Uni-Economic & Innovative Property Price Prediction in the HKSAR

Prof. Samuel K. M. Ho  
*Adjunct Professor, HK Buddhist College,  
Founder Chair, ICIT, ISSO, HKSSA & APBEST Academy, HKSAR*

Dr. Marco C. K. Lau  
*Assistant Professor, Division of Business Management, HKBU-BJNU United Int. College, Zhuhai, HKSAR & China*

**ABSTRACT**

Historically, the study of the world’s economy was classified into Micro-economics and Macroeconomics. Perhaps, contemporary economists should learn from the ‘astronomists’ about the universe which we are part of. We shall name this ‘Uni-economics’. Many scientists have found that sunspots affect human behaviour. Some research findings even relate the 11 year periodic cycle to war and peace of mankind. It is also widely-known in the medical profession that sunspot radiation actually affects the physiology of our human body. With all these evidence in mind, the aim of this exploratory research paper is to investigate how sunspot activities can affect the investors’ sentiment in the financial world since 1970 when the first post-war financial crisis was built up resulting from the oil crisis in the early ’1970s. Time series techniques were deployed to track down the changes of Sunspot Counts over the last 44 years and their impact on the world’s 4 main financial indices, i.e., S&P, FTSE, Nikkei & HSI. It was pretty astonishing to find out that, whilst there are insignificant correlations amongst the 4 financial indices over the period under investigation, the impact of the Sunspot Counts on them are highly significant, even on a day-to-day time series analysis. As a corollary of the finding, the HK Property Market is used as a test case for the research output. It was interesting to find out that, apart from the Solar Minima, the Change-of-Slope from positive to negative also has a significant impact on the HK property prices. Hence, it was evident that there are 2 property clashes during the 11 year sunspot cycle, and their timing can be predicted pretty accurately (2014 & 2019) within +/- one year.

**Keywords:** Uni-Economy, Sunspots numbers, Global Financial Indices, HKSAR Property Prices
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1.0 Introduction: What are ‘Uni-economics’ and Sunspot?

The classical study of the world’s economy can be broadly classified into Micro-economics and Macroeconomics. According to Wikipedia, Micro-economics is “a branch of economics that studies how individuals, households and firms and some states make decisions to allocate limited resources.” Macroeconomics is “a branch of economics that deals with the performance, structure, and behavior of a national or regional economy as a whole”. Perhaps contemporary economists should learn from the ‘astronomists’ about the universe which we are part of. The authors shall name this ‘Uni-economics’, and shall define it as “a branch of economics that explore the impact of the universe at large on the economy of mankind, including financial market, industrial, national and global development matters”.

One of the major criticisms of behavioral finance is that by choosing which bias to emphasize, one can predict either under-reaction or overreaction (Ritter, 2003). This criticism of behavioral finance might be called “model dredging.” In other words, one can find a story to fit the facts to ex post explain some puzzling phenomenon. But how does one make ex ante predictions about which biases will dominate? There are two excellent articles that address this issue: Barberis and Thaler (2002), and Hirshleifer (2001). Hirshleifer in particular addresses the issue of when we would expect one behavioral bias to dominate.
others. He emphasizes that there is a tendency for people to excessively rely on the strength of information signals and under-rely on the weight of information signals. This is sometimes described as the salience effect.

In the first section of the first chapter of the Bible, God started his creation and the first thing He did was “Let there be light”. This creation has put the Sun symbolically into the centre of the Universe affecting mankind. This also gives us the hint that we should study the sun first before human economic activities. Sunspots are dark spots, some as large as 5 times the Earth’s diameter, moving across the surface of the sun, contracting and expanding as they go (see Figure 1). These strange and powerful phenomena are known as sunspots. According to George Fischer (1998), a solar astronomer at the University of California, "A sunspot is a dark part of the sun's surface that is cooler than the surrounding area. It turns out it is cooler because of a strong magnetic field there that inhibits the transport of heat via convective motion in the sun. The magnetic field is formed below the sun's surface, and extends out into the sun's corona."

![Figure 1: An image of the region around a sunspot](image)

As well as being a darker area on the sun, a sunspot is an area that temporarily has a concentrated magnetic field. This magnetic force inhibits the convective motion, which ordinarily brings hot matter up from the interior of the sun, so the area of the sunspot is cooler than the surrounding plasma and gas. But as Fischer points out, sunspots are actually quite hot. "Instead of being about 5,400°C like the rest of the photosphere, the temperature of a sunspot is more like 3,700°C. But that is still very hot, compared to anything here on the Earth." (Fischer, 1998)

2.0 The Sunspot Cycle

In the last few decades, the forces behind sunspots are becoming better understood, but we have known for over 160 years that sunspots appear in cycles (Figure 2). The average number of visible sunspots varies over time, increasing and decreasing on a regular cycle of an average about 11 years. An amateur astronomer, Heinrich Schwabe (1789-1875), was the first to note this cycle, in 1843. The part of the cycle with low sunspot activity is referred to as "solar minimum" while the portion of the cycle with high activity is known as "solar maximum."
Figure 2: The Sunspot Cycle from 1945-2008 (Highest in 1949 at 174; Lowest in 2008 at 2)

3.0 Sunspot Light Image and X-ray Image

George Fischer discusses what can be seen in white light and x-ray images of the sun.

Figure 3: A visible light image (left) and an X-ray image (right) of the sun

Will the dark areas of high sunspot activity visible in white light images correspond to the bright areas of active regions visible in the x-ray images (Figure 3)? According to Fischer, "It is known that the area of sunspots group is roughly proportional to the amount of x-rays coming out of an active region."
4.0 The Sun-Earth Connection

The sun's energy has a great effect on Earth. Its light provides energy for photosynthesis in plants and algae, the basis for the food chain, which ultimately feeds almost all life on Earth. Scientists today have discovered a lot about the way the sunspots affect the Earth. According to Dearborn (1998), "The sunspot itself, the dark region on the sun, doesn't by itself affect the Earth. However, it is produced by a magnetic field, and that magnetic field doesn't just stop, it comes to the surface and expands out above the surface...." Hot material called plasma near a sunspot interacts with magnetic fields, and the plasma can burst up and out from the sun, in what is called a solar flare. Energetic particles, x-rays and magnetic fields from these solar flares bombard the Earth in what are called geomagnetic storms. When these storms reach Earth, they affect us in many ways.

Ordinarily, the Earth's own magnetic field protects the Earth from most of the sun's emissions. However during periods of intense sunspot activity, which coincide with solar flares and coronal mass ejections, the geomagnetic flow from the sun is much stronger. These magnetic storms produce heightened, spectacular displays of the Northern and Southern Polar Lights (Figure 4).

As Fisher describes it, "The Earth has a protective cocoon of magnetic field called the magnetosphere, and it normally protects us from the magnetic particles of the solar wind, and the other energetic particles in the solar wind. But during a coronal mass ejection we actually have a chunk of the sun that breaks away and hits the Earth's magnetosphere, and disturbs it, and this disturbance shows up as Polar Lights."

5.0 The Effect of Sunspots on the Earth's Climate

Even though sunspots are darker, cooler regions on the face of the sun, periods of high sunspot activity are associated with a very slight increase in the total energy output of the sun. Dark sunspot areas are surrounded by areas of increased brightness. Some parts of the solar spectrum, especially ultraviolet, increase a great deal during sunspot activity. Even though ultraviolet radiation makes very little contribution to the total energy that comes from the sun, changes in this type of radiation can have a large effect on the Earth's atmosphere, especially the energy balance and chemistry of the outer atmosphere. Though the connection between sunspot activity and the Earth's climate is still being debated, it is known that a period of unusually low sunspot activity from 1645-1715, called the Maunder Minimum, coincided with a period of long cold winters and severe cold temperatures in Western Europe, often called the "Little Ice Age." However, as far as we can currently tell, variations in the sunspot cycle seem to have
less impact on the Earth's climate than human actions, such as burning fossil fuels or clear-cutting forests, do.

### 6.0 Sunspots and Human Behavior

Borderland Sciences has been investigating the relationship of the Sun and human behaviour for many years, and we are quite confident that we can predict behaviours based on sunspot fluctuations over very short and long durations within the Solar Cycle of 11 years (James Borges, 1998?). Historically, research has been conducted to link the 11 year cycle of the sun to changes in human behavior and society. The most famous research had been done by Professor A.L. Tchijevsky, a Russian scientist, who presented a paper to the American Meteorological Society at Philadelphia in the late 19th century. He prepared a study of the history of mass human movement compared to the solar cycle, beginning with the division of the Solar cycle into four parts: 1) Minimum sunspot activity; 2) increasing sunspot activity; 3) maximum sunspot activity; 4) Decreasing sunspot activity. He then divided up the agitation of mass human movements into five phases:

- **(a)** provoking influence of leaders upon masses
- **(b)** the "exciting" effect of emphasized ideas upon the masses
- **(c)** the velocity of incitability due to the presence of a single psychic center
- **(d)** the extensive areas covered by mass movements
- **(d)** Integration and individualization of the masses

By these comparisons he constructed an "Index of Mass Human Excitability" covering each year from 500 B.C. to 1922 A.D. He investigated the histories of 72 countries in that period, noting signs of human unrest such as wars, revolutions, riots, expeditions and migrations, plus the number of humans involved. Tchijevsky found that fully 80% of the most significant events occurred during the years of maximum sunspot activity. He maintained that the "exciting" period may be explained by an acute change in the nervous and psychic character of humanity, which takes place at sunspot maxima.

Tchijevsky discovered that the solar minimum is the lag period when repression is tolerated by the masses, as if they lacked the vital energy to make the needed changes. He found that during the sunspot maximum, the movement of humans is also at its peak. Tchijevsky's study is the foundation of sunspot theory on human behavior, and as Harlan True Stetson (1937), in his book Sunspots and Their Effects (available from BSRF), stated, "Until, however, someone can arrive at a more convincing excitability quotient for mass movements than professor Tchijevsky appears yet to have done, scientists will be reluctant to subscribe to all the conclusions which he sets forth." Stetson did acknowledge that the mechanism by which ultraviolet radiation is absorbed was still a puzzle biologists had to solve.

The mechanism behind the stimulation of human behavior is still a mystery, but the theories of Georges Lakhovsky (1985) may shed some light. He considered his book, “The Secret of Life”, the extension of a scientific hypothesis of a new theory of life. The Sun is one of Earth’s primary sources of cosmic radiation. While the Sun does produce its own radiations, solar winds actually capture passing cosmic dust and radiation and blow it into the Earth’s atmosphere. While it may seem frightening to some, this can actually be considered the Primal Vibration that sets the cells vibrating with Vital Force. This is the Prana, that Cosmic Breath, which is meant to vitalize man, and is the source for our evolution.
7.0 Sun’s Radiation and Human Biological Reaction

Dr. George Crile, a distinguished American surgeon, studied the sun in light of its radiant energy. In the ‘Preliminary Remarks’ to Lakhovsky’s The Secret of Life, Professor d’Arsonval quotes Crile: “It is clear that radiation produces the electrical current which operates adaptively the organism as a whole, producing memory, reason, imagination, emotion, the special senses, secretions, muscular action, the response to infection, normal growth, and the growth of benign tumours and cancers, all of which are governed adaptively by the electric charges that are generated by the short wave or ionizing radiation in protoplasm.”

He felt that the entire energy system of living beings is controlled by radiant energy and electrical forces. D’Arsonval points out that Lakhovsky and Crile found that living cells are electrical cells functioning as system of generators, inductance lines, and insulators. The underlying mechanism is the oscillating circuit. D’Arsonval explains further that a conductor is said to possess inductance if a current flowing through it causes a magnetic field to be set up round it. From such a circuit, energy is readily given off in the form of waves. According to Lakhovsky, the nucleus of a living cell may be compared to an electrical oscillating circuit. The nucleus consists of tubular filaments, chromosomes, mitochondria, made up of insulating material and filled with a conducting fluid containing all the mineral salts found in sea water. These filaments are thus comparable to oscillating circuits endowed with capacity according to a specific frequency.

The cosmic radiation from the Sun is a blessing of Vital Force. As Lakhovsky has postulated, it is the cosmic radiations that give the cells their vibrant oscillations. While the sunspot maxima is occurring, the solar flares and the subsequent geo-magnetic reactions effect the many subtle reactions that take place within our bodies at the atomic level. It has been theorized that this has a direct relationship to the metabolism of the body. The increase of penetrating waves during a solar storm causes an excitation in these electro-chemical reactions within the body. Tchijevsky also identified correlations between changes in solar magnetic activity with biological processes. In light of Lakhovsky’s theory in his own words, “…with the aid of elementary analogies, that the cell, essential organic unit in all living beings, is nothing but an electromagnetic resonator, capable of emitting and absorbing radiations of very high frequency.” A plausible mechanism is provided to understanding the stimulating effects the radiation from the Sun has on human behavior.

8.0 Historical Evidence of the Link between Sunspot Cycle with Human Creativity and Cultural Development

In another historical study Suitbert Ertel writes in his article “Synchronous Bursts of Activity in Independent Cultures; Evidence for Extraterrestrial Connections” that evidence has been reported suggesting a link between historical oscillations of scientific creativity and solar cyclic variation. Eddy’s discovery of abnormal secular periods of solar inactivity (Maunders minimum type) offered the opportunity to put the present hypothesis to a crucial test. Using time series of flourish years of creators in science, literature and painting (A.D. 600-1800), it was found as expected:
1) Cultural flourish curves show marked discontinuities (bursts) after the onset of secular solar excursions synchronously in Europe and China;
2) During periods of extended solar excursions, bursts of creativity in painting, literature, and science succeeded one another with lags of about 10-15 years;
3) The reported regularities of cultural output are prominent throughout with eminent creators. They decrease with ordinary professionals. The hypothesized extraterrestrial connection of human culture has thus been strengthened.
The above evidence shows that during the maxima of sunspot activity human behavior is stimulated.

There are some Russian researches that show an increase in cardiac problems during sunspot maxima. We could see the stress of solar activity on the biology of living things as an evolutionary agent weeding out the old and sick and strengthening those who can resonate with its radiations. In his ‘Preliminary remarks to Lakhovsky’s The Secret of Life the Professor d’Arsonval gives several examples of research done in the last hundred years that shows the most malefic effects from solar activity come at the sunspot minima. He notes from the British Medical Journal, March 7th & 14th of 1936 that both Colonel C.A. Gill and Dr. Conyers Morrel found increases in pandemics of deadly diseases during the period of minimal sunspot activity. In Gill’s study he showed that every pandemic of malaria since sunspot records were taken had occurred when sunspot numbers were lowest. Similar trends were observed in East Africa and elsewhere with Yellow fever epidemics since 1800 occur during the sunspot minima. Dr. Conyers Morrel also finds that, “waves of epidemic diseases covering considerable periods exhibit a very close correspondence with the phases of sunspot periods. Diphtheria, Typhus, and Dysentery seemed to prosper when there was an absence of solar activity. The most significant world economic chronicle is summarized in Table 1 below.

Table 1: World Economic Chronicle since 1920

<table>
<thead>
<tr>
<th>Sunspot Minima *</th>
<th>World Economic Chronicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>Post WWI Economic Depression</td>
</tr>
<tr>
<td>1931</td>
<td>USA Wall Street Stock Crashes</td>
</tr>
<tr>
<td>1942</td>
<td>WWII Economic Depression</td>
</tr>
<tr>
<td>1953</td>
<td>1st Global Financial Crisis</td>
</tr>
<tr>
<td>1964</td>
<td>Second Global Financial Crisis. (HSI was listed in 1964 and dropped by 20% in the following year.)</td>
</tr>
<tr>
<td>1975</td>
<td>1st Global Oil Crisis</td>
</tr>
<tr>
<td>1986</td>
<td>2nd Global Oil Crisis</td>
</tr>
<tr>
<td>1997</td>
<td>1st Global Financial Tsunami</td>
</tr>
<tr>
<td>2008</td>
<td>2nd Global Financial Tsunami</td>
</tr>
<tr>
<td>2019</td>
<td>???</td>
</tr>
</tbody>
</table>

* around 11-year cycle

9.0 Sunspot and Financial Indices Cycles – Econometrics methodology

9.1 Past Literature

There have been several claims and counterclaims for the existence of a correlation between sunspot activity (as measured by the number of sunspots) and the economy or stock-market movements (Modis, 2007). Interestingly, opponents of this notion, like astronomers Wall and Jenkins (2003), claim that this correlation is well-known but mainly as folklore because trying to substantiate it is very difficult — and trying to find an underlying physical cause even more so. But they admit that this correlation may after all exist because global temperature is now known to correlate with sunspot number and long-term weather trends may have physical, social and economic effects.

At the same time, proponents of this notion, like “guru” Mandeville (2003), claim, “it is easy to see that both political and economic affairs are profoundly caught up and influenced by the ‘waves’ of sunspot
energy.” But he also admits that there is zero correlation between daily price movements and average daily sunspot numbers and there is only a weak connection between long-term historical trends in the prices and average monthly or annual trends in the numbers of the sunspots.

Unfortunately, the above claims fail to provide a scientific explanation on the link between sunspot and human activities, hence the stock movement. Moreover, they have not provided a rigorous proof based on sound statistical theory on the correlation between sunspot number and the major financial indices of the world.

9.2 Analytical Techniques Deployed

The econometrics methodology deployed is in three steps. Firstly, time series techniques were deployed to track down the changes of Sunspot Counts over the last 38 years on the world’s 3 main financial indices, i.e., S&P, FTSE and Nikkei. Secondly, the long run function of a particular stock price index could be specified as a natural logarithm transformation function. Finally, Granger’s (2003 Nobel Prize Winner in Economics) Cointegration Methodology is deployed to test the equilibrium relationships.

9.3 Preliminary Results

Time series techniques were deployed to track down the changes of Sunspot Counts over the last 38 years on the world’s 3 main financial indices, i.e., S&P, FTSE and Nikkei. The historical data of Heng Seng Index (HSI), FTSE_ALL (FTSE), S&P (SP), Japan Nikkei Index (Nik) and the number of sunspot (SUN) are plotted in Figure 5 and readers may have more information regarding the behavior of those daily time series span from 4/4/1962 to 26/12/2008. Two preliminary observations were found. First, the time series of “number of sunspots” exhibits strong cyclical behaviour. Second, all three stock markets seem to commove together, in particular for “FTSE” “Nik” and “S&P”.
Figure 5: Historical Data of Stock Indexes and Numbers of Sunspot (4/4/1962-26/12/2008)
In order to have a clearer picture regarding all series under investigation, series in natural logarithm are plotted in Figure 6.

![Figure 6: Natural logarithm of variables](image)

### 9.4 Long Run Equation

The long run function of a particular stock price index could be specified as below, for example, the HSI function may be written as:

\[
INHSI_t = \alpha_0 + \alpha_1 LNFTSE_t + \alpha_2 LNSP_t + \alpha_3 LNNIK_t + \alpha_4 LNSUN_t + \epsilon_t \tag{1}
\]

Where \(\alpha_0\) was the constant intercept term. \(\alpha_1, \alpha_2, \alpha_3\) and \(\alpha_4\) are sensitivity for LNFTSE, LNSP and LNNIK and LNSUN respectively; \(\epsilon_t\) was a random disturbance term with its usual classical assumptions; and \(L\) was natural logarithm transformation operator.

We expected \(\alpha_1 > 0, \alpha_2 > 0, \alpha_3 > 0\) and \(\alpha_4\) was uncertain. However, it was well known that spurious regression was problematic if using Ordinary Least Squares (OLS) when time series are not with the same order of integration. Moreover, if time series have a unit root we need to take the first difference of variables in eq (1) in order to obtain a stationary series:

\[
\Delta INHSI_t = \alpha_0 + \alpha_1 \Delta LNFTSE_t + \alpha_2 \Delta LNSP_t + \alpha_3 \Delta LNNIK_t + \alpha_4 \Delta LNSUN + \epsilon_t \tag{2}
\]

For the eq (2) \(\Delta\) is the difference transformation operator. However, Maddala (1992) argues that “long-run information” in the data was ignored in eq (2) once the data was manipulated by taking its first
difference. Hence, the error correction (EC) term should be introduced and it was the central idea of co-
integration theory. The one period lagged EC term, which integrated the short-run dynamics, in the long
run demand function was introduced and eq (2) becomes:

\[ \Delta \text{INHSI}_t = \alpha_0 + \alpha_1 \Delta \text{LNFTSE}_t + \alpha_2 \Delta \text{LNSP}_t + \alpha_3 \Delta \text{LNNIK}_t + \alpha_4 \Delta \text{LNSUN}_t + \beta \text{EC}_{t-1} \varepsilon_t \quad (3) \]

where \( \text{EC}_{t-1} \) was the one period lagged error-correction term and eq(3) was called the Error Correction
Model (ECM). The ECM model was estimated to determine the short-run dynamic behavior of index
function. Two features of ECM we should mention. Firstly, all variables included in the ECM were
stationary and first differenced to avoid superior outcome. Secondly, the sign of the EC must be
negative because the change of index can diverge from its long run equilibrium in the short run. However,
the error term, EC_{t-1} will correct such divergence behavior in the next period once such disequilibrium
occurred. This implied that the larger the coefficient (\( \beta \)) of EC_{t-1} the higher the speed of convergence
toward the equilibrium.¹

### 9.5 Unit Root Test

Unit root tests can be used to determine if trending data should be first differenced to render the data
stationary. Pre-testing for unit roots was often a first step in the cointegration modeling which aimed to
detect long-run equilibrium relationships among nonstationary time series variables. If the variables in
question were I (1), then cointegration techniques can be used to model these long-run relations. Useful
surveys on issues associated with unit root testing are given in Stock (1994), Maddala and Kim (1998)

Stationarity of a time series can be tested by Augmented Dicky Fuller (ADF) unit root test pioneered by
Dickey and Fuller (1979). They showed that under the null hypothesis of a unit root, ADF statistic did not
follow the conventional Student’s t-distribution; they further derived the asymptotic results and simulated
critical values for various test and sample sizes. The order of integration of the variables in eq (2) may be
determined by applying ADF test. Consider a series at time t,

\[ \Delta q_t = \alpha_0 + b q_{t-1} + \sum_{i=1}^{k} \sigma_i \Delta q_{t-i} + \varepsilon_t \quad \text{(4)} \]

Where \( q_t \) can be replaced by time series Ln(LM), Ln(LP), and Ln(LGDP), \( \Delta q_t \) was the series of interest in first
difference. \( \sum_{i=1}^{k} \sigma_i \Delta q_{t-i} \) is the augmenting term and \( \varepsilon_t \) was the Independently and Identically (IID)
distributed error, i.e. \( \varepsilon_t \sim iid(0, \sigma^2) \). Equation (4) were estimated by Ordinary Least Square (OLS)
technique, and the unit root null hypothesis was rejected when the ADF-statistic was found to be
significant for the null: \( b = 0 \) against the alternative \( b < 0 \). Findings were presented in Table 2, which
indicated that all variables in our study were non-stationary, therefore cointegration and error correction
approaches was proposed in the next sections. Phillips and Perron (1988) (hereafter PP test) proposed an
alternative (nonparametric) method of controlling for serial correlation when testing for a unit root.

¹ Results are available upon request.
9.6 Johansen and Jeuselius Cointegration test and ECM

The empirical model that was used in the 1980s was based on the assumption that the variables in these models were stationary. However, the problem was that statistical inference associated with stationary processes is no longer valid if the time series were indeed following nonstationary processes.

Granger (2003) demonstrated that the statistical methods used for stationary time series could yield wholly misleading results when applied to the analysis of nonstationary data. His significant discovery was that specific combinations of nonstationary time series may exhibit stationarity, thereby allowing for correct statistical inference. Granger called this phenomenon cointegration. He developed methods that have become invaluable in systems where short-run dynamics are affected by large random disturbances and long-run dynamics are restricted by economic equilibrium relationships. Examples include the relations between wealth and consumption, exchange rates and price levels, and short and long-term interest rates.

Granger and Newbold pointed out that traditional OLS test may often suggest a statistically significant relationship between variables where none in fact existed. They reached their conclusion by generating two independent nonstationary series and regressed these series on each other using traditional OLS. Surprisingly, the coefficient estimated was highly statistically significant despite the fact that the variables in the regression were independent. Later on, Engle and Granger considered the problem of testing the null hypothesis of no cointegration between a set of non-stationary variables and provided a rigorous proof of the Granger representation theorem. They won the Nobel Prize in Economics in 2003 due to their innovation on the framework of cointegration and error correction.

The term “cointegration” can be viewed as the statistical expression of the nature of equilibrium relationships. Variables may draft apart in the short run but if they diverge without bound, no equilibrium relationship could be said to be existed. Therefore, economic significance can be defined in terms of testing for equilibrium.

If all series were I(1) we may apply Johansen and Jeuselius cointegration test in order to see whether any combinations of the variables in eq(1) are cointegrated. Given a group of non-stationary series, we may be interested in determining whether the series are cointegrated, and if they were, in identifying the cointegrating (long-run equilibrium) relationships. We implemented Vector Auto-Regressive (VAR)-based cointegration tests as developed by Johansen (1990,1991,1995) to the eq (1).

Consider a VAR of order p:

\[ y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + \beta x_t + dD + \varepsilon_t \]  

(5)

Where \( y_t \) was a k-vector of non-stationary I(1) variables and in our case it consisted LNHSI, LFTSE, LNSP, and LNSUN; \( \varepsilon \) was a vector of innovations.

We can rewrite the VAR as:

\[ \Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \beta x_t + \varepsilon_t \]  

(6)

where \( \Pi = \sum_{i=1}^{p} A_i - I \), \( \Gamma_i = - \sum_{j=i+1}^{p} A_j \)

Granger’s representation theorem asserted that if the coefficient matrix \( \Pi \) has reduced rank \( r<k \), then there existed \( k \times r \) matrices \( \alpha \) and \( \beta \) each with rank \( r \) such that \( \Pi = \alpha \beta' \) and \( \beta' y_t \) was I(0). \( r \) was the number
of cointegrating relations (the cointegrating rank) and each column of $\beta$ is the cointegrating vector. As explained beforehand, the elements of $\alpha$ were known as the adjustment parameters in the VEC model. Johansen's method was to estimate the $\Pi$ matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of $\Pi$. It was pretty astonishing to find out that, whilst there are insignificant correlations amongst the 3 financial indices over the period under investigation, the impact of the Sunspot Counts on them are highly significant, even on a day-to-day time series analysis. Empirical findings were presented in Table 3.

10.0 Empirical Results

10.1 Unit Root Test

Table 2 presented the result for ADF unit root test on variables of our interest. The number of augmenting terms, $k$ was chosen by using Modified Akaike Information Criterion (MAIC) as suggested by Elliot, Rothenberg and Stock. ADF test shows evidence that all series are I (1) variables. ADF and PP unit root tests with time trend drew to the same conclusion, the results will not be reported here to save space but made available upon request. The results were expected since the time series dynamics in Figure 5 do not exhibit mean-reverting properties. Since we confirmed that all variables are non-stationary cointegration techniques can be used to model these long-run relations in the next section.

<table>
<thead>
<tr>
<th>Method</th>
<th>Statistic</th>
<th>Prob.**</th>
<th>Cross-sections</th>
<th>Obs</th>
</tr>
</thead>
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<tr>
<td>Levin, Lin &amp; Chu t*</td>
<td>2.15153</td>
<td>0.9843</td>
<td>4</td>
<td>47588</td>
</tr>
<tr>
<td>Breitung t-stat</td>
<td>2.71512</td>
<td>0.9967</td>
<td>4</td>
<td>47584</td>
</tr>
<tr>
<td>Im, Pesaran and Shin W-stat</td>
<td>1.28445</td>
<td>0.9005</td>
<td>4</td>
<td>47588</td>
</tr>
<tr>
<td>ADF - Fisher Chi-square</td>
<td>3.87690</td>
<td>0.8681</td>
<td>4</td>
<td>47588</td>
</tr>
<tr>
<td>PP - Fisher Chi-square</td>
<td>2.93938</td>
<td>0.9381</td>
<td>4</td>
<td>47707</td>
</tr>
</tbody>
</table>

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Null Hypothesis: LNSUN has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 29 (Automatic based on AIC, MAXLAG=39)

<table>
<thead>
<tr>
<th></th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Dickey-Fuller test statistic</td>
<td>-1.825463</td>
<td>0.6925</td>
</tr>
</tbody>
</table>

Test critical values:
1% level -3.959079
5% level -3.410314
10% level -3.126907

10.2 Johansen and Jeuselius Cointegration test

Lag of four in level for the Vector Auto-Regressive (VAR) model specification was selected as suggested by Pesaran and Pesaran. Table 3 presents the findings. Take the determinants of Hong Kong Stock market an example, we first look at null hypothesis of no cointegration (r=0) among variables. The p-value of the maximal eigenvalue test is 0.0000 & 0.0001 respectively, therefore we conclude that the null hypothesis of no cointegration (r=0) was rejected and the conclusions are in favor of the alternative of r=1 at the 1% significant level. Since the null hypothesis of \( r \leq 1 \) & \( r \leq 2 \) cannot be rejected at the 1% significant level hence conclude that there was a unique cointegrating relationship among variables under examination. Trace test also found the same conclusion that there was strong evidence in support of a unique cointegrating relationship among variables and we came to the same conclusion that all variables maintained a unique cointegrating relationship. It was pretty astonishing to find that, whilst there are insignificant correlations amongst the 4 financial indices over the period under investigation, the impact of the Sunspot Counts on them are highly significant, even on a day-to-day time series analysis (see Table 4).

Table 3a: Johansen and Jeuselius Cointegration Test #1

<table>
<thead>
<tr>
<th>Hypothesize</th>
<th>Trace</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>eigenvalue</td>
<td>statistic</td>
<td></td>
</tr>
<tr>
<td>None *</td>
<td>0.018384</td>
<td>218.7169</td>
<td>69.81889</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.001763</td>
<td>33.13379</td>
<td>47.85613</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.000961</td>
<td>15.48504</td>
<td>29.79707</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.000439</td>
<td>5.866159</td>
<td>15.49471</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.000147</td>
<td>1.470484</td>
<td>3.841466</td>
</tr>
</tbody>
</table>

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

<table>
<thead>
<tr>
<th>Hypothesize</th>
<th>Max-Eigen</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>eigenvalue</td>
<td>statistic</td>
<td></td>
</tr>
<tr>
<td>None *</td>
<td>0.018384</td>
<td>185.5831</td>
<td>33.87687</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.001763</td>
<td>17.64875</td>
<td>27.58434</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.000961</td>
<td>9.618880</td>
<td>21.13162</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.000439</td>
<td>4.395676</td>
<td>14.26460</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.000147</td>
<td>1.470484</td>
<td>3.841466</td>
</tr>
</tbody>
</table>

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Table 3b: Johansen and Jeuselius Cointegration Test #2

Unrestricted Cointegration Rank Test (Trace)

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Trace Statistic</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.001984</td>
<td>41.01946</td>
<td>47.85613</td>
<td>0.1881</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.000802</td>
<td>18.01634</td>
<td>29.79707</td>
<td>0.5648</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.000593</td>
<td>8.725259</td>
<td>15.49471</td>
<td>0.3914</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.000160</td>
<td>1.857061</td>
<td>3.841466</td>
<td>0.1730</td>
</tr>
</tbody>
</table>

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Max-Eigen Statistic</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.001984</td>
<td>23.00313</td>
<td>27.58434</td>
<td>0.1733</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.000802</td>
<td>9.291077</td>
<td>21.13162</td>
<td>0.8083</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.000593</td>
<td>6.868198</td>
<td>14.26460</td>
<td>0.5048</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.000160</td>
<td>1.857061</td>
<td>3.841466</td>
<td>0.1730</td>
</tr>
</tbody>
</table>

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

10.3 Impulse Response Function

The impulse response functions were tested to highlight the persistence and impact of one standard deviation shock, for example of INFTSE, LNSP, LNNIK, and LNSUN on LNHSI over a given horizon of 1 year (365 days). The initial impact effects of unit shock in number of sunspots (measured as one standard deviation) on ALL 4 financial indices were found positive and remains persistent after 50 days.

10.4 Long Run Price and Income elasticity

Lastly, we used HSI during the same period is used as a validation instrument. Table 4 presents the long run estimates such that:

\[ LNHSI_t + \alpha_1 LNFTSE_t + \alpha_2 LNSP_t + \alpha_3 LNSUN = I(0) \]  \hspace{1cm} (7)

which means the linear combination of the above variables is stationary.
Rewrite Eq. (7) we have:

\[
LN_{HSI} = \alpha_1 LN_{FTSE} + \alpha_2 LN_{SP} + \alpha_3 LN_{NIK} + \alpha_4 LN_{SUN},
\]

(8)

Table 4: Long run estimates

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-4.117457</td>
<td>0.068117</td>
<td>-60.44678</td>
<td>0.0000</td>
</tr>
<tr>
<td>LN_{FTSE}</td>
<td>0.650344</td>
<td>0.026502</td>
<td>24.53959</td>
<td>0.0000</td>
</tr>
<tr>
<td>LN_{SP}</td>
<td>0.583104</td>
<td>0.023883</td>
<td>24.41540</td>
<td>0.0000</td>
</tr>
<tr>
<td>LN_{NIK}</td>
<td>0.423528</td>
<td>0.012519</td>
<td>33.83045</td>
<td>0.0000</td>
</tr>
<tr>
<td>LN_{SUN}</td>
<td>0.086945</td>
<td>0.004277</td>
<td>20.32989</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.955425  Mean dependent var 7.528608
Adjusted R-squared 0.955409  S.D. dependent var 1.767371
S.E. of regression 0.373210  Akaike info criterion 0.867111
Sum squared resid 1505.957  Schwarz criterion 0.870480
Log likelihood -4684.770  Hannan-Quinn criter. 0.868247
F-statistic 57936.48  Durbin-Watson stat 0.005611
Prob(F-statistic) 0.000000

Our estimates suggest the following long run relationship which we shall call Sunspot Financial Indices (SFI) Model:

\[
LN_{HSI} = -4.12 + 0.65 LN_{FTSE} + 0.58 LN_{SP} + 0.24 LN_{NIK} + 0.087 LN_{SUN},
\]

(9)

Equation (9) suggested that 1% increase in LN_{FTSE} leads to 0.65% increase in LN_{HSI}, while LN_{SP} has less impact on LN_{HSI}. Finally, 1% increase in the number of sunspot will lead to 0.087% increase in LN_{HSI}. 
11.0 Uni-Economy induced Sunspot Index with HK Property Prices

Sunspot Cycle = 11 years

Fig. 4: Sunspot Cycle is 11 years (see Table 1 & 2)
* Post-2013 figures are prediction by the NASA

<table>
<thead>
<tr>
<th>Sunspot Minima</th>
<th>World’s Chronicle &amp; Forecasting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>Post-WWI Depression</td>
</tr>
<tr>
<td>1931</td>
<td>Wall Street Stock Clash</td>
</tr>
<tr>
<td>1942</td>
<td>Post-WWII Depression</td>
</tr>
<tr>
<td>1953</td>
<td>1st Global Economic Crisis</td>
</tr>
<tr>
<td>1964</td>
<td>2nd Global Economic Crisis</td>
</tr>
<tr>
<td>1975</td>
<td>1st Global Oil Crisis</td>
</tr>
<tr>
<td>1986</td>
<td>2nd Global Oil Crisis</td>
</tr>
<tr>
<td>1997</td>
<td>1st Global Financial Tsunami</td>
</tr>
<tr>
<td>2008</td>
<td>2nd Global Financial Tsunami</td>
</tr>
<tr>
<td>2019</td>
<td>Forecast: 1st Global e-Financial SARS</td>
</tr>
</tbody>
</table>

Table 1: Sunspot Minima (11 year period) – HK Stock & Property Market Clashes
Sunspot Index change-of-slope  |  HK Property Market Chronicle & Forecast
--- | ---
Early-1981  | Property Market clashed soon after Mrs. Margaret Thatcher fell at the steps of the China People Congress Hall
Early-1992  | HK Migration Bloom after the Tienanmum incidence
Early-2003  | HKSAR developed SAR hampers HK People’s confidence on property value
Early-2014  | **Forecast**: HK Property Market Super-bubble will clash following Government’s clamp-down and China Central Government’s Macro-economic Policy

Table-2: Sunspot rate-of-change moves from positive to negative (11 year period) – HK Property Market Clashes

**Author’s Deduction**

1. During Sunspot Minima, mankind (financial investors and fund managers in particular) will become high conservation and do nothing.

2. Recent Sunspot Minima occur in 1964, 1975, 1986, 1997, 2008 (11 year cycle). These are all Global stock clash years. Therefore, it is 95% confident that the next stock & property market clashes will be in **2019**.

3. When there is a change of slope for the Sunspot Indices, investors (HK property investors in particular as they are more volatile than the HK stock market) do not know what is the best course of action. As a result, they just sell off their properties.

4. Recent Sunspot Change-of-Slopes occur at the beginning of 1981, 1992 & 2003 (11 year cycle). These are also the year for HK property clashes. Therefore, it is 95% confident that the next property clashes will be in **early-2014**.

5. The speculation spirit of the property market in the HKSAR tops the world. Furthermore, most property speculators are not interested in long-term (over 5 years) investment in properties. Therefore, an innovative forecasting method has to be devised. It is now proven that within the 11 year sunspot cycle, there are 2 ups-and-downs mobilized by the speculators. The past 33 years’ experience has proven the case already (Luk, 2013).
12.0 Conclusion

The study of Economics is broadly classified into Micro-economic and Macro-economic. The Author now proposed in this paper a new term named “Uni-economic”. Since “Universe” is too big to manipulate, the most important object affecting the World is obviously the Sun. Consequently, the idea is to use the Sunspot Number as a forecasting tool. The aim is to provide confidence to the Readers on financial investment in the turbulent era of changing economy in this decade. The first part of this article was published at the Oxford Business & Economic Conference Proceedings in June 2009 at the Oxford University – the breeding ground for contemporary economic theories. The paper used approximately 50,000 data-pints over a 44 year period for the Sunspot Numbers and the 4 most popular stock indices in the world for data analysis based on Granger’s formula (2002 Nobel Winner on economics). As a result, the paper was highly commended and the Author was nominated as the Distinguished Professor of the Oxford Journal.

Furthermore, in Aug 2012, the Author was invited by the Faculty of Law at the Peking University to present this paper at their Convocation Ceremony. Being China’s expert in Economic Law, the Dean Zhang (張守文教授) had given high commendation on this paper. He even recommended this paper to be presented to Mr. Lao Zhi Wei (中國投資有限責任公司樓继伟董事長), the CEO of the China Investment Corporation, which is the largest Investment House in the World.

As said in Chinese, whenever there is ‘danger’, there is ‘opportunity’. It is hope that the Readers will have faith in the Sunspot theory and put it into their own investment practice. One has to be sensitive and rational that the 2013 property bloom is the best opportunity ever to sell off your property on hand. The chance is now in your hand, in particular for those property owners who have to work very hard for their mortgage. As advocated by Warren Buffet, the most difficult task of an investor is to find the right time to sell. As a role model, the Author has just sold off his 670 square feet (construction area) property that he purchased 6 years ago at a net profit margin of over 150%, and changed his status to be a tenant. It is expected that he can buy back the same property at half price in 2015, if not in 2019. At least, now there is a peace of mind. In terms of macro-economic, the Author is contributing to the lowering of property prices for those who are in real need. This is also in line with the HKSAR Government’s strategic direction of ‘helping the middle-income group to be a property owner’.
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Schwabe, Samuel Heinrich, German astronomer (1789-1875)  Available from:


Wall and Jenkins (2003), Practical statistics for astronomers, Cambridge University Press.

Useful Sunspot Data Websites:
The Solar Data Analysis Center at NASA's Goddard Space Flight Center has information on many solar research projects, and a fantastic archive of solar images, both past and current, including the SOHO eruptive prominence of the week.

Today's Space Weather at: http://www.sel.bldrdoc.gov/today.html Presented by the Space Environment Center, one of NOAA's research laboratories, this site provides a daily update on levels of solar activity, and the intensities of solar emissions reaching Earth.

European Space Agency Sunspot Data at: http://space-env.esa.int/Data_Plots/noaa/ssn_plot.html

The YOHKOH Data Archive at: http://ydac.mssl.ucl.ac.uk/ydac/
Authors’ Backgrounds

Prof. Samuel K. M. Ho (PhD in Mangt., FIQA, ISO9000 Lead Auditor, EQA Assessor) is an Adjunct Professor at the HK Buddhist College. Before then, he was the Professor of Strategy and Quality at the Luton Business School, the first professor in that discipline in the UK. In 1987-88, he was awarded the Oshikawa Fellowship by the Asian Productivity Organisation to do research in South East Asia and Japan. In 1993 he was invited as the first Quality Expert to the Malaysian Government by the Asian Development Bank for 6 months. As the ex-Editor of the Managing Service Quality Journal and a guest editor for four international journals on quality management, he has over 120 publications (with a Google Scholar Citation Index of 937). Sam is the Director for the HK 5-S Campaign funded by the HKSAR Government for US$600,000. Since 1993, he used the proprietary 5-S Checklist for training and consultancy in no less than 10 countries with over 100,000 persons from around 4,000 organisations world-wide. In 2003, he was conferred Distinguished Professor in Business Excellence by the Zhongshan University, one of the top 10 universities in China. As an ex-Research Fellow at Cambridge, and Guest Speaker at Oxford, he is also Visiting Professor in Quality Management of Coventry & Paisley (UK), RMIT (Australia) and Linnaeus (Sweden) University Business Schools.

Dr. Marco C. K. Lau is the Assistant Professor at the Division of Business Management, HKBU-BJNU United International College, Zhuhai, China. His interests span international economics, macroeconomics, applied time series econometrics and international finance, and international hedging strategies. Most of his recent research has been in empirical international finance and in macro-econometrics. He has extensively analyzed panel unit root test under nonlinearity and structural break and its application on international purchasing power parity as well as investigated non-linear growth dynamics in China. Moreover, he studies exchange rate volatility, strategic asset allocation and inter-temporal Hedging Demands, and hedging strategy in China’s Energy Oil Market. He published in such reputable journals as Applied Economics, Applied Economics Letters, Economics Modelling, Energy Policy, Singapore Economic Review, China Economic Review, Journal of Business Economics and Management, International Journal of Strategic Property Management. Dr. Lau is a co-editor of the Eurasian Business Review.