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## Indian culture, lunar phases and stock market returns

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**Abstract:** Return from the Indian stock market has been very attractive for investors from around the world during the last decade. Taking into account the importance of this emerging market, we examine the relation between lunar phases (full moon and new moon days) and the stock market returns from India, linking with Indian culture. Moon has a natural power which plays a significant role in phenomena of nature and also on human behaviour and stock market returns. The main purpose of the study is to examine the lunar effect on the stock markets and to test the normality and volatility of daily returns. Five major sectoral indices from the National Stock Exchange (NSE) were selected to investigate the relation between lunar phases and the stock market returns. Statistical tools like descriptive statistics, GARCH (1, 1) model and Granger causality were used to test the hypothesis and fulfil the objectives of this study. The results imply that the moon cycle affects individual mood and thinking process and leads to stock market volatility. The findings of this study would help the investors to formulate investment strategies to earn expected returns in the market.

**Keywords:** lunar phases; moon cycles; stock market; descriptive statistics; GARCH model; Granger causality.

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## 1 Introduction

It has been empirically proven, in psychological and biological literatures, at international level, that lunar phases affect the body, mood and mind. Behavioural finance literature reports an observed link between mood effects and stock market returns (Levy and Yagil, 2011). Behavioural finance is the paradigms where financial markets are studied using models that are less narrow (Ritter, 2003). There is considerable literature in psychology, medicine and Indian culture that investigate the effect of moon on the human mind, mood and behaviour. Some of these studies found that homicides, hospital admissions, and crisis incidents peak in the days closely preceding and following the full moon. Al-Khazali et al. (2017) investigated the religious practice on stock returns and volatility. The results indicate that volatility decreases during the month of Ramadan and is significantly different from the volatility observed in the other 11 months of the Islamic

calendar year in most Muslim countries. Rotton and Kelley (1985) examined 37 studies and concluded that there were influences of the lunar phase. However, Kelly and Martens (1994) found that the lunar cycle effects in existing studies were sporadic, unreliable and generally of little practical interest. The existing studies of lunar cycle effects on human behaviour are mostly limited to the investigation of pronounced abnormal behaviour such as suicides, aggressive acts and mental instabilities. Such studies usually rely on comparatively limited samples of extreme outcomes and could be of low arithmetical power, especially if the effects of lunar cycle on human behaviour were fairly mild.

India has emerged as the second fastest growing economy in the world (Paul and Mas, 2016; Paul, 2015; Paul and Benito, 2018). Return from the Indian stock market has been very attractive for investors from around the world during the last decade (Paul and Bhawsar, 2011). In the Indian financial market, there are 23 stock exchanges trading the securities. The National Stock Exchange of India (NSE), situated in Mumbai, is the largest and most superior exchange, in South Asia (source: <http://www.nseindia.com>). Indian Stock market is one of the advanced stock markets in the world and includes a sophisticated electronic trading system, rolling settlements (in place of the account period settlements), dematerialisation of shares, derivatives, etc. Furthermore, there have been significant measures to improve the capital market system. Portfolio investment by foreign institutional investors (FIIs), such as pension funds, mutual funds, investment trusts, and asset management companies have become catalytic in the growth of the Indian stock markets. With the financial sector reforms initiated in 1991, FIIs were allowed to invest in the Indian stock markets. As foreign investors drastically started investing in the stocks of Indian firms and indexes of India, this study is important and useful to them.

Normally, share price volatility occurs due to micro and macro economic factors in stock markets across the globe. There is widespread belief among the retail investors that lunar cycle affects human mind, mood, and particularly the investment pattern (Bodoh-Creed, 2013). In other words, many investors believe that lunar phases affect the stock markets. Some of them strongly believe that buying shares during a full moon day and new moon day is sentimentally linked to better returns. We performed this study keeping in mind the aforesaid background.

Further, numerous studies suggest that lunar phase, weather effect, religious practice, Ramadan effect, popular TV series finales and national culture, significantly affected investors', mood, human behaviour and stock market returns (Kathiravan et al., 2018, 2017; Al-Khazali et al., 2017; Kim, 2017; Sharma and Dahiya., 2017; Rthonis et al., 2016; Gavriilidis, et al., 2015; Lepori, 2015; Białkowski et al., 2012). But, moon has a natural power which plays a significant role in phenomena of nature and also on human behaviour and stock market returns (Levy and Yagil, 2011).

Lay theories explain that typical members of a culture present particular social behaviour cause and consequent events (Luk and Bond, 1992). Moon and its phases have played important role in people's thinking and decision-making process in Indian culture for a long time (Sivakumar and Sathyanarayan, 2009). However, few studies have been carried out to examine the impact of lunar phases in the Indian context. Taking into account the importance of this emerging market, we examined the relation between lunar phases (full moon and new moon days) and the stock market returns from India. Since Indian stock market has emerged as a destination for FIIs, being the market that has given the average highest return during the last fifteen years, we investigated the lunar effect on the Indian stock market, using data on sectoral indices. We also attempted to investigate

the relation between lunar phases and stock market index returns, with reference to sectoral indices of NSE in India. The main objective of the study was to examine the lunar effect on the Indian stock market and test the normality and volatility of daily returns on sectoral indices of the NSE.

Prior researchers investigated the relationship between lunar phase and stock market returns across the world. But no comprehensive study has been carried out on new moon periods and full moon periods in the Indian context. Hence we attempted to investigate the lunar effect on the Indian Stock Market using data on sectoral indices. Besides, since the Indian equity market is gaining increasing influence on world capital markets and it is attracting investors from all over the globe, our study would provide valuable insight to the international investors. In sum, the present study proposes to help the investors by providing information about lunar effect and volatility of share price movements at the time of new moon and the full moon days. The findings of this study would help them formulate investment strategies in such a way as to earn higher expected returns in the market.

## **2 Literature review**

The mood effect of lunar phases on stock market returns is examined in this section, in the context of previously published studies.

It is commonly believed that the full moon exerts violent influence and aggression in psychiatric settings (Owen et al., 1998). Rotton and Kelley (1985) conducted a meta-analysis of 37 studies to examine relations between phases of the moon, type of lunar cycle, sex, publication practices, geographical features (latitude, population density), and several types of lunacy, including mental hospital admissions, psychiatric disturbances, crisis calls, homicides, and other criminal offences. Results of effect-size estimates showed that phases of the moon did not account for significant variance in those activities. Wilson and Tobacyk (1990) tested the hypothesis, that lunar phases do not directly affect human behaviour, by time-series analysis of 4,575 crisis centre telephone calls (all calls recorded for a six-month interval). They did not find evidence to support the lunar hypothesis, even though the crisis centre workers believed in lunar effects.

There is a correlation between lunar phases and human feelings. More specifically, there exists significant correlation between full moon periods and depressed mood (Kelly, 1942). The hypothesis assumes that the investors generally value financial assets less during full moon periods than during new moon periods, due to a change in mood associated with lunar phases. Yen et al. (2001) examined the existence/non-existence of the Chinese Lunar New Year effect in Hong Kong, Japan, South Korea, Malaysia, Singapore, and Taiwan in the recent years. The cumulative returns, based on stock indices in the above-mentioned Asian markets, exhibited a consistently upward moving trend before or after the Chinese Lunar New Year, providing evidence for continued existence of the Chinese Lunar New Year effect in these six Asian stock markets in the recent years. The authors also recommended the best investment strategy to get maximum returns. Dichev and Janes (2003) interestingly found that the returns in the 15 days around new moon dates were about double the returns in the 15 days around full moon dates for all major US stock indices, over the last 100 years, and for nearly all

major stock indices of 24 other countries, over the last 30 years. Yuan and Gupta (2014) examined stock returns during the days preceding the Chinese lunar New Year for the major Asian stock markets for the period 1999–2012. Their results indicated higher stock returns in the trading days prior to the Chinese New Year holiday.

Yuan et al. (2006) investigated the relation between lunar phases and stock market returns of 48 countries. The findings indicated that the stock return was lower in the days surrounding a full moon than the days around a new moon. The magnitude of this difference in return was between 3% and 5% per year. Similarly, by analysing the effects of lunar cycles (full moon vs. new moon) on the stock market, Chandy et al. (2007) found the full moon effect to be different from the new moon effect on the stock market, and concluded that the sample stock market indices showed evidence of a full moon or a new moon effect. The Lunar New Year is the most significant festival for Chinese around the world (including Taiwanese). Borowski (2016) examined the influence of Moon phases on rates of return of the Warsaw Stock Exchange indices. The researcher mainly focused on the relationship between rates of return during sessions close to the four moon phases (new, 1st quarter, full and 3rd quarter). The finding from that study indicated that the average rates of return were higher than zero for mWIG40 in March (full moon), WIG20 in June and mWIG40 in July (for both indices, moon in the first quarter phase). At the same time, the average rates of return was lower than zero for WIG20 and mWIG40, during full moon sessions in June, mWIG40 for July (new moon) sessions, WIG20 for November and sWIG80 for October sessions (for both indices, moon in the first quarter phase). Chin and Chen (2007) empirically investigated the impact of the Lunar New Year on Taiwan's stock market. Empirical results supported their hypothesis that the anomaly appeared only when the Lunar New Year occurred in February. Their findings suggested that cultural factors were important in addressing the seasonal behaviour of Taiwan's stock markets.

Herbst (2007) investigated the influence of the lunar phases on the performance and volatility of the Dow Jones industrial average (DJIA). The study found only small effects, which did not support the hypothesis. Padmanaban and Gurusamy (2018) examined the impact of lunar cycle effects on gold price volatility. It was found that the impact of good news was less in times of full moon day's gold price return series. Greater volatility was reported during full moon days in gold prices. Hence, researchers concluded that it is advisable to buy gold during the new moon period. The gold price is highly volatile during the full moon days. Hence, people are more optimistic about buying gold exclusively during new moon day period rather than during full moon day period. Shetty and Haensly (2007) investigated the psychological aspect of investors during the period of lunar cycles and also the full moon effect separately from the new moon effect on the stock markets. In their study, stock market indices showed no evidence of a full moon or a new moon. Liu and Tseng (2009) studied the relationship between lunar effect and the stock returns. The mean daily stock returns were lower near the full moon and higher near the new moon days. The researcher investigated the association between the lunar phases and daily stock returns by using a two-regime, autoregressive model, with a GARCH (1, 1) innovation. Brahman et al. (2011) investigated the influence of moon on seven stock markets like Indonesia, Malaysia, the UK, the USA, the Philippines, Japan, and Thailand. It found that the moon phase did not play an important role on the investor decision in investing. The result of their study confirmed that even though moon phase might influence the mood, it did not influence the rational behaviour of investors'. Gao (2009) examined the relation between lunar phases and stock market returns of China. It

was found that the stock returns were lower on the days around a new moon than on the days around a full moon. In the study, using biological, psychological and medical evidence, Lingaraja et al. (2014) analysed the market efficiency (volatility) and the performance among the emerging stock markets in Asia. It was found that the four Asian stock market countries, namely, India, Indonesia, Malaysia and the Philippines recorded random distribution at 95% confidence level and these markets were highly volatile during the study period. Liu and Tseng (2009) suggested that the lunar phases may affect human behaviour and mood. The findings from the study indicated that the mean daily stock returns were lower near the full moon and higher near the new moon days. Bayesian approach was applied to the daily stock returns of 12 countries, including the G7 markets and five emerging markets in Asia. In general, the statistical results indicated the existence of lunar effects on daily stock returns, although the G7 markets and some of the sample Asian markets showed different patterns. In fact, this suggestion motivated the study of relationship between lunar phases and stock returns.

The findings from all relevant papers indicate that the lunar cycle does indeed have an effect on stock returns. In other words, stock market shows higher return volatilities in the full moon period. Kuo et al. (2010) focused on a new seasonal anomaly associated with the Lunar Moon Festival (LMF) in East Asian economies (it is also known as mid-autumn festival). The LMF effect was the strongest for China, Taiwan and South Korea, where it was not only celebrated as a public or cultural holiday, but it also influenced neighbouring stock markets where overseas Chinese investors possessed significant resources. Finally, they identified that the full moon was generally associated with mainly small, but positive seasonal effects on turnover. Sheikh et al. (2017) investigated the effect of mood-proxy variables on index returns and volatility in six South Asian markets. Mood-proxy variables included six weather variables (temperature, humidity, cloud cover, air pressure, visibility, and wind speed), three weather indicator variables (fog, thunder storm and rain or drizzle) and two biorhythmic variables [seasonal affective disorder (SAD) and lunar phases]. They found that the relationship between SAD and stock market returns was insignificant for countries other than India. Hammami and Abaoub (2010) examined the psychological and biological evidences of the moon cycle, to identify lunar (full moon and new moon) effect on human mood and its behaviours. Thach and Diep (2018) analysed the effects of super-moon phenomenon on stock market returns in Vietnam. It was found that super-moon phenomenon exercised a significantly negative impact on the stock returns. The authors also found that the super-moon phenomenon affect the behaviour of investors, thus affecting financial decisions. Lingaraja (2013) showed the relevance of lunar effect on the stock market, using data from select Asian countries. On the other hand, Sivakumar and Sathyanarayanan (2009) found that the effect of lunar phases on Indian stock market was limited, using data from Bombay Stock Exchange (BSE). Their research used the BSE Sensex data, over a period of 17 years, to study whether there were significant differences in the stock market activities and movements.

From the above studies, it has been found that the researchers investigated the relationship between lunar phase and stock market returns in markets across the world. However, not many studies have been carried out on new moon and full moon periods in the Indian context, despite the fact that Indian culture has popularly believed that the moon has a close relation with human thinking and decision making (Sivakumar and Sathyanarayan, 2009). As stock market activities and movements are based on human

behaviour and decision making, it is important to study the impact of lunar phases on investment decisions. Therefore, we have undertaken this study. Besides, the present study is an attempt to examine the normality, volatility and causality relationship of lunar phases (full moon day and new moon days) and stock market sectoral index returns in India. The hypotheses for the study were formulated on the basis of normality, volatility and causality relationship of lunar phases (full moon days and new moon days) and stock market index returns and these were also tested in the analysis part.

### **3 Hypotheses**

Based on the above objective, the following three null hypotheses (NH) were framed and tested.

- NH1 01 Normality in the returns distribution of sectoral indices is insignificant on full moon days.
- NH1 02 Normality in the returns distribution of sectoral indices is insignificant on new moon days.
- NH2 01 The volatility of return on sectoral indices is insignificant (nominal) on full moon days.
- NH2 02 The volatility of return on sectoral indices is insignificant (nominal) on new moon days.
- NH3 01 There is no causality relationship between returns of sectoral indices on full moon days.
- NH3 02 There is no causality relationship between returns of sectoral indices on new moon days.

### **4 Methodology and data**

This section is divided under five separate parts, sample selection, sources of data, period of study, tools used for analysis, methodology of analysis. We begin with introducing the five indices used in this study.

#### *4.1 Sample selection*

For the purpose of this study, all the sectoral indices of NSE were selected at the first stage. There are 12 sectoral indices listed in the NSE. For the purpose of analysis, the study identified only top five sectoral indices, based on the top turnover value, on February 22, 2013. Details of the top five sectoral indices, selected for this study, are given in Table 1.

The indices of NSE of India are known as CNX indices. The stocks included in these indices are most liquid and leading companies in terms of market capitalisation. For instance, The CNX Finance Index is designed to reflect the performance of the Indian financial market which includes banks, and financial institutions, and it comprises

of 15 stocks. The CNX Bank Index comprises 12 most liquid and large Indian Banking stocks in terms of market capitalisation. The CNX IT index is a benchmark tool that captures the performance of the Indian IT companies. It comprises of ten leading IT companies. CNX Energy sector index includes companies belonging to gas, petroleum, gas and power sectors. The index contains ten companies. The CNX FMCG Index includes stocks of 15 leading fast moving consumer goods (FMCGs) which are non-durable, mass consumption products.

**Table 1** List of samples sectoral indices based on turn over value in NSE

| <i>S. no</i> | <i>Name of the indices</i> | <i>Turnover as on 22.02.2013<br/>(<i>&lt; Cr</i>)</i> |
|--------------|----------------------------|---|
| 1            | CNX Finance                | 1,737.98  |
| 2            | CNX Bank                   | 1,248.15  |
| 3            | CNX IT                     | 725.40  |
| 4            | CNX Energy                 | 718.62  |
| 5            | CNX FMCG                   | 713.32  |

*Source:* <http://www.nseindia.com>

#### 4.2 Sources of data and selection of indices

The present study was based on secondary data. First, we decided to use sectoral indices instead of using aggregate indices, with the intention of conducting a comprehensive study. Then, we selected the most prominent sectoral indices of NSE India in order to study the lunar effect in a detailed manner. The rationale for selecting five indices was based on their importance in terms of trading volume and market capitalisation during the study period. The required information, relating to sectoral indices of NSE, was obtained from the prowess corporate database, CMIE and <http://www.nseindia.com>. The other required information was collected from various books, articles, journals and websites.

#### 4.3 Period of study

The present study is an attempt to analyse the lunar effect and volatility on top five sectoral indices of NSE. The required daily data were collected for a period of five years from January 1, 2008 to December 31, 2012. The rationale for selection of this five-year period was that we wanted enough observations in our time series analysis to ensure that we do not get biased result. Analysis was conducted in 2013 and therefore, our best choice was to collect the data for immediate the five-year period.

#### 4.4 Tools used for analysis

The following tools were used for analysis in this study: GARCH (1, 1), and Granger causality test. Before we proceeded with GARCH and Granger causality tests, we examined the basic features of data based on descriptive statistics. In order to test the normality of data, following Gujarati (2003) and Gupta (2004), mean, median, standard deviation, skewness, Kartsosis and Jarque-Bera test were used.



#### 4.4.1 GARCH (1, 1) model

GARCH models (p, q) permit a wider range of behaviour, in particular – more persistent volatility. Bollerslev (1986) proposed a model, appropriately termed the GARCH model, which has two equations. Numerous parametric specifications for the time varying conditional variance have been proposed in the literature. The formula to calculate the GARCH model is as follows.

$$\sigma^2_t = \alpha_0 + \alpha_1 u^2_{t-1} + \alpha_2 u^2_{t-2} + \dots + \alpha_q u^2_{t-q} + \beta_1 \sigma^2_{t-1} + \beta_2 \sigma^2_{t-2} + \dots + \beta_p \sigma^2_{t-p}$$

#### 4.4.2 Granger causality test

A time series X is said to have a Granger-cause effect on Y if it can be shown usually through a series of t-tests and F-tests on lagged values of X and Y. The X values provide statistically significant information about future values of Y.

Assume that the information set  $F_t$  has the form  $(x_t, z_t, x_{t-1}, z_{t-1}, \dots, x_1, z_1)$  where  $x_t$  and  $z_t$  are vectors (that includes scalars, of course), and  $z_t$  will usually include  $y_t$ . While  $z_t$  may or may not include variables other than  $y_t$ .

### 4.5 Methodology

The objective of this study was to examine the lunar effect on the returns and volatility of stock indices in the Indian market. The analysis carried out can be discussed as follows:

We used descriptive statistics to estimate normality of returns for the sectoral indices. This was conducted in two different ways. They are:

- 1 Descriptive statistics for the returns of sample sectoral indices on account of full moon effect.
- 2 Descriptive statistics for the returns of sample sectoral indices on account of new moon effect.

We employed GARCH model for analysing the volatility of returns. This analysis was also conducted in the same way, as mentioned above.

- 1 Volatility using GARCH model for selected sectoral indices on account of full moon effect.
- 2 Volatility using GARCH model for selected sectoral indices on account of new moon effect.

Next, we employed Granger causality analysis to estimate causality of returns. This was also carried out in the same fashion and can be divided under two sub-headings:

- 1 Granger causality test for selected sample sectoral indices on account of full moon effect.
- 2 Granger causality test for selected sample sectoral indices on account of new moon effect.

## 5 Results and discussion

The results of these tests can be discussed in detail as follows.

### 5.1 Normality of return for selected sectoral indices

#### 5.1.1 Descriptive statistics of the returns for sample sectoral indices on account of full moon

The results of descriptive statistics for the returns of sample sectoral indices on account of full moon during the study period from January 1, 2008 to December 31, 2012 are presented in Table 2. This table includes the analysis of five sample indices, namely CNX Finance Index, CNX Bank Index, CNX IT Index, CNX Energy Index, and CNX FMCG Index. This table uses 60 observations from each sample index. It is to be noted that there was a positive mean return earned by all the sample indices, except CNX Energy Index (−0.001435) during the study period. The mean return value was found to be higher (0.008514) for CNX IT Index among all sample sectoral indices on full moon day. It should be noted from the analysis of the table that the lowest mean return value (−0.001435) was found for energy index during the study period. Also, out of the five sample sectoral indices, CNX Bank Index earned the highest standard deviation (0.106338) while CNX FMCG Index earned the lowest standard deviation (0.053765). From this analysis, it is inferred that there was high risk (0.106338) with high returns (0.006018) for the CNX Bank Index on account of the full moon. According to the analysis of Skewness, two sectoral indices, CNX Energy Index and CNX IT Index, were positively skewed with values of 0.313217 and 0.019095, respectively. The level of kurtosis was high for all sample indices, i.e., finance (4.566466), bank (4.53161), IT (3.444989), energy (4.115655) and FMCG (3.416947). It should be kept in mind that where all the sample sectoral indices earned a value of 3, it indicates Leptokurtic.

**Table 2** Results of descriptive statistics of the returns for sample sectoral indices on account of full moon from 01-01-2008 to 31-12-2012

| <i>Sample sectoral indices</i> | <i>CNX Finance Index</i> | <i>CNX Bank Index</i> | <i>CNX IT Index</i> | <i>CNX Energy Index</i> | <i>CNX FMCG Index</i> |
|--------------------------------|--------------------------|-----------------------|---------------------|-------------------------|-----------------------|
| <i>Mean</i>                    | 0.005598                 | 0.006018              | 0.008514            | −0.001435               | 0.017759              |
| <i>Median</i>                  | 0.002622                 | 0.000883              | 0.005173            | −0.010160               | 0.026574              |
| <i>Maximum</i>                 | 0.277556                 | 0.286534              | 0.224337            | 0.240840                | 0.100220              |
| <i>Minimum</i>                 | −0.322224                | −0.326134             | −0.246231           | −0.232634               | −0.130676             |
| <i>Std. Dev.</i>               | 0.102995                 | 0.106338              | 0.094603            | 0.079395                | 0.053765              |
| <i>Skewness</i>                | −0.15389                 | −0.192639             | 0.019095            | 0.313217                | −0.755761             |
| <i>Kurtosis</i>                | 4.566466                 | 4.53161               | 3.444989            | 4.115655                | 3.416947              |
| <i>Observation</i>             | 60                       | 60                    | 60                  | 60                      | 60                    |

*Source:* Computed from <http://www.nseindia.com> using e-views

This confirms the fact that there was an abnormal distribution of returns for all sample indices under the full moon days during the study period. Hence the NH (NH101): there

is no normal distribution in the returns of the selected sample sectoral indices at full moon day; is accepted.

### 5.1.2 Descriptive statistics of the return for sample sectoral indices on account of new moon

It is a known fact that the emerging sectoral indices across the globe are well known for their volatility, and it is not surprising to observe big swings from negative to positive returns on the account of lay theory-based beliefs, such as full moon or new moon, of people. Table 3 shows the results of descriptive statistics for the returns of sample sectoral indices on account of new moon from January 1, 2008 to December 31, 2012. It is to be noted that the average daily returns were significantly higher during the period under consideration. The highest average daily index mean returns were recorded for the CNX FMCG Index (0.010097), followed by CNX IT Index (0.001817), as shown in Table 3. Lowest average returns were recorded for CNX Energy Index (-0.010976) and CNX Finance Index (-0.000528). It is interesting to note that when the CNX Bank Index experienced the maximum returns (0.320912), CNX Energy Index suffered with the minimum returns (-0.419864), together with CNX Finance Index (-0.287373) and CNX Bank Index (-0.261483) during the study period. According to the analysis of the table, the most volatile stock indices were CNX Bank Index, with the standard deviation value of 0.111195, followed by CNX Finance Index (0.110152) and CNX Energy Index (0.096202); while CNX FMCG Index recorded the least volatile index with the standard deviation value of 0.069057. The excess value of kurtosis (greater than 3) provided supportive evidence. The analysis of this study confirms the fact that for all sample indices under the new moon days, there was an abnormal distribution of returns during the study period from January 1, 2008 to December 31, 2012. Hence, the NH (NH102): there is no normal distribution in the returns of the selected sample sectoral indices at new moon day is accepted.

**Table 3** Results of descriptive statistics of the returns for sample sectoral indices on account of new moon from 01-01-2008 to 31-12-2012

| <i>Sample sectoral indices</i> | <i>CNX Finance Index</i> | <i>CNX Bank Index</i> | <i>CNX IT Index</i> | <i>CNX Energy Index</i> | <i>CNX FMCG Index</i> |
|--------------------------------|--------------------------|-----------------------|---------------------|-------------------------|-----------------------|
| <i>Mean</i>                    | -0.000528                | 0.000401              | 0.001817            | -0.010976               | 0.010097              |
| <i>Median</i>                  | 0.017393                 | 0.016811              | 0.008841            | 0.011934                | 0.025682              |
| <i>Maximum</i>                 | 0.314577                 | 0.320912              | 0.150165            | 0.180692                | 0.113392              |
| <i>Minimum</i>                 | -0.287373                | -0.261483             | -0.252372           | -0.419864               | -0.221289             |
| <i>Std. Dev.</i>               | 0.110152                 | 0.111195              | 0.088335            | 0.096202                | 0.069057              |
| <i>Skewness</i>                | -0.181173                | -0.064105             | -0.587685           | -1.672706               | -1.825199             |
| <i>Kurtosis</i>                | 3.603353                 | 3.420822              | 3.096573            | 7.648667                | 6.560694              |
| <i>Observation</i>             | 62                       | 62                    | 62                  | 62                      | 62                    |

*Source:* Computed from <http://www.nseindia.com> using e-views

The overall analysis of descriptive statistics clearly explained the fact that due to lunar phases (full moon and new moon days), the returns of five selected sample sectoral

indices were not normally distributed. Hence, it is inferred that both lunar phases lead to volatility of index returns in India. Investors may note this information and devise their investment strategies accordingly.

## 5.2 Volatility of returns of selected sectoral indices

### 5.2.1 Volatility using GARCH model for selected sample sectoral indices on account of full moon

The results for daily share price returns of sample sectoral indices on account of full moon during the study period from January 1, 2008 to December 31, 2012, are given in Table 4. It is to be noted that the sample indices included five indices – CNX Finance, Bank, IT, Energy and FMCG Index. From the analysis given in Table 4, it can be clearly observed that the probability value for all sample indices was zero at 1% level of significance. It is worth noting that the values of  $(RESID (-1) ^2 + GARCH (-1))$  for all sample sectoral indices at full moon were close to one (above 0.92). The actual values of  $(RESID (-1) ^2 + GARCH (-1))$  for five sample indices were 0.957817 (CNX Finance Index), 0.955597 (CNX Bank Index), 0.974542 (CNX IT Index), 0.927694 (CNX Energy Index) and 0.944776 (CNX FMCG Index) during the study period.

**Table 4** Results of GARCH (1, 1) model for selected sample sectoral indices on account of full moon from 01-01-2008 to 31-12-2012

| <i>Selected sectoral indices</i> | <i>C</i> | <i>RESID (-1)^2</i> | <i>GARCH (-1)</i> | <i>RESID (-1)^2 + GARCH (-1)</i> | <i>Probability</i> |
|----------------------------------|----------|---------------------|-------------------|----------------------------------|--------------------|
| CNX Finance Index                | 0.000226 | -0.156738           | 1.114555          | 0.957817                         | 0.0000             |
| CNX Bank Index                   | 0.000301 | -0.161004           | 1.116601          | 0.955597                         | 0.0000             |
| CNX IT Index                     | 3.930005 | -0.07903            | 1.053572          | 0.974542                         | 0.0000             |
| CNX Energy Index                 | 0.000431 | 0.251839            | 0.675855          | 0.927694                         | 0.0000             |
| CNX FMCG Index                   | 0.000144 | -0.134764           | 1.07954           | 0.944776                         | 0.0000             |

*Source:* Computed from <http://www.nseindia.com> using e-views

The results of GARCH (1, 1) Model for individual sample sectoral indices taken for this study were compared with the returns of the same on Full Moon Days. According to the analysis of GARCH (1, 1) model, the value  $(RESID (-1) ^2 + GARCH (-1))$  for CNX IT Index (0.974542) was close to one. This indicates the fact that the returns for the entire five sample sectoral indices were volatile during the study period. Hence the NH (NH201) there is no volatility in the returns of selected sectoral indices at full moon day; is rejected.

### 5.2.2 Volatility using GARCH model for selected sample sectoral indices on account of new moon

The results of daily stock price returns of sample sectoral indices on account of new moon days during the study period from January 1, 2008 to December 31, 2012 are given in Table 5. As stated earlier, the sample sectoral indices included CNX Finance, Bank,

IT, Energy and FMCG Index. It is clearly observed from Table 5 that the probability value for all sample indices was zero at 1% level of significance. It is significant that the values of  $RESID(-1)^2 + GARCH(-1)$  for all sample indices at new moon days were close to one. The values of  $RESID(-1)^2 + GARCH(-1)$  for five sample indices were 0.977232 (CNX Finance Index), 0.986374 (CNX Bank Index), 0.971142 (CNX IT Index), 0.923096 (CNX Energy Index) and 0.912065 (CNX FMCG Index) during the study period.

From the comparison of the results of GARCH (1, 1) model for individual sample sectoral indices with the returns of new moon days, it is evident that the value of CNX Bank Index (0.986374) was highly volatile during the study period. The values for five sectoral indices were close to one and this indicates the fact that the returns for all the five sample sectoral indices were highly volatile during the study period. Hence the NH (NH202): there is no volatility in the returns of selected sectoral indices at new moon day; is rejected.

**Table 5** Results of GARCH (1, 1) model for selected sample sectoral indices on account of new moon from 01-01-2008 to 31-12-2012

| <i>Selected sectoral indices</i> | <i>C</i> | <i>RESID (-1)<sup>2</sup></i> | <i>GARCH (-1)</i> | <i>RESID (-1)<sup>2</sup> + GARCH (-1)</i> | <i>Probability</i> |
|----------------------------------|----------|-------------------------------|-------------------|--|--------------------|
| CNX Finance Index                | 9.280005 | -0.08125                      | 1.058482          | 0.977232                                   | 0.0000             |
| CNX Bank Index                   | 7.970005 | -0.101158                     | 1.087532          | 0.986374                                   | 0.0000             |
| CNX IT Index                     | 6.450005 | -0.082912                     | 1.054054          | 0.971142                                   | 0.0000             |
| CNX Energy Index                 | 0.000255 | -0.133657                     | 1.056753          | 0.923096                                   | 0.0000             |
| CNX FMCG Index                   | 0.000219 | -0.184697                     | 1.096762          | 0.912065                                   | 0.0000             |

*Source:* Computed from <http://www.nseindia.com> using e-views

### 5.3 Causality of returns for selected sectoral indices

#### 5.3.1 Granger causality test for indices return on account of full moon

The results of causality test for the returns on five indices in account of full moon days during the period from January 1, 2008 to December 31, 2012 are given in Table 6. An attempt was made using Granger causality test to examine the inter relationship between the sample indices at full moon days; both at 5% and 10% significant levels. A total of 58 observations from each sample index were used for the analysis. In order to apply Granger causality test, the five sample indices were grouped into 20 pairs of indices. According to the analysis of F-Statistics, five pair of indices (CNX Bank Index and CNX Finance Index (3.32814), CNX Finance Index and CNX Bank Index (3.03415), CNX Energy Index and CNX Bank Index (2.56519), CNX Bank Index and CNX Energy Index (2.46949), and CNX Energy Index and CNX Finance Index (2.44682)) earned significant F-values. In other words, there was an impact of full moon on the index returns in respect to these indices. It is noted that only five pairs of indices were significant both at 5% and 10% levels. Hence, the NH (NH301), there is no causality on the returns of selected sample sectoral indices for Full Moon Days; was rejected in respect to the five pairs of indices. As per the analysis of Probability, the same five pairs of indices out of 20 pairs were CNX Energy Index and CNX Bank Index (0.0435), CNX Bank Index and CNX Energy Index (0.0565), CNX Finance Index and CNX Bank Index (0.0864), CNX Bank

Index and CNX Finance Index (0.0943), and CNX Energy Index and CNX Bank Index (0.0963).

**Table 6** The results of Granger causality test for indices return on account of full moon day during period from 01-01-2008 to 31-12-2012

| <i>Pair wise Granger causality tests for full moon day</i> |   |            |                    |              |                           |
|--|---|------------|--------------------|--------------|---------------------------|
| <i>S. no</i>   | <i>Null hypothesis:</i>                       | <i>Obs</i> | <i>F-statistic</i> | <i>Prob.</i> | <i>Reject or accepted</i> |
| 1  | CNX_Energy does not Granger cause CNX_Bank    | 58         | 2.56519            | 0.0864**     | Rejected                  |
| 2  | CNX_Bank does not Granger Cause CNX_Energy    |            | 2.46949            | 0.0943**     | Rejected                  |
| 3  | CNX_Finance does not Granger cause CNX_Bank   | 58         | 3.03415            | 0.0565**     | Rejected                  |
| 4  | CNX_Bank does not Granger cause CNX_Finance   |            | 3.32814            | 0.0435*      | Rejected                  |
| 5  | CNX_FMCG does not Granger cause CNX_Bank      | 58         | 0.14304            | 0.8671       | Accepted                  |
| 6  | CNX_Bank does not Granger cause CNX_FMCG      |            | 0.68672            | 0.5076       | Accepted                  |
| 7  | CNX_IT does not Granger cause CNX_Bank        | 58         | 1.54075            | 0.2237       | Accepted                  |
| 8  | CNX_Bank does not Granger cause CNX_IT        |            | 0.94937            | 0.3935       | Accepted                  |
| 9  | CNX_Finance does not Granger cause CNX_Energy | 58         | 1.57371            | 0.2168       | Accepted                  |
| 10   | CNX_Energy does not Granger cause CNX_Finance |            | 2.44682            | 0.0963**     | Rejected                  |
| 11   | CNX_FMCG does not Granger cause CNX_Energy    | 58         | 0.57516            | 0.5661       | Accepted                  |
| 12   | CNX_Energy does not Granger cause CNX_FMCG    |            | 1.36513            | 0.2642       | Accepted                  |
| 13   | CNX_IT does not Granger cause CNX_Energy      | 58         | 0.88707            | 0.4179       | Accepted                  |
| 14   | CNX_Energy does not Granger cause CNX_IT      |            | 2.07777            | 0.1353       | Accepted                  |
| 15   | CNX_FMCG does not Granger cause CNX_Finance   | 58         | 0.30518            | 0.7383       | Accepted                  |
| 16   | CNX_Finance does not Granger cause CNX_FMCG   |            | 1.1031             | 0.3393       | Accepted                  |
| 17   | CNX_IT does not Granger cause CNX_Finance     | 58         | 1.0733             | 0.3492       | Accepted                  |

Notes: \*Indicates significant causal relationship at 5% significance level.

\*\*Indicates significant causal relationship at 10% significance level.

Rejection of null hypothesis when the probability value is less than or equal to 0.10.

Source: Computed data from <http://nseindia.com/using e-views>

**Table 6** The results of Granger causality test for indices return on account of full moon day during period from 01-01-2008 to 31-12-2012 (continued)

| <i>Pair wise Granger causality tests for full moon day</i> |   |            |                    |              |                           |
|--|---|------------|--------------------|--------------|---------------------------|
| <i>S. no</i>   | <i>Null hypothesis:</i>                   | <i>Obs</i> | <i>F-statistic</i> | <i>Prob.</i> | <i>Reject or accepted</i> |
| 18   | CNX_Finance does not Granger cause CNX_IT |            | 0.51602            | 0.5999       | Accepted                  |
| 19   | CNX_IT does not Granger cause CNX_FMCG    | 58         | 0.03541            | 0.9652       | Accepted                  |
| 20   | CNX_FMCG does not Granger cause CNX_IT    |            | 0.05839            | 0.9433       | Accepted                  |

Notes: \*Indicates significant causal relationship at 5% significance level.

\*\*Indicates significant causal relationship at 10% significance level.

Rejection of null hypothesis when the probability value is less than or equal to 0.10.

*Source:* Computed data from <http://nseindia.com/using e-views>

The probability analysis, as given in Table 6, further confirms the fact that index returns have significant influence due to full moon days. At the same time, the remaining 15 pairs of indices (out of 20) were accepted at 5% and 10% significant levels. The 15 pairs of indices were CNX Energy Index and CNX IT Index, CNX Finance Index and CNX Energy Index, CNX IT Index and CNX Bank Index, CNX Energy Index and CNX FMCG Index, CNX Finance Index and CNX FMCG Index, CNX IT Index and CNX Finance Index, CNX Bank Index and CNX IT Index, CNX IT Index and CNX Energy Index, CNX Bank Index and CNX FMCG Index, CNX FMCG Index and CNX Energy Index, CNX Finance Index and CNX IT Index, CNX FMCG Index and CNX Finance Index, CNX FMCG Index and CNX Bank Index, CNX FMCG Index and CNX IT Index, and CNX IT Index and CNX FMCG Index. The Granger causality test analysed the returns of sample indices in detail. The overall analysis of the table clearly reveals the fact that there was an impact of full moon days on the returns of five pairs of indices, namely CNX Bank Index and CNX Finance Index, CNX Finance Index and CNX Bank Index, CNX Energy Index and CNX Bank Index, CNX Bank Index and CNX Energy Index, and CNX Energy Index and CNX Finance Index. However, there was no impact in the case of other 15 sample pair indices taken for this study. The highest impact was registered in respect to CNX Bank Index and CNX Finance Index, with a value of probability (0.0435) and a value of F-Statistics (3.32814). This was followed by CNX Finance Index and CNX Bank Index, with a value of probability (3.03415) and a value of F-statistics (0.0565), CNX Energy Index and CNX Bank Index with a value of probability (0.0864) and a value of F-statistics (2.56519), CNX Bank Index and CNX Energy Index with a value of probability (0.0943) and a value of F-Statistics (2.46949) and CNX Energy Index and CNX Finance Index with the value of probability (0.0963) and the value of F-statistics (2.44682). This shows that there are significant returns on full moon days. Investors are advised to take note of this information and devise their strategy in such a way so as to reap maximum benefit from full moon days.

### 5.3.2 Granger causality test for return on indices on account of new moon

The results in Table 7 reveal the results of Granger causality test for returns of five sample indices on account of new moon days during the study period from January 1, 2008 to December 31, 2012. An attempt has been made, using the Granger causality test, to examine the inter relationship between the indices at new moon days both at 5% and 10% significant levels. A total of 60 observations from each sample index were used for the analysis. Based on the probability analysis, we find that only four pairs of indices (CNX Bank Index and CNX Finance Index (0.0253), CNX Finance Index and CNX Bank Index (0.0461), CNX Bank Index and CNX FMCG Index (0.0866), and CNX Finance Index and CNX FMCG Index (0.0901) earned significant returns. In other words, there was an impact of new moon on the sample indices returns. It is noted that those four pairs of indices were significant at 5% and 10% levels. Hence, the hypothesis (NH302): there is no causality on the returns of selected sample sectoral indices for new moon day; is rejected in respect of the four pairs of indices. As per the analysis of F-statistics, the same four pairs of indices CNX Bank Index and CNX Finance Index (3.9402), CNX Finance Index and CNX Bank Index (3.25895), CNX Bank Index and CNX FMCG Index (2.56122), and CNX Finance Index and CNX FMCG Index (2.51679) were found to be significant. At the same time, the remaining pairs of indices were accepted at 5% and 10% significant levels. Those 16 pairs of indices (out of 20) were CNX IT Index and CNX Energy Index, CNX IT Index and CNX Finance Index, CNX IT Index and CNX Bank Index, CNX IT Index and CNX FMCG Index, CNX Finance Index and CNX IT Index, CNX FMCG Index and CNX Energy Index, CNX Bank Index and CNX IT Index, CNX Bank Index and CNX Energy Index, CNX FMCG Index and CNX Finance Index, CNX FMCG Index and CNX Bank Index, CNX Finance Index and CNX Energy Index, CNX Energy Index and CNX FMCG Index, CNX Energy Index and CNX IT Index, CNX Energy Index and CNX Bank Index, CNX Energy Index and CNX Finance Index, and CNX FMCG Index and CNX IT Index. The overall figures reported in this table clearly reveal the fact that there was significant effect of the new moon days on the returns of four pairs of indices, namely CNX Bank Index and CNX Finance Index, CNX Finance Index and CNX Bank Index, CNX Bank Index and CNX FMCG Index, and CNX Finance Index and CNX FMCG Index. However, there was no impact for other sample pairs of indices. The highest impact was registered in respect of CNX Bank Index and CNX Finance Index with a value of probability (0.0253) and a value of F-statistics (3.9402), followed by CNX Finance Index and CNX Bank Index with a value of probability (0.0461) and a value of F-Statistics (3.25895), CNX Bank Index and CNX FMCG with a value of probability (0.0866) and a value of F-statistics (2.56122), and CNX Finance Index and CNX FMCG Index with a value of probability (0.0901).

Granger causality test results indicate that there is a positive relationship between the lunar effect and stock market returns in India based on returns from the market indices. Investors can take note of this information and devise their investment strategy in such a way as to benefit from these two lunar phases.



**Table 7** The results of Granger causality test for indices return on account of new moon day during period from 01-01-2008 to 31-12-2012

| <i>Pair wise Granger causality tests for new moon day</i> |   |            |                    |              |                           |
|---|---|------------|--------------------|--------------|---------------------------|
| <i>S. no</i>  | <i>Null hypothesis:</i>                       | <i>Obs</i> | <i>F-statistic</i> | <i>Prob.</i> | <i>Reject or accepted</i> |
| 1   | CNX_Energy does not Granger cause CNX_Bank    | 60         | 0.09215            | 0.9121       | Accepted                  |
| 2   | CNX_Bank does not Granger cause CNX_Energy    |            | 0.96015            | 0.3893       | Accepted                  |
| 3   | CNX_Finance does not Granger cause CNX_Bank   | 60         | 3.25895            | 0.0461*      | Rejected                  |
| 4   | CNX_Bank does not Granger cause CNX_Finance   |            | 3.9402             | 0.0253*      | Rejected                  |
| 5   | CNX_FMCG does not Granger cause CNX_Bank      | 60         | 0.78988            | 0.4591       | Accepted                  |
| 6   | CNX_Bank does not Granger cause CNX_FMCG      |            | 2.56122            | 0.0866**     | Rejected                  |
| 7   | CNX_IT does not Granger cause CNX_Bank        | 60         | 1.43911            | 0.2461       | Accepted                  |
| 8   | CNX_Bank does not Granger cause CNX_IT        |            | 1.00719            | 0.372        | Accepted                  |
| 9   | CNX_Finance does not Granger cause CNX_Energy | 60         | 0.67911            | 0.5113       | Accepted                  |
| 10  | CNX_Energy does not Granger cause CNX_Finance |            | 0.08628            | 0.9175       | Accepted                  |
| 11  | CNX_FMCG does not Granger cause CNX_Energy    | 60         | 1.05547            | 0.3551       | Accepted                  |
| 12  | CNX_Energy does not Granger cause CNX_FMCG    |            | 0.32266            | 0.7256       | Accepted                  |
| 13  | CNX_IT does not Granger cause CNX_Energy      | 60         | 1.73968            | 0.1853       | Accepted                  |
| 14  | CNX_Energy does not Granger cause CNX_IT      |            | 0.28305            | 0.7546       | Accepted                  |
| 15  | CNX_FMCG does not Granger cause CNX_Finance   | 60         | 0.84056            | 0.437        | Accepted                  |
| 16  | CNX_Finance does not Granger Cause CNX_FMCG   |            | 2.51679            | 0.0901**     | Rejected                  |
| 17  | CNX_IT does not Granger cause CNX_Finance     | 60         | 1.50704            | 0.2307       | Accepted                  |
| 18  | CNX_Finance does not Granger cause CNX_IT     |            | 1.06584            | 0.3516       | Accepted                  |
| 19  | CNX_IT does not Granger cause CNX_FMCG        | 60         | 1.17378            | 0.317        | Accepted                  |
| 20  | CNX_FMCG does not Granger cause CNX_IT        |            | 0.07742            | 0.9256       | Accepted                  |

Notes: \*Indicates significant causal relationship at 5% significance level.

\*\*Indicates significant causal relationship at 10% significance level.

Rejection of null hypothesis when the probability value is less than or equal to 0.10.

Source: Computed data from [http://nseindia.com/using e-views](http://nseindia.com/using-e-views)

## **6 Limitations**

Although our study could provide insights for the investors and policy makers, it is not without limitations. Our study was based on a lay theory (moon phases have significant influence on returns from stock market) and two assumptions. The assumptions are:

- 1 returns on one index should have a causal relationship with the returns from another index
- 2 we assumed that there is causality relationship between returns of sectoral indices on full moon and new moon days.

Another important aspect that we could not address was comparison. The results, obtained for a particular pattern (for instance, lunar phases in our study) has to be compared with those obtained during other periods.

Since, our goal was to focus only on lunar effect; we did not examine other effects such as calendar effects or festival days or holidays, although there is scope for examining such phenomenon, as depicted by Chakrabarti and Sen (2008) in stock market in India.

## **7 Conclusions**

The evidence from this study clearly suggests that there has been significant returns and volatility, during new moon as well as full moon days, in Indian stock indices. Thus, our study contributes to the knowledge about the relationship between lunar phases and the Indian stock market. Investors and regulators can consider this information so that they can wisely formulate their strategies and policies for better decision making. The lunar cycle has attracted tremendous interest among researchers, as it is important to understand the investors' beliefs and investment strategies on full moon and new moon days. The important insights, gained from this study, can be summarised as follows:

- 1 Our findings are not in line with the results, obtained by Sivakumar and Sathyanarayan (2009). However, we concur with the findings of Yuan et al. (2006) and Kuo et al. (2010).
- 2 The results indicate a more direct influence of lunar effect on emerging markets, like India, during new moon periods than during full moon periods. The evidences in this study suggest that people are more optimistic during new moon periods. This evidence could be used to predict changes in the stock prices. The findings of different studies, cited in the literature review, are also consistent with the notion that the lunar phases do affect individual moods, which in turn affect the investment behaviour.
- 3 The empirical evidence, presented in this study, demonstrates that lunar cycle exercises significant influence on stock returns and stock volatility. For example, the evidence in this study suggests that people are more optimistic during new moon periods than during full moon periods.
- 4 The results imply that the moon cycle affects individual mood and thinking, and leads to stock market returns. This evidence could be used to design controlled

experiments and to identify predictable changes, in relative optimism, as a function of the lunar cycle. Our results also concur with the result of Dichev and Janes (2003). Investors could make higher profit by timing their investment, looking at effects like the lunar effect.

## 8 Scope for further research

The results and recommendations of this present study were based on the data, samples with appropriate statistical tools. However, it is also a platform for future research in this area. For example, a study with similar objectives could be made with reference to other types of stock indices (broad market indices, large cap, mid cap and small cap indices). Similar studies may be conducted by considering stock market returns on weather, temperature and calendar effect. A study could be made on the effect of culture and lunar phases on exchange rate and ETF. Similar study could also be made for a longer study period, i.e., ten years or 20 years.

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## Appendix 1

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The important technical terms used in this paper can be defined as follows.

a Moon cycle

The term *moon cycle* (or lunar cycle) refers to the moon's continuous orbit around the earth. As the moon orbits the earth, its appearance (the phase) changes and thus gives us an indication of the moon's progress in the cycle.

b Full moon

When the moon appears perfectly round in the sky, it is known as full moon indicating that the disc of the Moon is full or complete. This happens, on an average, every 29 days and advances in astronomy have allowed scientists to carefully predict its patterns. Many traditions and superstitions are associated with the full moon in almost every culture across the globe, especially when the moon becomes eclipsed, which happens periodically.

c New moon

The new moon occurs when the moon is between the earth and the sun. Nights are the darkest during this period as the moon cannot be seen for most of the night since the earth obscures it. The moon is at its brightest when it is full.

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## Appendix 2

### *New moon and full moon days for the year 2012*

| <i>New moon days</i> | <i>Full moon days</i> |
|----------------------|-----------------------|
| January 23           | January 9             |
| February 21          | February 7            |
| March 22             | March 8               |
| April 21             | April 6               |
| May 20               | May 6                 |
| June 19              | June 4                |
| July 19              | July 3                |
| August 17            | August 2              |
| September 16         | August 31             |
| October 15           | September 30          |
| November 13          | October 29            |
| December 13          | November 28           |
|                      | December 28           |

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Source: [http://www.moongiant.com/full\\_moon\\_calendar.php](http://www.moongiant.com/full_moon_calendar.php)

**Appendix 3***New moon and full moon days for the year 2011*

| <i>New moon days</i> | <i>Full moon days</i> |
|----------------------|-----------------------|
| January 4            | January 19            |
| February 3           | February 18           |
| March 4              | March 19              |
| April 3              | April 18              |
| May 3                | May 17                |
| June 1               | June 15               |
| July 1               | July 15               |
| July 30              | August 13             |
| August 29            | September 12          |
| September 27         | October 12            |
| October 26           | November 10           |
| November 25          | December 10           |
| December 24          |                       |

*Source:* [http://www.moongiant.com/full\\_moon\\_calendar.php](http://www.moongiant.com/full_moon_calendar.php)

**Appendix 4***New moon and full moon days for the year 2010*

| <i>New moon days</i> | <i>Full moon days</i> |
|----------------------|-----------------------|
| January 15           | January 30            |
| February 14          | February 28           |
| March 15             | March 30              |
| April 14             | April 28              |
| May 14               | May 27                |
| June 12              | June 20               |
| July 11              | July 26               |
| August 10            | August 24             |
| September 8          | September 23          |
| October 7            | October 23            |
| November 6           | November 21           |
| December 6           | December 21           |

*Source:* [http://www.moongiant.com/full\\_moon\\_calendar.php](http://www.moongiant.com/full_moon_calendar.php)

## Appendix 5

### *New moon and full moon days for the year 2009*

| <i>New moon days</i> | <i>Full moon days</i> |
|----------------------|-----------------------|
| January 26           | January 11            |
| February 25          | February 9            |
| March 26             | March 11              |
| April 25             | April 9               |
| May 24               | May 9                 |
| June 22              | June 7                |
| July 22              | July 7                |
| August 20            | August 6              |
| September 18         | September 4           |
| October 18           | October 4             |
| November 16          | November 2            |
| December 16          | December 2            |
|                      | December 31           |

*Source:* [http://www.moongiant.com/full\\_moon\\_calendar.php](http://www.moongiant.com/full_moon_calendar.php)

## Appendix 6

### *New moon and full moon days for the year 2008*

| <i>New moon days</i> | <i>Full moon days</i> |
|----------------------|-----------------------|
| January 8            | January 22            |
| February 7           | February 21           |
| March 7              | March 21              |
| April 6              | April 20              |
| May 5                | May 20                |
| June 3               | June 18               |
| July 3               | July 18               |
| August 1             | August 16             |
| August 30            | September 15          |
| September 30         | October 14            |
| October 28           | November 13           |
| November 27          | December 12           |
| December 27          |                       |

*Source:* [http://www.moongiant.com/full\\_moon\\_calendar.php](http://www.moongiant.com/full_moon_calendar.php)