

# MOON PHASE AS THE CAUSE OF MONDAY IRRATIONALITY: CASE OF ASEAN DAY OF THE WEEK ANOMALY

**RAYENDA KHRESNA BRAHMANA**  
*Universiti Malaysia Sarawak, Malaysia*

**CHEE-WOOI HOOY**  
*Universiti Sains Malaysia, Penang, Malaysia*

**ZAMRI AHMAD**  
*Universiti Sains Malaysia, Penang, Malaysia*

Received: August 28, 2013

Accepted: January 22, 2014

Online Published: February 5, 2014

## ***Abstract***

*Many Day-of-the week anomaly papers have suggested investor behaviour as the explanation of highly differentiated returns on Mondays; yet, rarely found a paper has empirically investigated it. Therefore, this paper proposes Moon-Induced mood as the determinant of that irrational behaviour. This proposition is based on our preliminary findings that the full moon phase occurred more often on Mondays compared to other days; an indication of a causal relationship. By taking Indonesia, Malaysia, Thailand, and the Philippines as samples during the period of 1999-2010, this paper found: (1) There is evidence of a Monday effect across all the ASEAN stock markets, (2) The moon phase and its interaction with Mondays has significantly influenced the Monday effect, and (3) A full moon on Monday has significant negative influenced on Monday returns. In conclusion, the stimulation by moon phase forms affection bias, and the resulting outcome is the irrational stock market behavior.*

**Keywords:** Moon Effect, Day-Of-Week-Anomaly, Irrational Behavior, ASEAN

## **1. Introduction**

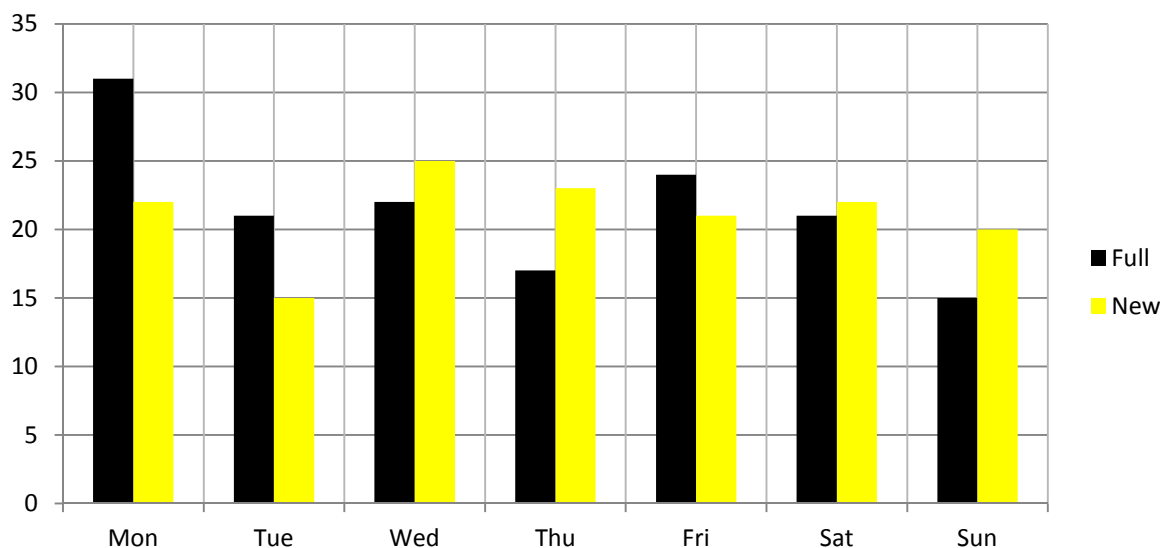
The belief that phases of the moon affect behavior dates back to ancient times. However, the debate about lunar effect on the human body and mind has been a hugely argued anecdotally as well as empirically in literature. For instance is Campbell (1983) who asserts that lunar lunacy research is not scientifically encouraging and explaining human behavior. This is supported by research findings which found there is no relationship between moon phase and behavior (i.e. Guiterrez-Garcia and Tusell, 1997; Chapman and Morrell, 2000; Biermann, 2005; Brahmna et al, 2011).

In another side, several scholars found the evidence of this lunar-lunacy behavior. Their stand point is that similar to the behavior of the ocean, the gravity of the moon creates an

impact on human behavior as 80% of the human body consists of water. The outcome of this moon phase circumstance to humans is the deviant behavior which has already been largely investigated in psychology (*see* Huston and Passerello, 1971; Cuningham, 1979; Katzeff, 1981; Nogueira, 1982; Kelly et al, 1996; Wilkinson, 1997; Barr, 2000; Kanth et al., 2012). The moon phase might also influence an investor's behavior and generate irrationality in his or her stock trading (*see* Dichev and Janes, 2001; Sivakumar and Satyanarayan, 2009; Gao, 2009).

Interestingly, our pre-investigation found that the full moon occurs more on Mondays (*see* figure 1). This moon cycle anomaly is consistent with the Day-Of-the Week Anomaly (hereafter DOWA) in finance where it is reciprocated with other psychological studies about moon-caused irrationality. If the DOWA shows the anomaly during Mondays, with the full moon occurring more on Mondays, it is only logical to hypothesize that the full moon affects the behavior.

Figure 1 – The Frequency of Full Moon and New Moon



In short, there are four important pieces of information found during our pre-investigation: (1) the literature shows a moon phase might affect investor behavior in the same way that it affects human behaviour, (2) A full moon phase occurs more on Mondays, (3) There is a DOWA in the stock market, showing that Monday returns are significantly different from other trading days, and (4) in finance literature, Monday returns of a DOWA can be explained by using trading behavior perspectives. Compiling this information, this paper hypothesizes that a Moon phase which occurs more on Mondays is the determinant of a DOWA.

This study emphasizes in examining the role of full moon on the day-of the week anomaly (DOWA). DOWA is a market anomaly which has been thoroughly investigated since the first seminal paper: French (1980). It remarked that the stock price returns on a certain day (usually Monday) have been highly and negatively differentiated from other days of the week. Much research has addressed trading behaviour as an explanation of the DOWA (*see* Abraham and Ikenberry, 1994; Wong et al., 2006); however, empirical investigation is rarely found in this particular research.

This research is in line with DeBondt and Thaler (1995) who suggested that finance theory has to be based on the evidence of the participants' psychology, which in this case is a moon-induced mood. In psychology literature, one of the early studies on the effects of moon

phase on human behaviour was conducted by Huston and Passerello (1971). Their conclusion was that lunar phases, especially during full moon phases, affect human moods and change them to be more depressive or more emotionally disturbed or be changed normally. Cuningham (1979) investigated the role of temperature and the moon on human moods and found that the full moon phases affect the generosity of humans. The effects of the moon phases significantly affect violent behavior (Katzeff, 1981), work accident rates (Nogueira, 1982), strange behavior (Kelly et al, 1996), and anxiety and depression (Wilkinson, 1997). Barr (2000) stated that the moon is a comprehensive source of mood changes. In medical science, the mood of humans is shown by increasing psychotic disorders, violence, and other deviant behaviors during the full moon phase. Furthermore, Barr concluded that the moon cycle has a significant relationship with the quality of life of humans in terms of moods. In summary, those psychology research papers have found that the role of the full moon is significant in inducing deviant behavior, irrationality, depression, or mood disturbances in humans.

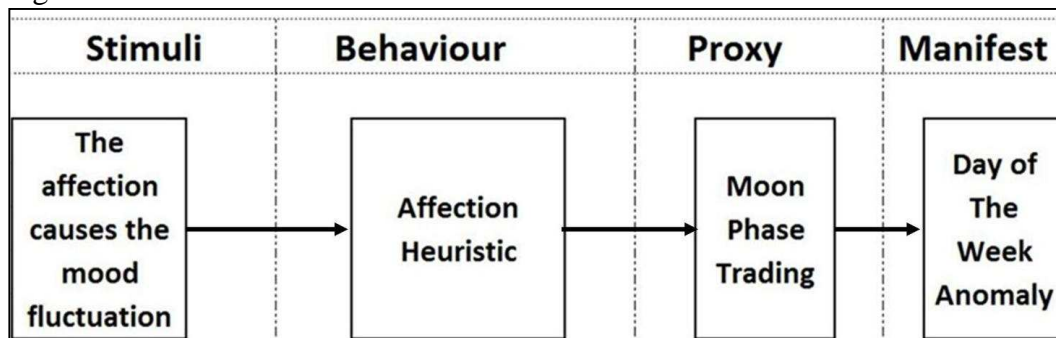
Empirical results have also proven that the moon cycles influence decision making in finance. One early study was conducted by Dichev and Janes (2001). They investigated the major US stock index over the previous 100 years and all the major stock indices of 24 other countries over 30 years and found that the moon cycle was aligned with the market returns. However, the research proved that the moon cycle did not affect the return volatility and trading volume. Herbst (2007) also conducted research on the relationship between the moon cycle and market returns. The results of the relationships were various and inconsistent. He demonstrated how the moon cycle inconsistently explained either daily returns or the price volatility of the Dow Jones index. Sivakumar and Satyanarayan (2009) investigated the relationship between the moon cycle and the Bombay Stock Exchange returns over 17 years and concluded that the moon cycle was linked with returns. Gao (2009) also investigated the relationship between the moon cycle and market returns in two major Chinese stock markets over 16 years and concluded that lunar phases affected stock returns. Further, Gao (2009) also showed that the returns were relatively lower in the new moon phase and relatively higher in the full moon phase. Additionally, Liu (2009) conducted research on 12 countries using the GARCH model and the Bayesian approach. His/Her results indicated that the existence of the lunar phase affects daily stock returns, in particular that the impacts of the lunar phases were varied across the nation. Liu showed that there is a higher volatility of stock returns during full moon periods. Based on these empirical results and theories, it can be concluded that the moon cycle affects moods of the decision making of market participants.

The role of the moon on investor behavior can be explained by using three major theories, namely, Ellis' ABC model, the Somatic market theory and Forgas' (1995) affection infusion model (AIM). Ellis' ABC model addressed these stimulating events as the activation of irrational behavior in humans. In this matter, the moon phase gravity was the stimuli and it activated irrationality of investors in decision making. Meanwhile, the somatic marker theory explains that strong threats from the environment create bodily reactions that reinforce sustained panic (Tvede, 2002). Relating to this research, full moon gravity affects investors, and reinforces sustained panic in a form of irrational decision making. Lastly, Forgas's (1995) AIM described how the affection from external environments (in our research it is the full moon affection) was infused into the information processing and created biased decision making. Elaborating on those theories, the flow of the full moon affects investors is that investors are stimulated by the full moon's gravity on Mondays. Having this stimulus, investor experiences affection bias and shows moon-induced mood behavior, and as a result, it generates the DOWA. Depicted in Figure 2, the hypothesis is reasonable and logical. This is aligned with our objective which is to investigate whether the moon phase, proxy of

moods, can explain the the Day-of-The-Week Anomaly (DOWA). Based on the literature review, our proposition is “**Moon Mood is the determinant of the Day of Week Anomaly**”.

This study addresses an intriguing but interesting question: is there any relationship between the moon and the Day-Of-Weekend Anomaly? It defers to other studies in three ways, first, it investigates the relationship between the moon phase and the DOWA. Second, the moon phase dummy in this research was only taken if it was a peak phase. Lastly, the psychology theory was introduced as the underlying cause as a way of explaining the relationship. The rest of paper is organized as follows. The research method is addressed in section 2; data is addressed in section 3; the findings and results are discussed in section 4; the conclusion is detailed in section 5.

Figure 2 – Theoretical Framework



## 2. Research Design

### 2.1 Procedures

Several phases were conducted in this paper to check the relationship between moods (moon phase as the proxy) and DOWA. First, the existence of the Monday effect of the DOWA was investigated (see equation 1). After the DOWA was found, the relationship between market returns and moon phases was examined. In this phase, the mean difference and t-statistic was used to check the level of influence. Then, a modified French’s (1980) regression model was utilized with one lag to investigate the relationship between the DOWA and the moon phase (see equation 2). For a robustness check, the effect of the Monday’s moon on Monday’s return was revisited (see equation 3). The model is described below.

### 2.2 Day-of-Weekend Anomaly Model

The Day-Of-Weekend Anomaly is run by replicating the seminal model of French (1980):

$$R_t = \alpha_t + \gamma_1 dTue_t + \gamma_2 dWed_t + \gamma_3 dThu_t + \gamma_4 dFri_t + R_{t-1} + \epsilon_t \tag{1}$$

Where:  $R_t$  is Return of the stock at t-time.  $dTue_t$ ,  $dWed_t$ ,  $dThu_t$ , and  $dFri_t$  are Tuesday dummy, Wednesday dummy, Thursday dummy, and Friday dummy, respectively. To eliminate the variance error, a one-day lagged was introduced.

### 2.3 Moon Phase and Day-of-Weekend Anomaly Model

This research employs equation 2 by introducing the dummy variable interaction to test the relationship between moon phases on DOWA. In this model, there are two dummy variables (

$dME_t, dMOON_t$ ), one dummy interaction, and one-lagged return as the variance error elimination ( $R_{t-1}$ ). The model is:

$$R_t = \alpha_1 + \alpha_2 dME_t + \alpha_3 dMOON_t + \alpha_4 (dME_t * dMOON_t) + \alpha_4 R_{t-1} + \varepsilon_t \quad (2)$$

Where  $dME_t$  is Monday Effect dummy as the proxy of DOWA. 1 if it is Monday, and 0 if otherwise.  $dMOON_t$  is the moon phase dummy. 1 if it is full moon peak, and 0 if otherwise.  $R_{t-1}$  is the one-lagged return or the return of the period t-1.

### 2.4 Moon on Monday and Monday Returns Model

This research investigates in detail the association between the moon on Monday and the Monday return as the robustness. Closing prices and opening prices were used to calculate the Monday returns. The Friday return was introduced as the one-lagged return in the model to eliminate the variance error.

$$\text{Log} \left( \frac{\text{Monday}_{close}}{\text{Monday}_{open}} \right) = \alpha_1 + \alpha_2 dMOON_t + \alpha_3 \text{Log} \left( \frac{\text{Friday}_{close}}{\text{Friday}_{open}} \right) + \varepsilon_t \quad (3)$$

Where  $\text{Monday}_{close}$  is the Monday closing price.  $\text{Monday}_{open}$  is the Monday opening price.  $\text{Friday}_{close}$  is the Friday closing price.  $\text{Friday}_{open}$  is the Friday opening price.  $dMOON_t$  is the moon phase dummy where 1 if it is full moon, and 0 if otherwise.

## 3. Data

This research used 4 stock markets; Indonesia, Malaysia, Philippines, and Thailand, as samples. The period was from January 1999 until December 2010 as a daily basis of market returns. The market returns data was retrieved from Thomson Datastream. Meanwhile, the moon phase calendar is retrieved from [www.moonconnection.com](http://www.moonconnection.com)<sup>1</sup>. For the sample to be reliable, the moon had to first be checked cyclically<sup>2</sup>. (Dichev and Janes, 2003).

## 4. Results

### 4.1 Descriptive Results

Based on table 1, from the descriptive results two main issues arise. First, in terms of returns, the mean of the daily returns in the ASEAN-4 markets is relatively small. In terms of volatility, the ASEAN-4 markets have a relatively high dispersion of returns. This indicates that the probability of losing is higher than the probability of returns. This description depicts the distribution of normal returns.

<sup>1</sup> Most of seminal papers of Moon Research use this website or [www.lunarphases.com](http://www.lunarphases.com).

<sup>2</sup> The result does not appear in this research. We can give it by request.

Table 1 – Descriptive Results of the Market Returns Each Countries

	INDONESIA	MALAYSIA	PHILIPPINES	THAILAND
Mean	0.0529	0.0247	0.0099	0.0267
Maximum	7.9212	6.0250	17.5597	11.1567
Minimum	-10.3754	-9.4968	-12.2683	-14.8395
Std. Dev.	1.5554	1.0539	1.4469	1.5814

Note: Numbers stated in the table is the returns of market in percentage

#### 4.2 Evidence of the Day-of-Weekend Anomaly in ASEAN

Common sample group statistics in equation 1 were used on the ASEAN-4 stock market to investigate whether the returns were generated in calendar time. The calendar-time hypothesis surmises that the expected market returns are the same for each day. Furthermore, this hypothesis surmises that if a certain day has a high return, the following day should also have the same rate of return. Thus, our results reject this calendar time hypothesis and are able to claim the existence of a DOWA.

Panel A depicts the difference between the returns for Monday and the returns for other days of the week in the ASEAN-4 markets. It describes the returns of Mondays and shows that they were mostly in the negative region, while the returns of the other days were null or positive over all markets. It also demonstrates that the market returns were not constant throughout the week nor had the same relative level of return. In addition, to have high negative returns for Mondays indicates the Monday Effect of a DOWA.

PANEL A – Descriptive of Daily Returns Each Countries

INDONESIA	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mean	-0.2243	0.0834	0.0318	0.1177	0.2366
Maximum	5.9673	5.5013	7.9212	7.2258	7.1630
Minimum	-10.3571	-7.6977	-10.3754	-5.9361	-6.9055
Std. Dev.	1.7320	1.3788	1.5651	1.4090	1.4460

MALAYSIA	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mean	-0.1438	0.0936	0.0487	0.0571	0.0676
Maximum	4.1893	4.1224	4.6056	5.8765	6.0250
Minimum	-9.4968	-3.8421	-6.1453	-3.7681	-4.8907
Std. Dev.	1.2435	0.9267	1.0374	0.9580	1.0220

PHILIPPINES	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mean	-0.0457	-0.0059	0.0095	0.0954	0.0609
Maximum	17.5597	9.8178	4.4725	4.1948	4.6940
Minimum	-12.2683	-5.5163	-7.9201	-6.0067	-8.3306
Std. Dev.	1.8430	1.3029	1.3293	1.2662	1.2588

THAILAND	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mean	-0.2626	0.0162	0.0266	0.0245	0.2882
Maximum	5.3921	10.1012	11.1567	10.7700	8.5950
Minimum	-10.4974	-14.8395	-6.8790	-6.7197	-9.6062
Std. Dev.	1.5267	1.5678	1.6801	1.4536	1.5182

Note: Numbers stated in the table is the returns of market in percentage

Panel A shows three important findings. First, mean returns on Mondays show a highly negative difference in the ASEAN-4 markets. Meanwhile, other days have stable positive



mean returns which indicate the DOWA, specifically, the Monday Effect. Second, the spread of the maximum and minimum on Mondays is relatively higher than other days, which means that irrational behavior occurs implicitly on Mondays. This spread also indicates the existence of the DOWA. Lastly, the volatility of Monday returns are relatively higher compared to other days indicating the DOWA anomaly existence on the ASEAN-4 markets.

Table 2 confirms the evidence of the DOWA. It documents that all ASEAN-4 stock markets experienced the calendar anomaly between 1999 and 2010, which is in line with the prior research of Jaffe & Westerfield (1985), Lakonishok & Maberly (1990), Agrawal & Tandon (1993), Kok & Wong (2004), Wong et al., (2006), and Chandra (2006). The mean of Monday returns was negative and significantly associated with the market returns. Additionally, the negative coefficient on Monday increased to positive returns and diminished again when it closed on Friday. The coefficient of the model was found to be significant at a 1% level. As seen in Table 2, the evidence of DOWA shows that we can continue to the next level of our research.

#### 4.3 The Full Moon and New Moon Differences

Now we can proceed to the differences between full moon and new moon returns. It is important to examine the significant differences between these two phases. If the full moon effect on the returns is the same as the effect of the new moon phase, it indicates that the moon phase has no effect on returns. Furthermore, it implies that the cyclical movement of the moon is ordinary without any impact. To investigate this in detail, the mean difference, standard deviation, and, t-test must be checked.

Table 2 – The French's (1980) DOWA Model Result

		Indonesia	Malaysia	Thailand	Philippines
intercept/Mon	Coefficient	-0.0023***	-0.0014***	-0.0026***	-0.0005***
	Std. Error	0.0007	0.0005	0.0007	0.0007
Tuesday	Coefficient	0.0034***	0.0022***	0.0030***	0.0002***
	Std. Error	0.0010	0.0007	0.0010	0.0009
Wednesday	Coefficient	0.0027***	0.0018***	0.0027***	0.0011***
	Std. Error	0.0009	0.0006	0.0009	0.0009
Thursday	Coefficient	0.0036***	0.0022***	0.0035***	0.0004***
	Std. Error	0.0012	0.0008	0.0012	0.0011
Friday	Coefficient	0.0045***	0.0020***	0.0055***	0.0010***
	Std. Error	0.0010	0.0007	0.0010	0.0009
T-1	Coefficient	0.1584***	0.0941***	0.0549***	0.1095***
	Std. Error	0.0200	0.0202	0.0203	0.0202
R-Squared		0.0332	0.0621	0.0334	0.0535
F-Value		16.6773***	3.7910***	7.0824***	6.6574***

Note: \*\*\* is significant in 1% level.; T-1 is lagged one return

In terms of the mean difference, table 3 shows that the full moon mean returns are different compared to new moon mean returns, which are twice as high as or more than full moon mean returns, while confirms the psychology literature, the full moon phase promotes aggressive behavior. A hypothetical explanation is that there are negative returns during the full moon day. Likewise, the standard deviation of the new moon is also lower than the full

moon. The t-test indicates that aggressiveness during the full moon phase is higher compared to in the new moon phase. The t-test difference was conducted to evaluate it further in a statistical manner.

Table 3 - The Returns of Full Moon and New Moon in ASEAN-4 Stock Markets

		Indonesia	Malaysia	Philippines	Thailand
Mean Daily Return	New Moon	0.0835	0.0509	0.0136	0.0337
	Full Moon	0.0227	0.0013	0.0062	0.0196
Standard Deviation	New Moon	1.4643	1.0512	1.4436	1.5721
	Full Moon	1.6143	1.0564	1.4518	1.5915

Note: Numbers stated in the table is the returns of market in percentage

By conducting the paired t-test, our results show an interesting effect. Based on table 4, the full moon phase had a different effect on market returns compared to the new moon phase, which implies that there are distinguished returns between a full moon and a new moon phase in Indonesia, Malaysia, the Philippines, and Thailand. This could also imply that the ASEAN-4 stock market investors are irrational by following their moon phase affection; a confirmation of the mean difference result.

Table 4 – T-Statistic Results

Indonesia	Standard Errors	-4.83
	T-Stats	-2.43**
Malaysia	Standard Errors	-5.97
	T-Stats	-2.44**
Philippines	Standard Errors	-12.07
	T-Stats	-3.14***
Thailand	Standard Errors	-8.6
	T-Stats	-2.91***

Note: \*\*, \*\*\* denote the significant at the 5%, and 1% respectively

#### ***4.4 The Role of the Moon Phase on the Day-of-the Week Anomaly***

The next procedure is to investigate the relationship between moon phases and market returns by introducing the dummy interaction of the Monday effect and the Monday moon. The interaction between the Monday dummy effect and the moon phase dummy indicates the role of the Monday's moon phase effect. It is noteworthy that this model was constructed under the dummy interaction model. Hence, the Moon dummy variable was been found to be significantly influenced by the returns. If the moon significantly affects the returns, it will lead to a second question; on which day does the moon have the most influence? To prove this hypothesis, equation model 2 was employed to see if there was a relationship between the moon and market returns.

This research is designed so that the entire distribution of the new moon returns and full moon returns plot into a frequency distribution table (see Figure 3). The distribution of the returns is depicted as new moon and full moon in the pooled data of the ASEAN-4 markets. Over 44 country-years on a daily basis were observed. In total, the observation was 4892 days for the full moon period and 4836 days for the new moon period.

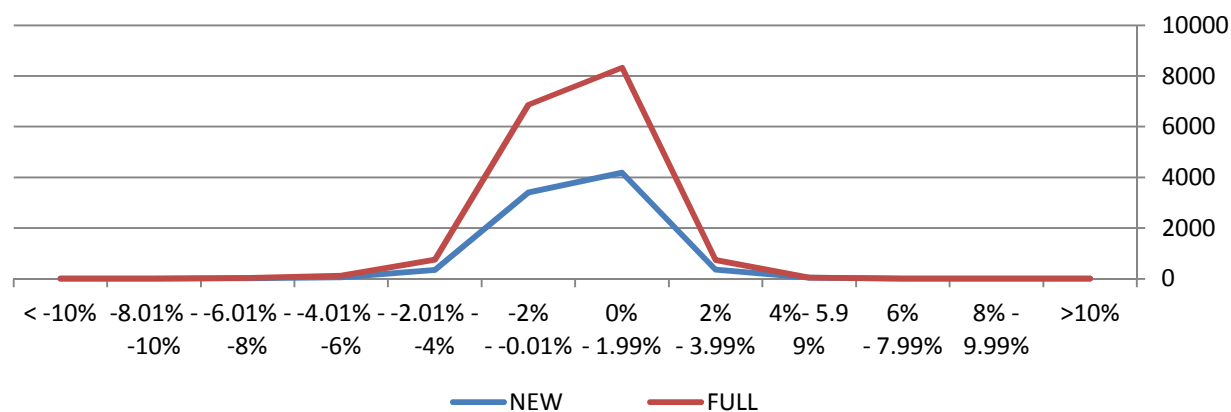
The ASEAN-4 stock markets were grouped into 2% return intervals to provide a density of the frequency distribution of the returns. Interestingly, the results are different from the previous research of Dichev and Janes (2003) where the new moon returns and full moon



returns were relatively different in peak shape (kurtosis) and in their increase / decrease rate shapes. In terms of dispersion, the skewness is similar to the results of Dichev and Janes (2003), in which the shift looks regular and clean throughout the entire right side and left tail end for a normal distribution. The shape difference between the new moon and full moon confirms that certain moon phases have different impacts on returns behavior. It also implicitly shows that moon phases influence the market; an indication of the effect of the moon on market behavior. To check the relationship robustly, this study investigated the relationship by employing equation 3.

The role of the full moon on Monday encourages the irrational behavior of investor, and this irrationality generates the DOWA as the outcome. The interaction of the Monday Effect variable and the Full Moon variable is used to prove there is a relationship. Panel B shows the significant relationship between this interacting variable on market returns implying that a relationship exists between the full moon and the DOWA. This relationship is in line with the previous results of Annuar and Shamsir (1987), Ho (1990), Wong, Hui and Chan (1992), Aggarwal and Rivoli (1994), Agrawal and Tandon (1996), Foo and Kok (2000), and Basher and Sadorsky (2006).

Figure 3 – Frequency distribution of the returns of moon phases



Panel B consists of four tables. Each table shows the regression result of equation 2 from each country of ASEAN-4. It addresses the coefficient, probability, and R-Square. The ME stands for the Monday effect, the Moon represents the Full Moon dummy; M\*Moon represents the dummy interaction; and RMIN1 is the one lag return.

A different relational conclusion for each independent variable can be observed in Panel B. In terms of the Monday Dummy, a significant relationship is shown in the market returns of each ASEAN-4 countries. The relationships were negatively significant at a 5% level, and confirmed the previous results about the Monday effect on the ASEAN-4 stock markets. Meanwhile, the relationships between the full moon phase and market returns also shows a negatively significant association. It was negatively significant at a 5% level in the stock markets of Indonesian, Malaysian, and the Philippines with a coefficient of -0.10, -0.02, and -0.06 respectively. In addition, the relation between the full moon and Thailand stock market returns was significant at a 10% level with coefficient value of -0.03. This relationship highlights the role of the full moon on market returns.

By introducing the dummy interaction, it was found that the full moon on Mondays had an effect on the market. Thailand and the Philippines had a negatively significant relationship at a 5% level, while it was negatively significant at a 10% level for the stock markets of Indonesia and Malaysia. This is in line with our hypothesis and plots, whereas, the full moon

phase occurs more on Mondays. Those occurrences of full moon on Mondays affect the investors decision making through their mood; as an outcome, the DOWA occurs in those ASEAN-4 stock markets.

Table 1 of Panel B describes the results of the Indonesian stock market. First, the Monday effect is significantly associated with market returns, signaling the DOWA. The relationship was at a 5% significance level with a coefficient value of -0.06. The negative sign strengthens the DOWA indication as it is identical to with the French (1980) DOWA model. The Moon phase dummy was also found to significantly influence the market returns at a 5% level with a coefficient value of -0.10. This indicates that the full moon has a role in manipulating market returns. If the full moon occurs the Indonesian stock market returns might fall to 0.1%. The interaction variable of the Monday effect and moon phase implies that the Moon phase and Monday Effect plays a role in the Indonesian stock markets, where it was negatively significant at 10% with a coefficient value of -0.28. Therefore, it can be concluded that the numbers of full moon occurs on Mondays is the determinants of DOWA.

The Malaysian stock market result is shown in Table 2 of Panel B. Similar to the Indonesian stock market results, there is an indication of the role of the Moon phase on the DOWA. The Monday variable effect shows a significant level at 1%; whereas, the moon phase had a significant level at 5%. The values were also similar to the Indonesian result where it was -0.09 and -0.02 for the Monday effect and the full moon dummy, respectively. The dummy interaction shows a significant relationship to market returns at a 10% level which implies that it might be the full moon on Monday which causes the Monday irrationality (DOWA) in the Malaysian stock market.

Table 3 of Panel B addresses the result of the Thai stock market. It shows a negatively significant relationship between the Monday effect and the market returns at a 1% level where the coefficient was -0.14. Meanwhile, the full moon dummy variable was significant at 10% level, and the coefficient value was -0.03, confirms the evidence of the DOWA and supports our hypothesis about the full moon being the driver of the DOWA. The dummy interaction was significant at a 5% level with coefficient of -0.11. In other words, the full moon on Monday in Thailand affected the investors' decision making on Monday.

In the last table of Panel B, the result of the Philippines stock market was addressed. Again, the result comes to the same conclusion as the other tables in Panel B. A negatively significant relationship was found from the entire list of regressors (Monday Effect, Moon Phase, and Dummy interaction) on the market returns of the Philippines at a 5% level, which means Monday's full moon had an effect on the DOWA in the Philippine market. If the full moon occurs on a Monday, the Philippines stock market might have DOWA with a 0.04% drop in of market returns.

In terms of the R-Square value, the Indonesian stock market had the largest R-Square. At the same time, the Philippine market has the smallest value. The Indonesian R-Square was 3.64%, and the Philippines value was 1.86%. In addition, Malaysia had a 3.31% value and Thailand had a 2.87% value. This indicates that the regressor can be used to explain the model. Note that the small number of R-Square values in our model is a common fact as our model was constructed under a dummy variable interactive model. In summary, the moon phase has played a role in the Monday effect of the ASEAN-4 DOWA between 1999 and 2010. The interaction between the Monday Moon and Monday Effect has had a negative association to market returns.

PANEL B – The results of Moon Phases and Market Returns

	Variable	Coefficient	Prob.		Variable	Coefficient	Prob.
INDONESIA	C	0.08	0.0621	MALAYSIA	C	0.012	0.0421
	ME	-0.06	0.0349		ME	-0.09	0.0088
	MOON	-0.10	0.0440		MOON	-0.02	0.0312
	M*MOON	-0.28	0.0745		M*MOON	-0.05	0.0644
	RMIN1	0.1557	0.0000		RMIN1	0.1555	0.000
	R-Squared	0.0364			R-Squared	0.0331	
THAILAND	C	0.013	0.0023	PHILIPPINES	C	0.013	0.0445
	ME	-0.14	0.0047		ME	-0.05	0.0387
	MOON	-0.03	0.0687		MOON	-0.06	0.0349
	M*MOON	-0.11	0.0125		M*MOON	-0.04	0.0482
	RMIN1	0.0511	0.0119		RMIN1	0.1125	0.0000
	R-Squared	0.0287			R-Squared	0.0186	

Note: C is the intercept; ME is the Monday Dummy; MOON is the Moon Dummy; RMIN1 is the Lagged-one returns.

#### 4.6 Monday Moon and Monday Returns

As a robustness check, the role of Monday’s full moon on the DOWA was investigated further by using Equation model 3. The returns were based on the daily return, by taking the opening and closing price.<sup>3</sup> The random walk model was adopted as the control variable for the estimation<sup>4</sup>.

Table 5 addresses the results of equation 3 which consists of the regression coefficient values, probability value, R-Squared value, F test Value, and the probability result of the F test. In terms of R-Squared, the value lies between 1.2% and, inclusive of 2.5% where the Indonesian stock market returns are explained by the Moon, while the Philippines returns are at a lower value. This range is considered normal for an event study with a dummy variable model. The F-Value of the model in each market shows a high value where we can surmise the model cannot be rejected. In conclusion, it may be stated that the model can be used to explain the relationship between the full moon phase and market returns.

Table 5 documents that the Indonesian, Malaysian, and the Philippines stock markets were negatively and significantly influenced by the Moon Phase at a 5% level. Meanwhile, the significant level of the relationship between the Thailand stock market and the moon phase was only 10%. The full moon on Monday was a negatively significant influence on Indonesian stock market returns on Mondays where the coefficient value was -0.0282. Meanwhile, the coefficient values were -0.0024, -0.00108, and -0.00136 for the relationship between Monday full moon and Monday stock returns of the Malaysian, the Thai, and the Philippine stock market, respectively. The negative sign shows that the Monday full moon might cause a bearish Monday (DOWA) in every ASEAN-4 stock markets. Furthermore, Friday’s returns in each market showed a significant relationship to Monday’s returns at a 1% level.

It can be concluded that the Monday full moon has a negative impact on Monday returns. The affection bias, which was generated by the full moon, influences investment decisions. It was deemed that gravity during the full moon caused irrationality in an investor’s

<sup>3</sup> If the standard calculation is used, which is the normal logarithm of that day’s closing price which is then divided by previous closing price, it will be weekly returns. We do this to avoid any biased results.

<sup>4</sup> We adopted the random walk model by adding one-lagged returns, which is in this case is Friday returns.

Monday trading behavior; which is in line with the Forgas (1985) affection infusion model, and also with our previously demonstrated results. Hence, the full moon occurring on Monday is a determinant of DOWA.

Table 5 – The results of Monday Moon and Monday Returns

Items	INDONESIA	MALAYSIA	THAILAND	PHILIPPINES
C	0.0307**	0.0168**	-0.000176*	0.00765*
MOON	-0.0282**	-0.0024**	-0.00108*	-0.00136**
FRIDAY	0.156625***	0.1530***	0.047878***	0.112058***
R-Squared	0.0251	0.0243	0.002369	0.012678
F-Value	30.9025	29.9407	2.854432	15.43509
Prob(F-statistic)	0.0000	0.0000	0.057784	0.0000

Note: \*, \*\*, \*\*\* is significant in 10%, 5%, and 1% level

C is the equation intercept; Moon is the Moon Dummy; FRIDAY is the Friday returns. The figures stated are the coefficient value.

## 5. Conclusion

The moon is believed to be one of the factors of moods. In the abnormal psychology field, the affective influences of the moon-mood can affect cognitive decision making. As proven by previous empirical results, the affect of the moon on moods can also affect economic behavior. This study aims to investigate the role of the moon on irrational behavior of calendar anomalies. By using Ellis' ABC model plus the Somatic Marker and Forgas' Affection Infusion Model, this research able to explain the day-of-the week anomaly (DOWA) in a psychological manner.

Our findings are divided into 3 sections: (1) the existence of the DOWA, (2) the relationship between the moon and market returns, and (3) the relationship between the moon and the DOWA. First, it can be stated that the DOWA initially existed in the ASEAN-4 stock markets. The high negative returns on Mondays were different to returns on other days, and the regression results confirmed this conclusion. Further, based on these results, we surmised that the type of DOWA, which occurred in the entire stock market, was the Monday Effect.

Second, the possibility of an explanation of the moon on market returns was mentioned. Figures 1 depicts that there are some links between the phase of the moon and the behavior of market returns. These links were then investigated further. The results showed that there was a negatively significant relationship between the interaction of the moon phase, Monday effect, and the DOWA. These results can also be used as an explanation of the DOWA from a behavioral perspective.

For a more robust investigation we ran the equation model of the relationship between Monday full moon and Monday returns (equation 3). We detained the "real" Monday returns by using the opening and closing price as the measurement for these returns. The purpose was to grasp the power of moon phase on Monday's behavior. Further, we utilized the random walk by introducing the one-lagged day returns to control the model, which, in this case, was Friday. Fascinatingly, we found that the Monday moon was connected to the Monday returns, thus confirming our first results. This means that the moon phases significantly influences the DOWA.

In summary, our findings are as follows. First, full moon occurred more often on Mondays from 1999 to 2010. This occurrence generated the deviant behavior caused by the affection bias, which became the activating event for an investor to be more irrational on Mondays compared to others days. In other words, the Moon Phase is the stimulant of investor trading behaviors. Second, the moods induced by moon phases caused a biased decision making;

which in economics called “irrational behavior”. This irrational behaviour was portrayed by the Day-of-the week anomaly. Our regression model and the T-Test delivered the evidences of it implying that the moon phase plays a role on trading behavior. In more simple words, the affection bias (caused by the moon phase) produces the day-of-the week anomaly.

The findings can be discussed using the above three mentioned theories (Ellis’ ABC, Somatic Marker, and Forgas’ AIM). Using Ellis’ ABC model, the relationships were analyzed as follows:

**Activating Event (A):** Full Moon on Monday

**Beliefs and Cognition Process (B):** Mood disturbance

- Investor A: “I feel tired with my stock performance. Just sell it”  
or
- Investor A: “I feel it is the time to sell”

*Inferences about the event:* Hedonic Utility

**Consequences (C):** Overweighted on the selling side causing Day of the Week Anomaly (DOWA)

*Feelings:* depressed, aggressive, hedonic, moody

*Behaviors:* Investor made pressure on the market and caused Monday Irrationality (Day of the week anomaly).

The relationship between the moon phase and DOWA can also be explained as a Somatic Marker. In this hypothesis, if there is a strong threat from an external factor (in our case full moon gravity), it can create a human reaction that reinforced panic or heuristic bias. The full moon occurrences anomaly (more full moon on Monday than other days) forces the human body to be more heuristically biased in decision making. Hence, DOWA occurs as a consequences of it.

Lastly, using Forgas’ Affect Infusion Model (AIM), our result can be explained as follow. The first process in AIM is “Direct Access” where the full moon hit the investor frequently on Monday. The second stage is the “Motivational Process”. This occurs when the affect of the full moon gives a biological issue in the human body through its gravity. The influence of a full moon on human biology leads to irrationality. The third stage is “Heuristic Infusion” where the irrationality drives the investor to make biased decision. The last stage of AIM is “Substantive Procession”, which is the infusion process of affection bias causing biased decision making which is portrayed in DOWA.

In summary, it can be claimed that the moon phase and the affection bias are the drivers of the day-of-the week anomaly in the ASEAN-4 stock markets. Future research might look at other psychological biases such as cognitive dissonance or from the point of view of market microstructure.

2. Before employing the whole equation, the cyclical process of moon phases has to be checked. It is very important to put the dummy moon phase in the equation. We employed equation 4 that used continuous lunar impact sinusoidal model to test for the cyclical pattern. According to this model, the lunar effect reaches a peak at the time of the full moon and bottoms out at the time of the new moon, following a cosine curve with a period of 29.53 days (the mean length of a lunar cycle). The edge of the new moon is the first quarter, and the edge of the full moon is the last quarter. Dichev and Janes (2003) model was replicated for equation 4, which can be written as:



$$R_t = \alpha + \beta^* \text{Cos}\left(\frac{2\pi d_t}{29.53}\right) + \varepsilon_t \quad (4)$$

Where  $R_t$  is the daily return during a full moon or a new moon period in period “t”.  $d$  is the number of days since the last full moon day, and the  $\beta$  coefficient indicates the relationship between stock returns and lunar cycles.

#### NOTE

1. The moon phase cannot be observed during the day because sunlight beams make it hidden from the naked eye.

Phase	Visibility	Standard time of culmination (mid-phase)
New moon	after sunset	12 Noon
Waxing crescent moon	afternoon and post-dusk	3 PM
First quarter moon	afternoon and early night	6 PM
Waxing gibbous moon	late afternoon and most of night	9 PM
Full moon	sunset to sunrise (all night)	12 midnight
Waning gibbous moon	most of night and early morning	3 AM
Third (last) quarter moon	late night and morning	6 AM
Waning crescent moon	pre-dawn and morning	9 AM
Dark moon	before sunrise	12 noon

#### References

- Barr, W., (2000) Lunar Revisited: The Influence of the moon on mental health and quality of life. *Journal Psychosocial Nurse Mental Health Science* 38(5): 28-35.
- Biermann, T., Estel, D., Sperling, W., Bleich, S., Kornhuber, J., & Reulbach, U. (2005). Influence of lunar phases on suicide: the end of a myth? A population-based study. *Chronobiology international*, 22(6), 1137-1143.
- Brahmana, R., Hooy, C-W., and Ahmad, Z. (2011) Moon Effect on Pacific Basin Stock Markets. *Indonesian Capital Market Review*, 3(2), 117-126.
- Chapman, S., & Morrell, S. (2000). Barking mad? Another lunatic hypothesis bites the dust. *BMJ*, 321(7276), 1561-1563.
- Cross, F., (1973) The Behavior of Stock Prices on Fridays and Mondays. *Financial Analysts Journal* 29, 67-69.
- Cunningham, M.R., 1979. Weather, mood and helping behavior: Quasi-experiment with the sunshine samaritan. *Journal of Personality and Social Psychology* 37: 1947–1956.
- Dewey, Edward R. 1971. Cycles: The mysterious forces that trigger events. Foundation for the Study of Cycles, New York.
- Dichev, I.D., Janes, T.D., 2003. Lunar cycle effects in stock returns. *Journal of Private Equity*, 6 (Fall): 8–29.
- Gao, Q. (2009) Lunar Phases Effect in Chinese Stock Returns. 2009 International Conference on Business Intelligence and Financial Engineering. Beijing, China July 24-July 26.
- Gardner, M.P., (1985) Mood States and Consumer Behavior. *Journal of Consumer Research*, Vol.12: 281-294.
- Gutierrez-Garcia, J. M., & Tusell, F. (1997). Suicides and the lunar cycle. *Psychological reports*, 80(1), 243-250.
- Herbst, A. (2007) Lunacy in the Stock Market—What is the Evidence? *Journal of Bioeconomics* (2007) 9:1–18.



- Hirshleifer, D. (2001) Investor Psychology and Asset Pricing. *The Journal of Finance*, Vol. 56, No. 4, Papers and Proceedings of the Sixty-First Annual Meeting of the American Finance Association, New Orleans, Louisiana, January 5-7, 2001, pp. 1533-1597.
- Hirshleifer, D., and Shumway, T. (2003) Good Day Sunshine: Stock Returns and the Weather. *The Journal of Finance*, Vol. 58, No. 3. (Jun., 2003), pp. 1009-1032.
- Howarth, E. and Hoffman, M. S. (1984). A Multidimensional Approach to the Relationship between Mood and Weather. *British Journal of Psychology*, 75(February): 15-23.
- Isen, Alice., Shalcker, Thomas, E., Clark, M., and Karp, L.(1978) Affect, accessibility of material in memory and behavior: A cognitive loop? *Journal of Personality and Social Psychology* 36: 1-12.
- Johnson, Eric J., and Amos Tversky. (1983) Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology*, 45, 20-31.
- Kamstra, Mark J., Lisa A. Kramer, and Maurice D. Levi, (2000) Winter blues: Seasonal Affective Disorder (SAD), the January effect, and stock market returns, Working paper, Faculty of Katzeff, K., 1981. Moon Madness. Citadel Press, Secaucus, N.J.Commerce, University of British Columbia.
- Kanth, R., Berg, R.L., and Rezkalla, S.H. (2012). Impact of Lunar Phase on the Incidence of Cardiac Events. *World Journal of Cardiovascular Diseases*, 2, 124-128.
- Kaufman, B. E. (1999). Emotional Arousal as a Source of Bounded Rationality. *Journal of Economic Behavior & Organization*, 38: 135-144..
- Lo, Andre, W., and Repin, Dimitry, V. (2001) The Psychophysiology of Real Time Financial Risk Processing. *Sloan Working Paper 4223.01*, MIT Sloan School of Management..
- Loewenstein, G.F., 2000. Emotion in economic theory and economic behavior. *American Economic Review*, 65: 426–432.
- Nogueira, D.P., (1982) Effect of lunar cycle on human behaviour. *Journal Royal Social Medicine*, 75(9): 753-754.
- Schwarz, Norbert. (1990) Feelings as information. Informational and motivational functions of affective states, in R. Sorrentino, and E.T. Higgins, eds.: *Handbook of Motivation and Cognition* (Guilford Press, NewYork).
- Shiller, R.J. (2003) From Efficient Markets Theory to Behavioral Finance. *The Journal of Economic Perspectives*, Vol. 17, No. 1, pp. 83-104.
- Sivakumar, N., and Satyanarayan, S. (2009) Do Krishna Paksha (New Moon Phase) and Shukla Paksha (Full Moon Phase) affect the Indian Stock Market? – A Study of Lunar cycles in the Bombay Stock Exchange. *International Journal of Indian Culture and Business Management* Vol. 2, Number 3: 281-293.
- Thaler, R.H., (1987). Anomalies: The January effect. *Journal of Economic Perspectives*, 1,197-201.
- Tvede, L., (2002). *The Psychology of Finance: Revised Edition*. John Wiley and Son.
- Wilkinson, G., (1997) Lunar Cycle and Consultation for Anxiety and Depression in General Practice. *International Journal of Social Psychiatry*, 43(1): 29-34.
- Yuan, K., Zheng, L., and Zhu, Q. (2006) Are Investor Moonstruck? Lunarphase and Stock Returns. *Journal of Empirical Finance*, (13) 1-23.

