

# Fibonacci – Lucas numbers, moon sun cycles and financial timing

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## Abstract

Fibonacci numbers and Phi ratios are used in various techniques to predict market outcomes and have long been accepted in technical analysis. The reason why these factors arise in financial patterns has never been clarified, thereby creating a credibility problem. Fibonacci – Lucas numbers and Phi ratios also appeared in the timing of historic May and autumn panics, as well as Moon Sun cycles. Thus, it was hypothesized that there were interrelationships between these phenomena – trading activity, lunisolar tidal harmonics and additive numbers. If proven, it would provide a sound scientific basis for using Phi and Fibonacci numbers in market forecasting, thereby supporting a fundamental tenet of technical analysis.

## Introduction

Fibonacci numbers and Phi (1.618) have long been used in technical analysis to help predict financial outcomes. Various market forecasting techniques are based on such factors, for example the Elliott Wave (Pretcher, 1980) and the Spiral Calendar (Carolan, 1992). Why additive numbers and Phi ratios arise in trading activity has never been explained, despite their common usage. This paper examines Fibonacci – Lucas numbers and inverse Phi ratios in relation to Moon Sun cycles, as well as the timing of historic financial panics.

Numerous correlates can be achieved to support a strong Moon Sun effect in market activity (Dichev & Troy, 2001; Yuan et al, 2006, McMinn, 2006, 2010), while Fibonacci – Lucas numbers and Phi ratios are evident in financial patterns. Based on these two strands of thinking, additive numbers and Phi were hypothesized also to show up in Moon Sun cycles. This was a reasonable speculation, assuming the various factors were valid and interrelated. On assessment, Fibonacci – Lucas numbers and Phi could be firmly established in patterns of lunisolar cycles.

Lunisolar tidal effects are believed to influence human physiological cycles, which in turn determined the prevailing

mass mood and thus market outcomes. Periods of optimism lead to rising markets, while periods of pessimism result in declining indices and depressed markets. The crisis occurs when there is a sudden shift in sentiment from greed to fear. The collective mood is viewed as fluctuating through cycles of optimism – crisis – fear, in harmony with lunisolar cycles. A connection between Moon Sun effects, physiological cycles and market outcomes can be supported by various studies. Hormone levels of animals and humans have been shown to fluctuate over the lunar month (Endres & Schaad, 2002; Zimecki, 2006), while studies have linked hormone levels to market trading success (Chen & Ozdenoren, 2005; Coates & Hebert, 2008; Coates et al, 2009).

Moon Sun data was timed at 12 noon in the financial centre where the crisis or panic occurred (daylight saving ignored). Data on the Dow Jones Industrial Average (DJIA) index was based on the daily closing values throughout the text. The abbreviation A° was used to represent the angular degree between the Moon and Sun (lunar phase), while the ecliptical degree is denoted by E°. This was to prevent confusion between two different concepts. Robert van Gent provides an excellent coverage of the various eclipse

cycles discussed in this paper and is recommended as background reading.

## Fibonacci – Lucas numbers

Readers with a background in technical analysis will already be familiar with Fibonacci numbers. These are an additive series in which each number is the sum of the previous two, beginning 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89..... Lucas numbers are another additive series beginning 2, 1, 3, 4, 7, 11, 18, 29, 47, 76, 123..... Both series are interrelated. Lucas numbers may be derived by adding or subtracting two Fibonacci numbers as shown in Table 1. The Fibonacci series commencing 1, 1.... and the Lucas series commencing 2, 1.... are the simplest additive number series, both of which show up in Moon Sun cycles and financial patterns.

**Table 1**  
**Relationships between Fibonacci and Lucas Numbers**

Adding Fib Numbers	Subtracting Fib Numbers	Lucas Number
1 + 1	1 - (-1)	2
0 + 1	2 - 1	1
1 + 2	3 - 0	3
1 + 3	5 - 1	4
2 + 5	8 - 1	7
3 + 8	13 - 2	11
5 + 13	21 - 3	18
8 + 21	34 - 5	29
13 + 34	55 - 8	47

The golden ratio Phi (1.618) is denoted by the symbol  $\Phi$  and is produced between two successive numbers in any additive series. For example, the ratio of any two successive Fibonacci numbers is alternately greater or less than 1.618 as follows – 1/1 – 1.000; 2/1 – 2.000; 3/2 – 1.500; 5/3 – 1.667; 8/5 – 1.600; 13/8 – 1.625; 21/13 – 1.615; 34/21 – 1.619; 55/34 – 1.618 and so forth. For the larger Fibonacci numbers, the ratio increasingly approaches 1.618.

The important Fibonacci ratios are 0.382, 0.618, 1.382, 1.618, 2.382, 2.618 and so forth. In technical analysis, these ratios are used to help forecast future turning points in market patterns. Inverse Phi ratios are given in Table 2 overleaf.

**Table 2**  
**Inverse Phi Ratios**

Inverse Sqrt Phi Ratios*		Inverse Phi Ratios	
0.786	1/sqrt Phi		
0.618	1/sqrt Phi <sup>2</sup>	0.618	1/Phi
0.486	1/sqrt Phi <sup>3</sup>		
0.382	1/sqrt Phi <sup>4</sup>	0.382	1/Phi <sup>2</sup>
0.300	1/sqrt Phi <sup>5</sup>		
0.236	1/sqrt Phi <sup>6</sup>	0.236	1/Phi <sup>3</sup>
0.186	1/sqrt Phi <sup>7</sup>		
0.146	1/sqrt Phi <sup>8</sup>	0.146	1/Phi <sup>4</sup>
0.115	1/sqrt Phi <sup>9</sup>		
0.090	1/sqrt Phi <sup>10</sup>	0.090	1/Phi <sup>5</sup>
0.071	1/sqrt Phi <sup>11</sup>		
0.056	1/sqrt Phi <sup>12</sup>	0.056	1/Phi <sup>6</sup>

\* Sqrt ratio is the square root of 1.618 i.e. 1.272

### October panics

Major historic October panics occurred in a notable 10 – 50 – 30 – 50 – 10 year series (see Table 3). The six events happened in the two weeks to October 27, with lunar phase around the full Moon (between 160 and 200 A°) or before the new Moon (between 320 and 325 A°). The intervals between the **1857**, **1907**, **1937** and **1987** panics occurred in Fibonacci numbers (3, 5, 8 and 13 multiplied by 10) and thus yielded inverse Phi ratios (see Table 4). NB: Years in **bold** contained major financial crises as listed by Kindleberger (Appendix B, 1996).

How the **1847** and 1997 panics integrate into the overall pattern is puzzling. These panics give intervals in a 5:1 ratio (both Fibonacci numbers) that adds up to 6 (neither a Fibonacci or Lucas number). Even so, the series 10 – 50 – 30 – 50 – 10 years appeared too neat to be coincidental.

October panics in 1929, 1987 and 1997 can also be adjusted to give inverse Phi ratios and double Fibonacci – Lucas numbers (see Table 4). Double Lucas numbers (11 x 2 & 4 x 2) also appeared between the **1907**, **1929** and 1937 October panics.

### September panics

Kindleberger (Appendix B, 1996) only listed three September crises/panics in recent centuries.

1763, September. Amsterdam panic.  
1873, September 19. US Black Friday. Jay Cook & Co failed.  
1931, September 20. Britain announced that it would go off the gold standard.

**Table 3**  
**October panics and Fibonacci numbers**

British and US October Panics										
<b>1847</b> Oct 23	+ 10	<b>1857</b> Oct 14	+ 50	<b>1907</b> Oct 22	+ 30	1937 Oct 18	+ 50	<b>1987</b> Oct 19	+ 10	1997 Oct 27
174 A°		324 A°		196 A°		164 A°		324 A°		320 A°

**Table 4**  
**October panics and inverse Phi ratios**

<b>1857</b> Oct 14	+ 50	<b>1907</b> Oct 22	+ 30	1937 Oct 18	+ 50	<b>1987</b> Oct 19
324 A°		196 A°		164 A°		324 A°
<p><b>1857</b> + 50 <b>1907</b> + 30 1937 <b>1907</b> + 30 1937 + 50 <b>1987</b> 50 divided by 80 = 0.625 (1/Phi). 30 divided by 80 = 0.375 (1/Phi<sup>2</sup>). 3, 5 &amp; 8 are all Fibonacci numbers.</p> <p><b>1857</b> + 50 <b>1907</b> + 80 <b>1987</b> <b>1857</b> + 80 1937 + 50 <b>1987</b> 80 divided by 130 = 0.615 (1/Phi). 50 divided by 130 = 0.385 (1/Phi<sup>2</sup>). 5, 8 &amp; 13 are all Fibonacci numbers.</p>						
<b>1847</b> Oct 23	+ 60	<b>1907</b> Oct 22	+ 30	1937 Oct 18	+ 60	1997 Oct 27
174 A°		196 A°		164 A°		320 A°
<p><b>1847</b> + 60 <b>1907</b> + 30 1937 <b>1907</b> + 30 1937 + 60 <b>1987</b> These are in the ratio of 2:1:2 1, 2, 3 &amp; 5 are all Fibonacci numbers.</p>						
<b>1929</b> Oct 28	+ 58	<b>1987</b> Oct 19	+ 10	1997 Oct 27		
313 A°		324 A°		320 A°		
<p>10 divided by 68 = 0.147 (1/Phi<sup>4</sup>). 58 divided by 68 = 0.853 (1 - 1/Phi<sup>4</sup>). 10, 58 &amp; 68 divided by 2 equals 5 &amp; 34 (Fibonacci numbers) and 29 (Lucas number). The intervals are based on the equation (29 + 5 = 34) x 2.</p>						
<b>1907</b> Oct 22	+ 22	<b>1929</b> Oct 28	+ 8	1937 Oct 18		
196 A°		313 A°		164 A°		
<p>8 &amp; 22 divided by 2 gave 4 &amp; 11 (both Lucas numbers) respectively.</p>						

The intervals between these three events produced the ratio 55:29 – a Fibonacci and a Lucas number respectively (see Appendix 1).

Seven major annual one day (AOD) falls (=> -4.50%) for the DJIA have taken place in September since 1896. These events yield Fibonacci – Lucas numbers and inverse Phi ratios, as shown in Appendix 1. The notable anomaly was the 31 year interval between the AOD falls in 1955 and 1986. NB: The AOD fall is taken as the biggest % DJIA one day fall during the year commencing March 1. It represents the biggest one day shift in negative trader sentiment during a given solar year.

### May panics

A listing of US and Western European May panics were sourced from Kitchin (1933) and Kindleberger (Appendix B, 1996). Historically, May panics have clustered between the 9th and the 21st of the month. If placed in chronological order, the intervals between May panics were nearly always in Lucas numbers (see Table 5). The exception was the 1884-1920 interval of 36 years, which was a double Lucas number (18 x 2). Unlike October panics, May panics showed no lunar phase emphasis.

Lucas intervals between key historic May panics yielded many inverse Phi ratios (see Table 6).

**Table 5**  
**May panics and Lucas numbers**

Historical US and European May Panics												
<b>1819</b> May	+18	<b>1837</b> May 10	+29	<b>1866</b> May 11	+7	<b>1873</b> May 9	+11	1884 May 13	+36	<b>1920</b> May 19(a)	+11	<b>1931</b> May 11
(a) The biggest % one day DJIA fall in 1920 was used as the maximum panic intensity, as no panic date was given by Kindleberger (1996).												
NB: The US 1893 panic was not regarded as a May event, because Black Wednesday occurred on July 26.												

**Table 6**  
**Inverse Phi ratios derived from May panics**

<b>1819</b> May US panic	+ 18	<b>1837</b> May 10 US panic	+ 29	<b>1866</b> May 11 British panic
18 divided by 47 = 0.383 (1/Phi <sup>2</sup> ). 29 divided by 47 = 0.617 (1/Phi). 18, 29 & 47 (all Lucas numbers).				
<b>1837</b> May 10 US panic	+ 29	<b>1866</b> May 11 British panic	+ 18	1884 May 13 US panic
18 divided by 47 = 0.383 (1/Phi <sup>2</sup> ). 29 divided by 47 = 0.617 (1/Phi). 18, 29 & 47 (all Lucas numbers).				
<b>1837</b> May 10 US panic	+ 36	<b>1873</b> May 9 Austrian panic	+ 58	<b>1931</b> May 11 Austrian crisis
36 divided by 94 = 0.383 (1/Phi <sup>2</sup> ). 58 divided by 94 = 0.617 (1/Phi). 36, 58 & 94 divided by 2 = 18, 29 & 47 respectively (all Lucas numbers).				
<b>1873</b> May 9 Austrian panic	+ 11	1884 May 13 US panic	+ 47	<b>1931</b> May 11 Austrian crisis
11 divided by 58 = 0.190 (1/sqrt Phi <sup>7</sup> ). 47 divided by 94 = 0.810 (1 - 1/sqrt Phi <sup>7</sup> ). 11 & 47 (Lucas numbers), 58 (double Lucas number)				

**Table 7**  
**Lucas numbers and eclipse cycles**

n	Phi <sup>n</sup>	Lucas No	Eclipse Cycle	Lunar months	Solar Years
0	1.000	02	Hexon	035	2.830
1	1.618	01	Half Lunar Yr	006	0.485
2	2.618	03	Hepton	041	3.315
3	4.236	04	Octon	047	3.800
4	6.854	07	Tzolkinex	088	7.115
5	11.089	11	Tritos	135	10.915
6	17.942	18	Saros	223	18.030
7	29.030	29	Inex	358	28.945
8	46.971	47	47 YC	581	46.975
9	75.999	76	Short Calippic (a)	939	75.920
10	122.966	123	Half 246 YC (b)	1520	122.895

(a) One Calippic equals 76.0 solar years (940 lunar months) or four Metonic cycles of 19.0 solar years each. The Short Calippic is equal to the Calippic minus one lunar month (939 lunar months).

(b) **Robert van Gent** listed a 246 year eclipse cycle (unnamed) of 3040 lunar months, which divided by two gave the 123 year cycle of 1520 lunar months.

Abbreviation: YC – Year cycle.

**Source of Eclipse Cycle Data:** Robert van Gent **Source:** McMinn, 2006.

The German Black Friday (May 13, 1927) was not listed by Kindleberger (Appendix B, 1996), but this event gave Lucas numbers 4 and 7 when inserted between the 1920 and 1931 May crises. The anomaly was the US Black Thursday (May 9, 1901), which failed to produce Lucas numbers when inserted between the 1884 and 1920 panics. Additionally, the interval between US stock market panics of May 14/21, 1940 and May 28, 1962 was 22 years – a double Lucas number.

### Lunisolar eclipse cycles

Fibonacci – Lucas numbers can be directly linked to Moon Sun cycles. The additive series commencing 35 and 6 lunar months gave Lucas numbers (in terms of solar years) for the following eclipse cycles – Tzolkinex (7 years), Tritos (11 years), Saros (18 years), Inex (29 years), 47 year cycle, Short Calippic (76 years) and the 123 year cycle (see Table 7). For cycles less than 7 years and over 123 years, the link with Lucas numbers peters out, as solar years align less precisely at integral numbers.

According to van den Bergh (1955), the interval (in terms of lunar months) between two solar or lunar eclipses can be derived from the formula:

$$T = a \cdot \text{Inex} + b \cdot \text{Saros}$$

where T is the interval between successive eclipses in numbers of lunar months.

a and b are integral numbers (zero, negative or positive).

The Saros equals 18 solar years (223 lunar months), while the Index equals 29 solar years (358 lunar months) with 18 and 29 both being Lucas numbers.

Based on van den Bergh's formula, the series commencing 35 and 6 lunar months is composed in multiples of the Inex and Saros in patterns of Fibonacci numbers (see Table 8). The Saros or Inex number may be positive or negative for eclipse cycles below 135 lunar months. For eclipse cycles of 223 lunar months or more, the Saros and Inex numbers are always positive.

Another additive series may be produced commencing 62, 37 lunar months, which was equivalent to a series beginning 5, 3 solar years (two Fibonacci numbers) (see Table 9). In this series, the same lunar phase repeats at

**Table 8**  
**Fibonacci numbers and eclipse cycles**

Lun Mths	Eclipse Cycle	Inex	Saros	a.Inex + b.Saros
35	Hexon	-8	13	-8 I + 13 S
6	Half Lunar Year	5	-8	5 I - 8 S
41	Hepton	-3	5	-3 I + 5 S
47	Octon	2	-3	2 I - 3 S
88	Tzolkinex	-1	2	-I + 2 S
135	Tritos	1	-1	I - S
223	Saros	0	1	S
358	Inex	1	0	I
581	47 YC Unnamed	1	1	I + S
939	Short Calippic	2	1	2 I + S
1520	Half 246 YC Unnamed	3	2	3 I + 2 S
2459	199 YC Unknown (a)	5	3	5 I + 3 S
3979	322 YC Unknown (a)	8	5	8 I + 5 S
6438	521 YC Unnamed	13	8	13 I + 8 S

(a) Eclipse cycle not listed by Robert van Gent..

Abbreviations: S - One Saros cycle of 223 lunar months.

I - One Inex cycle of 358 lunar months. YC - Year Cycle.

**Source of Eclipse Data:** Robert van Gent **Source:** McMinn, 2006.

**Table 9**  
**The additive series commencing 5, 3 solar years**

Named Cycle	Lunar Months	Solar Years	5, 3 Year Series	van den Bergh's Formula a.Inex + b.Saros
	62	5.012	5	-97 I + 156 S
	37	2.992	3	68 I - 109 S
Octaeteris	99	8.004	8	-29 I + 47 S
	136	10.996	11	39 I - 62 S
Metonic	235	19.000	19	10 I - 15 S
	371	29.996	30	49 I - 77 S
	606	48.996	49	59 I - 92 S
	977	78.993	79	108 I - 169 S
	1583	127.989	128	167 I - 261 S
	2560	206.981	207	275 I - 430 S
	4143	334.970	335	442 I - 691 S

the same time of year over hundreds of years and included the important 8 year Octaeteris and 19 year Metonic cycles. Applying van den Bergh's formula to this series did not yield Fibonacci - Lucas numbers. How the series beginning 5, 3, 8.... years integrates with the additive series in Table 7 remains unknown.

### Discussion and conclusions

Eclipse cycles are important because they give repeating angles between the Moon, the Sun and other lunisolar factors (McMinn, 2006). The changing angles between the Moon and the Sun in the heavens play a key role in terrestrial tidal harmonics, which are believed to influence the mass mood. Eclipse cycles, as discussed in this analysis, are separate from eclipse phenomena. Eclipse events

may appear spectacular to humans on Earth, but the author could not establish any direct links between market trends and the timing of solar/lunar eclipses.

Moon Sun astronomical planes seem highly relevant - the plane of the Earth's orbit around the Sun (the ecliptic), the plane of the Moon's orbit around the Earth, the plane of the Earth's equator extended out onto the heavens (celestial equator) and so forth. The points where these planes intersect are called nodes, imaginary points that seem to yield maximum significance.

The random walk - efficient market hypothesis was the prevailing paradigm in academic finance during the latter decades of the 20th century. According to this tenet, financial markets were

believed to function both efficiently and randomly. This completely contradicted technical analysis, which viewed market activity as being repetitive and mathematically structured. Moon Sun correlates, additive numbers and Phi cannot arise in a random market and thus the findings of this paper completely contradict the concept of market randomness. A more realistic view is to consider markets to be mathematically structured, moving in tune with Moon Sun cycles.

Lunisolar cycles can be intimately linked with Fibonacci - Lucas numbers, as shown in this assessment. The additive series commencing 35 and 6 lunar months gave:

\* Lucas numbers 7, 11, 18, 29, 47, 76, 123.... in terms of solar years (see Table 7).

\* Fibonacci numbers using van den Berg's formula (see Table 8).

Another additive series beginning with 5 and 3 solar years (both Fibonacci numbers) produced the same lunar phase at the same time of year over hundreds of years (see Table 9). Fibonacci - Lucas numbers also show up in trends of historic May and autumn panics. Thus, close interrelationships are speculated to arise between financial trends, lunisolar cycles, additive numbers and Phi ratios. This would give strong support for the use of Phi and Fibonacci - Lucas numbers in market forecasting. There may be emerging a simple theory based on Moon Sun tidal harmonics, which would reduce the complexity of market cycles to a few basic principles. This would greatly boost our understanding of financial timing and offer the potential to make accurate market forecasts years in advance. Only time will tell.

The connection between free markets, lunisolar cycles and Fibonacci - Lucas numbers can only be proposed as a hypothesis. How Moon Sun tidal harmonics actually functioned in relation to financial trends remained enigmatic. Much more research is necessary before definitive conclusions can be drawn. Lunisolar cycles potentially offer a causal explanation why financial patterns exhibit additive numbers and Phi ratios, thereby supporting a fundamental principle in technical analysis. Hopefully, this paper offers an impetus for other researchers to explore this topic more fully.

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**Appendix 1**

**Inverse Phi ratios derived from September AOD falls**

**DJIA AOD September falls => -4.50% since 1896**

AOD Fall	% Fall	Sun E°	Moon E°	Phase A°
Sep 24, 1931	-7.07	181	338	157
Sep 03, 1946	-5.56	161	252	091
Sep 26, 1955	-6.54	183	301	118
Sep 11, 1986	-4.61	169	264	095
Aug 31, 1998	-6.63	158	265	107
Sep 11, 2001	na (a)	169	090	281

**Kindleberger's September Panics**

1763 Sep	+ 110	1873 Sep 19	+ 58	1931 Sep 20
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These intervals gave a 55:29 ratio, which comprised a Fibonacci and a Lucas number respectively. Adding these numbers gave 84, which cannot be linked to Fibonacci - Lucas numbers.

**Inverse Phi Ratios Derived From September DJIA AOD Falls => -4.50%**

1931 Sep 24 157 A°	+ 15	1946 Sep 3 091 A°	+ 40	1986 Sep 11 095 A°
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Intervals gave an 3:8 ratio comprising two Fibonacci numbers. Adding 3 and 8 gave 11, a Lucas number, while 55 was a Fibonacci number.

1946 Sep 3 091 A°	+ 40	1986 Sep 11 095 A°	+ 15	2001 Sep 11 281 A°
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Intervals gave an 8:3 ratio comprising two Fibonacci numbers. Adding 3 and 8 gave 11, a Lucas number, while 55 was a Fibonacci number.

1931 Sep 24 157 A°	+ 15	1946 Sep 3 091 A°	+ 55	2001 Sep 11 281 A°
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Intervals gave an 3:11 ratio comprising two Lucas numbers. Adding 3 and 11 gave 14 a double Lucas number.

1931 Sep 24 157 A°	+ 55	1986 Sep 11 095 A°	+ 15	2001 Sep 11 281 A°
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Intervals gave an 11:3 ratio comprising two Lucas numbers. Adding 3 and 11 gave 14 a double Lucas number.

1986 Sep 11 095 A°	+ 12	1998 Aug 31 107 A°	+ 3	2001 Sep 11 281 A°
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Intervals gave a ratio of 4:1 or two Lucas numbers. Adding 4 and 1 equals 5, a Fibonacci number.

<b>1931</b> Sep 24 157 A°	+ 15	1946 Sep 03 091 A°	+ 9	1955 Sep 26 118 A°
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Intervals gave a ratio of 5:3, which added together gave 8. All Fibonacci numbers.

Includes falls DJIA AOD falls => -4.50% since 1896.

(a) The September 11 terrorist attack was taken as the day of maximum panic intensity for 2001.

**Abbreviations:** E° is the degree on the ecliptical circle. A° is the angular degree between the Moon and Sun (lunar phase). AOD - The annual one day fall is taken as the biggest % one day fall in the year commencing March 1.