	133	366.9259	5.73E-06
	156	412.9259	9.93E-07
	83	266.9259	0.000126
	101MEAN		
	2STDEV		

Table 3 - BRT vs. WTM cycle periodicity distribution calculation

	Date (GMT)	ENTRY IN DAYS	EXIT IN DAYS	LONG BRT	NET PROFIT/LOSS	SHORT WTM	NET PROFIT/LOSS	NET SPOT RETURN	FILTERED FOR 10% SPOT	ANNUALIZED SPOT
ENTRY	6/9/1998			12.76		13.42				
EXIT	7/24/1998		45	12.37	-3.06%	13.71	-2.12%	-5.17%	-5.17%	-42%
ENTRY	9/8/1998	91		12.48		14.19				
EXIT	10/27/1998		49	12.41	-0.56%	13.92	1.94%	1.38%	1.38%	10%
ENTRY	12/15/1998	98		9.88		11.38				
EXIT	1/26/1999		42	10.77	9.01%	11.94	-4.69%	4.32%	4.32%	32%
ENTRY	3/10/1999	85		11.49		14.42				
EXIT	5/25/1999		76	15.02	30.72%	17.2	-16.16%	14.56%	14.56%	106%
ENTRY	8/9/1999	152		19.37		21.11				
EXIT	10/27/1999		79	22.01	13.63%	22.58	-6.51%	7.12%	7.12%	52%
ENTRY	1/14/2000	158		25.5		27.85				
EXIT	3/3/2000		49	29.62	16.16%	31.08	-10.39%	5.76%	5.76%	42%
ENTRY	4/25/2000	102		23.39		26.02				
EXIT	5/20/2000		25	28.74	22.87%	29.67	-12.30%	10.57%	10.57%	77%
ENTRY	6/16/2000	52		27.96		32.2				
EXIT	8/3/2000		48	26.99	-3.47%	28.72	12.12%	8.65%	8.65%	63%
ENTRY	9/20/2000	96		33.13		36.82				
EXIT	11/7/2000		48	31.6	-4.62%	33.3	10.57%	5.95%	5.95%	43%
ENTRY	12/27/2000	98		22.58		26.31				
EXIT	1/26/2001		30	27.21	20.50%	29.5	-10.81%	9.69%	9.69%	71%
ENTRY	2/26/2001	61		25.68		27.98				
EXIT	5/7/2001		70	27.71	7.90%	27.49	1.78%	9.69%	9.69%	71%
ENTRY	7/12/2001	136		23.7		26.54				
EXIT	8/23/2001		42	25.69	8.40%	25.2	5.32%	13.71%	13.71%	100%
ENTRY	10/4/2001	84		21.09		22.43				
EXIT	11/14/2001		41	17.95	-14.89%	19.34	15.98%	1.09%	1.09%	8%
ENTRY	12/26/2001	83		18.65		21.06				
EXIT	1/22/2002		27	18.64	-0.05%	18.14	16.10%	16.04%	16.04%	117%
ENTRY	2/19/2002	55		20.04		20.62				
EXIT	4/5/2002		45	25.39	26.70%	25.99	-20.66%	6.03%	6.03%	44%
ENTRY	5/21/2002	91		24.22		26.97				
EXIT	7/3/2002		43	25.84	6.69%	26.66	1.16%	7.85%	7.85%	57%
ENTRY	8/20/2002	91		27.35		29.83				
EXIT	10/4/2002		45	28.3	3.47%	29.51	1.08%	4.56%	4.56%	33%
ENTRY	11/19/2002	91		23.66		26				
EXIT	1/21/2003		63	32.06	35.50%	34.22	-24.02%	11.48%	11.48%	84%
ENTRY	3/25/2003	126		25.97		33.37				
EXIT	5/7/2003		43	24.13	-7.09%	25.93	28.69%	21.61%	21.61%	158%
ENTRY	6/20/2003	87		26.07		30.23				
EXIT	9/4/2003		76	27.54	5.64%	28.59	5.74%	11.37%	11.37%	83%
ENTRY	11/19/2003	152		29.71		32.52				
EXIT	12/29/2003		40	29.62	-0.30%	32.24	0.87%	0.57%	0.57%	4%
ENTRY	2/4/2004	77		29.14		32.16				
EXIT	3/15/2004		40	34.9	19.77%	37.26	-13.69%	6.08%	6.08%	44%
ENTRY	4/22/2004	78		33.89		37.53				
EXIT	6/28/2004		67	33.03	-2.54%	36.13	3.87%	1.34%	1.34%	10%
ENTRY	9/3/2004	134		40.9		43.6				
EXIT	10/11/2004		38	51.27	25.35%	53.53	-18.55%	6.80%	6.80%	50%
ENTRY	11/17/2004	75		40.37		46.28				
EXIT	1/21/2005		65	45.88	13.65%	47.9	-3.38%	10.27%	10.27%	75%
ENTRY	3/30/2005	133		49.81		53.84				
EXIT	6/16/2005		78	53.7	7.81%	56.6	-4.88%	2.93%	2.93%	21%
ENTRY	9/2/2005	156		65.75		67.42				
EXIT	10/13/2005		41	59.03	-10.22%	62.53	7.82%	-2.40%	-2.40%	-18%
AVERAGE		102	50		8.41%		-1.30%	7.11%	7.11%	51.72%

Table 4 - BRT vs. WTM long short pair strategy

Fig. 16 – XOM vs. CVX intermarket ratio line vs. the K factor

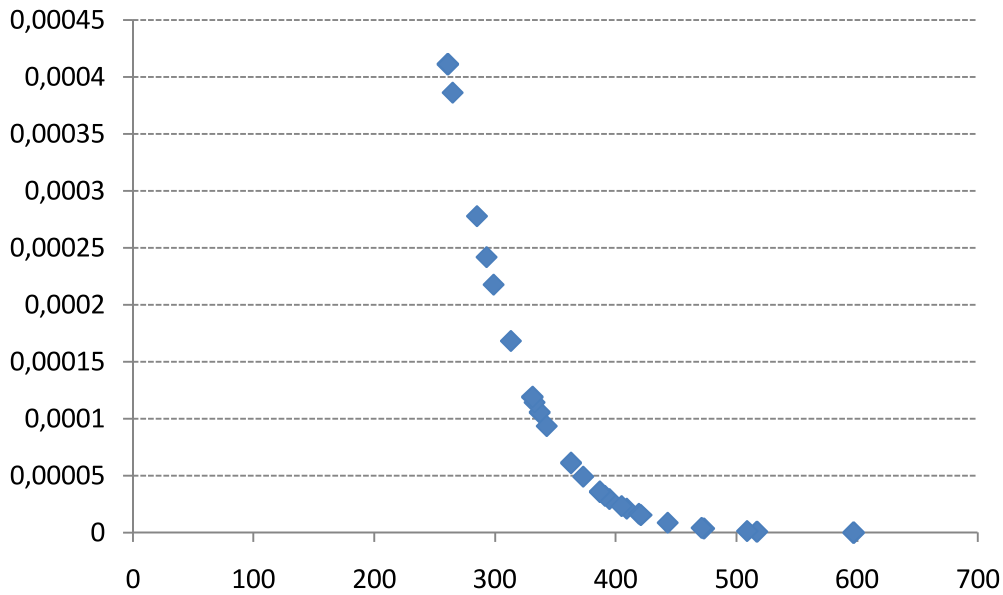

Fig. 17 - XOM vs. CVX cycle periodicity distribution

A	B	C
104	336.8462	0.00010575
107	342.8462	9.3593E-05
146	420.8462	1.571E-05
78	284.8462	0.00027823
133	394.8462	2.9663E-05
140	408.8462	2.1172E-05
82	292.8462	0.00024231
66	260.8462	0.00041158
102	332.8462	0.00011458
129	386.8462	3.5776E-05
172	472.8462	3.8997E-06
122	372.8462	4.9201E-05
131	390.8462	3.2592E-05
171	470.8462	4.1268E-06
117	362.8462	6.1331E-05
68	264.8462	0.00038651
92	312.8462	0.00016864
234	596.8462	7.287E-08
194	516.8462	1.0562E-06
101	330.8462	0.00011922
145	418.8462	1.6521E-05
146	420.8462	1.571E-05
138	404.8462	2.3342E-05
157	442.8462	8.8875E-06
190	508.8462	1.351E-06
85	298.8462	0.0002179
128.8462	386.5385	3.6032E-05
128.8462	MEAN	
2	STDEV	

Table 5 - XOM vs. CVX cycle periodicity distribution calculation

	DATE	ENTRY IN DAYS	EXIT IN DAYS	LONG XOM	NET PROFIT/LOSS	SHORT CVX	NET PROFIT/LOSS	NET RETURN ON SPOT	FILTERED FOR 10% STOP	ANNUALIZED
ENTRY	3/30/1999			35.66		44.5				
EXIT	5/21/1999		52	46.72	31.03%	41.375	7.55%	38.58%	38.58%	271%
ENTRY	7/12/1999	104		39.72		49.46875				
EXIT	9/4/1999		54	46.84	17.94%	39.53125	25.14%	43.08%	43.08%	291%
ENTRY	10/27/1999	107		35.91		44.9375				
EXIT	1/8/2000		73	45.13	25.67%	42.46875	5.81%	31.49%	31.49%	157%
ENTRY	3/21/2000	146		38.47		43.0625				
EXIT	4/29/2000		39	42.56	10.64%	38.84375	10.86%	21.50%	21.50%	201%
ENTRY	6/7/2000	78		40.66		46.1875				
EXIT	8/13/2000		67	42.00	3.31%	40.6875	13.52%	16.82%	16.82%	92%
ENTRY	10/18/2000	133		43.28		41.25				
EXIT	12/27/2000		70	41.53	-4.04%	43.875	-5.98%	-10.03%	-10.00%	-52%
ENTRY	3/7/2001	140		42.11		45.69				
EXIT	4/18/2001		42	46.63	10.74%	42.355	7.87%	18.61%	18.61%	162%
ENTRY	5/29/2001	83		43.90		47.775				
EXIT	7/1/2001		33	45.25	3.08%	43.675	9.39%	12.46%	12.46%	138%
ENTRY	8/2/2001	65		41.73		45.525				
EXIT	9/22/2001		51	42.01	0.66%	35.83	27.06%	27.72%	27.72%	198%
ENTRY	11/12/2001	102		40.06		44.615				
EXIT	1/16/2002		65	44.60	11.33%	39.3	13.52%	24.86%	24.86%	140%
ENTRY	3/21/2002	129		43.53		45.19				
EXIT	6/15/2002		86	43.39	-0.33%	39.15	15.43%	15.09%	15.09%	64%
ENTRY	9/9/2002	172		34.00		37.005				
EXIT	11/9/2002		61	33.75	-0.74%	34.61	6.92%	6.18%	6.18%	37%
ENTRY	1/9/2003	122		35.74		34.56				
EXIT	3/16/2003		66	32.10	-10.20%	34.39	0.49%	-9.70%	-9.70%	-54%
ENTRY	5/20/2003	131		35.27		33.335				
EXIT	8/14/2003		86	36.62	3.83%	36.5	-8.67%	-4.84%	-4.84%	-21%
ENTRY	11/7/2003	171		35.56		37.275				
EXIT	1/5/2004		59	43.78	23.10%	41.58	-10.35%	12.75%	12.75%	79%
ENTRY	3/3/2004	117		41.90		44.915				
EXIT	4/6/2004		34	44.53	6.26%	42.19	6.46%	12.72%	12.72%	137%
ENTRY	5/10/2004	68		42.05		44.585				
EXIT	6/25/2004		46	46.70	11.05%	44.25	0.76%	11.80%	11.80%	94%
ENTRY	8/10/2004	92		45.29		47.135				
EXIT	12/5/2004		117	52.81	16.60%	50.14	-5.99%	10.61%	10.61%	33%
ENTRY	4/1/2005	234		60.55		59.31				
EXIT	7/7/2005		97	57.80	-4.54%	59.52	-0.35%	-4.89%	-4.89%	-18%
ENTRY	10/12/2005	194		58.94		60.96				
EXIT	12/4/2005		53	59.64	1.19%	59.51	2.44%	3.62%	3.62%	25%
ENTRY	1/26/2006	106		59.95		60.22				
EXIT	4/6/2006		70	59.41	-0.90%	62.09	-3.01%	-3.91%	-3.91%	-20%
ENTRY	6/15/2006	140		59.12		59.43				
EXIT	7/14/2006		29	64.94	9.84%	64.07	-7.24%	2.60%	2.60%	33%
ENTRY	8/11/2006	57		69.73		67.85				
EXIT	12/3/2006		114	73.11	4.85%	77.2	-12.11%	-7.26%	-7.26%	-23%
ENTRY	3/26/2007	227		75.47		74.4				
EXIT	6/13/2007		79	80.56	6.74%	82	-9.27%	-2.52%	-2.52%	-12%
ENTRY	8/30/2007	157		85.40		87.19				
EXIT	12/3/2007		95	87.84	2.86%	88.85	-1.87%	0.99%	0.99%	4%
ENTRY	3/7/2008	190		82.49		85.26				
EXIT	5/12/2008		66	88.27	7.01%	88.92	-4.12%	2.89%	2.89%	16%
AVERAGE		131	66		6.24%		3.07%	9.31%	9.31%	76%

Table 6 - XOM vs. CVX long short pair strategy

CONCLUSION

The proof of the superiority of the time fractal over the price fractal clearly emerges when we redraw Mandelbrot's multifractals and put to test intermarket ratios cycle periodicities for power law and as an investment strategy . The K factor indicator assists in this process. The author relies on both high and low correlated pairs to showcase the performance cyclicality over the K/9 factor time frame. All strategies under study return positive gains. The intermarket ratio strategy introduced first time ever in this research redefines long-short technique as a time fractal strategy. The strategy can be used by fund mangers across different assets and time frames, aggressively or passively by altering the K factor. The study has assumed a leverage of 1, but real market leverage can change the profile of the strategy. Overall, time fractals is a subject which traverses beyond capital market forecasting and can be utilized in many areas of scientific research.

FOOTNOTES

1. Ralph N. Elliott, Father of the Elliott Wave Principle and author of the Nature's Law.
2. Benoit B. Mandelbrot, is a French mathematician, best known as the father of fractal geometry. The Mandelbrot set, named after him is a set of points in the complex plane, the boundary of which forms a fractal.
3. A fractal is generally "a rough or fragmented geometric shape that can be split into parts, each of which is (at least approximately) a reduced-size copy of the whole, a property called self-similarity."
4. A power law is a special kind of mathematical relationship between two quantities. If one quantity is the frequency of an event, the relationship is a power-law distribution, and the frequencies decrease very slowly as the size of the event increases.
5. William Strauss and Neil Howe presented a strong case for an intergenerational, 85- to 99-year cycle.
6. Brian Berry pointed to the presence of a generation-length, 25- to 35-year, cycle.
7. Clement Juglar reported a medium term, seven- to 11-year, cycle.
8. Joseph Kitchen reported a short-term, three- to five-year, business cycle.
9. Intermarket ratio is a line built from price series of two different assets.
10. Tony Plummer is a time cyclist and author of the book 'Forecasting Financial markets'.
11. Triad of Patterns are the classic six wave pattern structure found in cycles with 1-2-3-a-b-c legs.
12. Forecasting purposes can include price, macro and micro economic, social trend and scientific forecasts.
13. John Murphy is a market technician considered as the father of modern technical analysis.

REFERENCES

1. Elliott Wave Principle, (1938), R N Elliott
2. The Fractal Geometry of Nature, (1975), B B Mandelbort
3. A Multifractal Walk Down Wall Street, (1999), B B Mandelbrot
4. Color of Infinity, (1994) Nigel Lesmoir-Gordon
5. Power laws, Pareto distributions and Zipf's law, (2004), M. E. J. Newman
6. Financial Markets and Psychology of Investing, (1989), T Plummer
7. Intermarket Analysis, (2004), J Murphy
8. Selected Studies of the Principle of Relative Frequency in Language. (1932), G K Zipf