Are Investors Moonstruck?
Lunar Phases and Stock Returns

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Abstract

Psychological evidence and casual intuition predict that lunar phases regulate mood. This paper investigates the relation between lunar phases and stock market returns in 48 countries. We find strong global evidence that stock returns are lower on days around a full moon than on days around a new moon. The magnitude of the return difference is 6.6 percent per annum from our 15-day window panel analysis. The lunar effect is independent of other calendar-related anomalies such as the January effect, the day-of-week effect, and the calendar month effect.

It is the very error of the moon,
She comes more near the earth than she was wont.
And makes men mad.
(Othello, Act V, Scene ii)

Introduction

Moon phases regulate mood; this belief dates back to ancient times. The lunar effect on the human mood is supported anecdotally, as well as empirically through psychological research. Do moon phases regulate the asset market?

If investors make decisions strictly through rational maximization, then the answer is no. However, extensive evidence suggests that investors are subject to various psychological and behavioral biases when making investment decision, such as loss-aversion, overconfidence, and mood fluctuation.[1] On a general level, numerous psychological studies indicate a link between mood and human judgment and behavior.[2] Behavioral finance literature also finds some evidence of the effect of mood on asset prices.[3] Since lunar phases affect mood, by extension, these phases may affect investor behavior and thus asset prices. If so, then asset returns during full moon phases may be different from those during new moon phases.

Similar to Hirshleifer and Shumway (2001), this study of the effect of lunar phases on stock market returns is motivated by a psychological hypothesis and therefore is not likely subject to the criticism of datasnooping. Moreover, in modern society, the lunar cycle has little tangible impact on people's economic and social activities, even less

[1] Odean (1998) tests for the disposition effect and finds that investors demonstrate a strong preference for realizing winners rather than losers. Odean (1999) shows that investors trade excessively.
[2] For example, Frijda (1988) argues that mood may affect human judgment through misattribution. Schwarz and Bless (1991) show that mood may influence people's ability to process information.
[3] Kamstra, Kramer, and Levi (2000) show that the Friday-Monday return is significantly lower on daylight-saving weekends than other weekends. Hirshleifer and Shumway (2001) also find that sunshine is positively correlated with stock returns. Coval and Shumway (2001) document that traders who experience

so than sunshine and seasonal changes. Consequently, it would be difficult to find rational explanations for any correlations between lunar phases and stock returns. Thus, investigating the lunar effect on stock returns is a strong test of whether investor mood affects asset prices.

To investigate the relation between lunar phases and stock returns, we use a sample of stock market data from 48 countries from the first available data date (which varies from country to country) to July 2001. Specifically, we first test the association of lunar phases and daily stock returns for each of the 48 countries. The results of this investigation indicate that, for all 23 developed stock markets, stock returns are negatively correlated with 15-day full moon phases. For the remaining 25 emerging markets, stock market returns are negatively correlated with 15-day full moon phases in 20 of the markets. A simple non-parametric test suggests that the likelihood of observing only 5 out of 48 countries with a positive correlation by chance is almost zero.

In addition to a 15-day window, we also examine the relation between lunar phases and stock returns by looking at a 7-day window around the full moon and a 7-day window around the new moon. This test of the relation between lunar phases and daily stock returns yields similar results to the findings for the 15-day window for the emerging markets. For the developed markets, the 7-day window lunar effect is weaker, but still significant.

To fully utilize our panel data, we estimate a simple pooled regression and a country-specific fixed effect panel regression with panel corrected standard errors (PCSE) for the following categories: G-7 countries, other developed countries,

morning losses are more likely to assume more risks in the afternoon than traders with morning gains. This behavior bias has short-term consequences for afternoon prices.

emerging-market countries, and all 48 countries. In all cases, we find a statistically significant relation between moon phases and stock returns for both the 7-day and the 15-day windows. For all countries, stock returns are, on average, 6.6 percent lower for the 15 days around the full moon than for the 15 days around the new moon on an annual basis. Using a 7-day window, stock returns are, on average, 8.3 percent lower on the full moon days than on the new moon days on an annual basis. Furthermore, the magnitude of this lunar effect is larger in the emerging market countries (a 7.09 basis points daily difference for the 15-day window and a 13.35 basis points daily difference for the 7-day window) than in the G-7 countries (a 3.47 basis points daily difference for the 15-day window and a 2.6 basis points daily difference for the 7-day window).

To test explicitly for the cyclical pattern of the lunar effect, we estimate a sinusoidal model. According to this model, the lunar effect reaches its peak at the time of full moon and declines to a trough at the time of new moon, following a cosine curve with a period of 29.53 days (the mean length of a lunar cycle). Our test results indicate a significant cyclical lunar pattern in stock returns.

We examine the profitability of a simple trading strategy based on lunar phases by trading an equal-weighted global portfolio of country stock indices. We short this global portfolio during full moon phases and long this portfolio during new moon phases. Following this trading strategy, we find the mean annualized return on this portfolio to be 4.2 percent, significant at the 5 percent level.

In addition to investigating the profitability of a lunar-based portfolio, we also examine whether the lunar effect on stock returns is related to stock size, and thus individual vs. institutional decision-making, since institutional ownership is higher for large cap stocks. Indeed, we find evidence that the lunar effect is more pronounced for small (although not the smallest) cap stocks than for large cap stocks. Thus, the evidence suggests that the lunar effect is stronger for stocks that are held mostly by individuals. This finding is consistent with the idea that lunar phases affect individual moods, which in turn affect investment behavior.

To understand the relation between lunar phases and stock markets even further, we also investigate the relation between lunar phases and trading volumes. We find no evidence that trading volumes are associated with lunar phases. However, we find a marginally significant positive relation between the lunar effect on stock returns and the lunar effect on trading volumes: countries that display a stronger lunar effect on stock returns tend to have a stronger (which may be insignificant) lunar effect on trading volumes.

Finally, we explore whether lunar effects are related to other calendar-related anomalies, such as the January effect, the day-of-week effect, and the calendar month effect. The findings indicate the lunar effect remains the same after controlling for other calendar effects. Thus, we conclude that the lunar effect is unlikely to be a manifestation of these calendar anomalies.

The remainder of the paper is organized as follows. Section I discusses the literature on how lunar phases affect human moods and behavior. Section II describes the data. Section III reports the test results. Section IV concludes.

I. Literature

In testing whether psychological biases and sentiments affect investor trading behavior and asset prices, it is difficult to find a proxy variable for sentiment or mood that is observable and exogenous with economic variables. Nonetheless, there are several ingenious attempts. For example, in their respective studies of the relation between mood and stock returns, Saunders (1993) and Hirshleifer and Shumway (2001), drawing on psychological evidence that sunny weather is associated with an upbeat mood, find that sunshine is strongly positively correlated with stock returns. Likewise, in their study of the seasonal time-variation of risk premia in stock market returns, Kamsta, Kramer and Levi (2000 and 2001) draw on a documented medical phenomenon, Seasonal Affective Disorder (SAD), and use yearly daylight fluctuations to proxy for differences in mood. They find a statistical significant relationship between SAD and stock market returns.

In this paper, we appeal to a popular wisdom that lunar phases affect mood and study the relation between lunar phases and stock returns. We argue that lunar effect is an exogenous proxy for mood since lunar phases do not have tangible effects on economic and social activities.

The idea that the moon affects individual moods has ancient roots. The moon has been associated with mental disorder since olden time, as reflected by the word ``lunacy," which derives from Luna, the Roman goddess of the moon. Popular belief has linked the full moon to such disparate events as epilepsy, somnambulism, crime, suicide, mental illness, disasters, accidents, birthrates, and fertility. A US survey finds that 49.4% of the respondents believe in lunar phenomena (Rotton and Kelly 1985a). Interestingly, among psychiatric nurses, this percentage rises to 74% (Agus 1973). Studies have linked moon phases with abnormal behavior such as an increase in general practice consultation patterns (Neal and Colledge 2000), violence (Lieber 1978), various crimes (Tasso and Miller 1976), and crisis calls (Weiskott 1974). Numerous explanations have been proposed to account for the moon's effect on the brain: sleep deprivation, heavy nocturnal dew, tidal effect, weather patterns, magnetism and polarization of the moon's light (Raison, et al 1999; McG. Kelley 1942; Katzeff, 1981).

Interestingly, there is a lot of research that concerns biological rhythms. The most extensively studied and well known cycle is circadian cycle. Circadian cycle is a rhythm with a 24-hour cycle and guided by sunlight. There are also a lot of biological and physiological studies concerning circatrigintan cycle, which is moon-related human cycle. The most common monthly cycle is menstruation. A woman's menstrual cycle is about the same length as a lunar cycle, which suggests the influence of the moon. A synchronous relationship between the menstrual cycle and lunar rhythm is confirmed in Law (1986). Studies also find a lunar effect on fertility (Criss and Marcum, 1981) and a lunar rhythm of the meal and alcohol intake of humans (de Castro and Pearceym 1995).

Given the extensive documentation of the correlation between lunar phases and human feelings, thoughts, and behaviors, we hypothesize that investors may value financial assets differently during full moon periods than during new moon periods due to the changes in mood associated with lunar conditions.

Overall, the effect of the moon has been studied informally and formally for years. However, we must note that, despite the attention this effect has received, psychological evidence for the lunar hypothesis in general is not conclusive even though biological evidence is strong. For example, in a review of empirical studies on the lunar effect, Campbell and Beets (1978) conclude that lunar phases have no effect on psychiatric hospital admissions, suicides, or homicides. On the other hand, this lack of relation does not preclude a lunar effect. It may simply mean that the effect has not been adequately tested due to small sample sizes and short sample time periods (Cyr and Kaplan 1987; Garzino 1982).

In this paper, we study the relation between lunar phases and stock market returns across countries. This study is not the first attempt to link lunar phases and stock returns. Rotton and Kelly (1985) cite a working paper by Rotton and Rosenberg (1984) that investigates the relation between lunar phases and Dow-Jones closing averages. They find no relation when they difference Dow-Jones and correct for first-order autocorrelations. The present study differs from their research. First, we examine returns rather than prices. Second, we correct for heteroskedasity and autocorrelations, thus providing a more precise test for the relation. Most importantly, we examine a sample of 48 countries, which increases the power of tests.

Dichev and Janes (2001) also examine the effect of lunar phases on stock returns. Their study is concurrent with, and independent of, this paper. Consistent with our findings, Dichev and Janes (2001) report a significant lunar effect on stock returns using a different sample of countries and a different time period. The findings of the two papers complement each other. They focus more on the US market and use a longer time series of US stock returns. Our paper provides more global evidence by including 48 countries with different levels of market development in the sample. In addition, we control for contemporaneous correlation and heteroskedasity among country index returns and for autocorrelation within each country’s stock index returns. Besides documenting return differences between the full moon and the new moon phases, we find *a cyclical pattern* in stock returns that corresponds to lunar phases. Beyond documenting the lunar effect, our paper also examines other possible causes of such an effect. Additional tests lead us to conclude that the lunar effect is unrelated to the January effect, the day-of- week effect, or the calendar month effect.

II. Data

To examine whether stock returns are correlated with lunar phases, we need a lunar calendar and a sample of stock market returns. We obtain the lunar calendar from life-cycles-destiny.com. This website provides a table that documents the date and time (Greenwich Mean Time) of four phases of the Moon for the period 1861 to 2020. The four phases are: new moon, first quarter, full moon and last quarter. For the year 2000, the length of the mean synodic month (New Moon to New Moon) is 29.53059 days.

We obtain our stock market information on returns and trading volumes through Datastream. Our return sample consists of 48 countries listed in the Morgan Stanley Capital International (MSCI) as developed markets or emerging markets. We use the country indices calculated by Datastream (Datastream total market index) unless a country does not have this Datastream series for at least five years. In the case of an insufficient Datastream series, we collect other indices for the market from Datastream. All returns are measured as nominal returns in local currencies. We also collect trading volume data for 40 of the corresponding 48 stock indices. Eight of these 48 indices do not have trading volume data in Datastream.

We report summary statistics for the sample in Table I.

III. Test Results

This section describes the empirical results of testing the hypothesis that stock returns are associated with lunar phases. We first report test results estimated country by country. This set of results indicates the significance of lunar effects on stock returns for each country. It is not realistic to expect many countries to have statistically significant results due to the large amount of variation in daily stock returns and the relatively short time-series in our sample.

To increase the power of the test, we estimate joint tests using stock returns for the entire panel of countries. We also report the joint test results for the following country categorizations: G-7 countries, other developed countries, and emerging market countries. In addition, we report the profitability of a trading strategy based on the lunar phases.

To better understand the lunar effect on stock returns, we further examine whether such an effect is related to stock sizes and whether lunar phases are associated with patterns in trading volumes. We also investigate whether the lunar effect is related to other calendar-related anomalies, such as the January effect, the day-of-week effect, and the calendar month effect.

A. Country-by-Country Tests

We first estimate the coefficients of the following regressions for each country:

$$R_{it} = \alpha_i + \beta_i * \text{Lunardummy}_t + e_{it}, \qquad (1)$$

where Lunardummy is a dummy variable indicating the phase of a lunar cycle, specifically, the number of days around a full moon or a new moon. We define a full moon period as N days before the full moon day + the full moon day + N days after the full moon day (N = 3 or 7). Similarly, we define a new moon period as N days before the new moon day + the new moon day + N days after the new moon day (N = 3 or 7).[4] The Lunardummy variable takes on a value of one for a full moon period and zero otherwise. This dummy variable indicates the difference between the mean daily return during the full moon periods and that during the new moon periods.

In Tables II, III, IV, we report the OLS estimates of β_i for each of the G-7 countries, other developed countries and emerging market countries, respectively. In each table, we also report the results of different specifications of a full moon period: N = 3 and 7. The estimated country β's indicate the significance of lunar phases for stock returns. We find the most consistent results when we set N equal to 7 (a 15-day window).

For the 15-day window, each of the G-7 and other developed countries displays a negative β coefficient, suggesting that stock returns are, on average, lower around a full moon in all these countries. For the G-7 countries, 1 of the coefficients is statistically different from zero at the 5 percent significance level, and 4 of these coefficients are statistically significant at the 10 percent level. For the 16 other developed countries, 2 have statistically significant coefficients at the 5 percent level, and 3 have statistically significant coefficients at the 10 percent level. For the emerging market countries in Table IV, 20 out of these 25 countries have negative β estimates, and 3 of these estimates

[4] In the case of the 15-day window, a new moon period can be less than 15 days since a lunar month may

are significantly different from zero at the 5 percent significance level. The finding of a more statistically significant lunar effect in the developed countries reflects the relatively lower noise in these markets. We find similar results using the 7-day window.

To test explicitly for the cyclical pattern of the lunar effect, we next estimate a sinusoidal model of continuous lunar impact. According to the model, the lunar effect reaches its peak at the time of the full moon and declines to the trough 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). More specifically, we estimate the following regression for each country:

$$R_{it} = \alpha_i + \beta_i * \text{cosine}(2\pi d_t/29.53) + e_{it,} \qquad (2)$$

where d is the number of days since the last full moon day and the β coefficient indicates the association between stock returns and lunar cycles. Using this estimation, we find that all G-7 countries except Italy display a negative relation between stock returns and lunar cycles, with 1 estimate significantly different from zero at the 5 percent significance level. Furthermore, we find that 15 of the 16 other developed countries have negative signs, with 1 of these estimates significant at the 5 percent level. Of the 25 emerging market countries, 21 have negative β estimates, with 4 of these estimates significantly different from zero at the 5 percent level. Overall, the sinusoidal model suggests that the lunar effect is cyclical. Figure 1 displays this pattern by plotting the average daily stock returns on the days of a lunar month for an equal-weighted global index of all countries and the estimated sinusoidal curve.

Following Hirshleifer and Shumway (2001), we next examine the joint significance of these results with simple nonparametric calculations. In these joint tests,

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be less than 30 days. In these cases, the new moon period is defined as the remaining days of the lunar we assume: 1) each regression coefficient sign is an independent draw from the binomial distribution and 2) the probability of drawing a negative coefficient is 0.5. Thus, the probability of finding only 5 positive coefficients out of 48 countries for the 15-day window is 6.84e-9, which is almost impossible. For all model specifications, we can reject the null hypothesis that returns are the same over the lunar month, at the one percent significance level. In summary, the β coefficients of the country-by-country regressions provide overwhelming global evidence for a correlation between stock returns and lunar phases.

B. Joint Tests

To further examine the statistical significance of the lunar effect on stock returns and to fully utilize our cross-sectional and time series data, we use a pooled regression. In this section, we report the results of several joint tests for G-7 countries, other developed countries, emerging market countries, and all countries, respectively.

First, we estimate a regression similar to Equation (1) and (2):

$$R_{it} = \alpha + \beta * Lunardummy_t + \gamma_i * Countrydummy_i + e_{it} \quad (3)$$

$$R_{it} = \alpha + \beta * cosine(2\pi d_t/29.53) + \gamma_i * Countrydummy_i + e_{it} \quad (4)$$

We now stack all country data and include a dummy for each country. In Equation (3) and Equation (4), we constrain the parameters α and β to be the same across all countries.

The columns in Table V present the OLS estimates of Equation (3) and Equation (4) for G-7 countries, other developed countries, emerging market countries, and all

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month.

markets, respectively, for both the 15-day window and the 7-day window. Regardless of model specifications, the coefficients on the Lunardummy variable are negative; 7 of the 8 coefficients are statistically significant at the 5 percent level. From Table V, we also see that all coefficients on cosine($2\pi d_t/29.53$) are negative and statistically significant. Interestingly, the magnitude of the lunar effect is larger in the emerging market countries (a 7.09 basis points daily difference for the 15-day window and a 13.35 basis points daily difference for the 7-day window) than in the G-7 countries (a 3.47 basis points daily difference for the 15-day window and a 2.6 basis points daily difference for the 7-day window). The cosine regressions also show a higher coefficient for the emerging markets than for the developed markets. Market depth, maturity and the percentage of institutional investors may help explain the differences in the magnitude of lunar impact in these markets. [5]

Note that a simple pooled regression does not account for the contemporaneous correlations across the error terms of different index returns or for the serial autocorrelation in the error terms of a particular country index return. Given extensive evidence for both of these correlations, we next test the sensitivity of our results by adjusting for these correlations.

To do so, we estimate a country-specific fixed effect panel regression with panel corrected standard errors (PCSE):

$$R_{it} = \alpha_i + \beta * \text{Lunardummy}_t + e_{it} \qquad (5)$$

$$R_{it} = \alpha_i + \beta * \text{cosine}(2\pi d_t/29.53) + e_{it} \qquad (6)$$

[5] Stock markets in emerging market countries in general are less mature and shallower, which may magnify the effect of behavioral biases on stock prices. Institutional investors tend to invest according to some mechanical rules rather than impulses; hence, their involvement should reduce the lunar effect on stock prices.

The above PCSE specification adjusts for the contemporaneous correlation and heteroskedasticity among country index returns as well as for the autocorrelation within each country's stock index return. The results, in Table V, yield panel estimates very similar to those from the simple pooled regressions. Again, all 12 estimates are negative; 9 estimates are statistically different from zero at the 5 percent level. As with the earlier cosine regressions, this effect is strongest in the emerging markets.

We find that stock returns for all 48 countries during the 15-day full moon periods are 6.6 percent lower than stock returns during new moon periods on an annual basis. The cosine regression for all markets also indicates a significant relation between stock returns and lunar cycles.

In summary, we find that the effect of lunar phases on stock returns is statistically and economically significant.

C. Trading Strategy

We form a simple trading strategy to exploit the correlation between stock market returns and lunar cycles. Our strategy is straightforward. We first form an equal-weighted global portfolio of the 48 country stock indices. We then short this global portfolio during full moon periods and long this portfolio during new moon periods. Since lunar phases are not stochastic, trading strategies based on lunar phases can be formed perfectly *ex ante*. The expected return on our trading strategy should be zero if stock market returns are not related to lunar phases, since we long and short the market for the equal amount of time. To evaluate the profitability of our lunar trading strategy, we calculate the time series of the monthly returns of the strategy and test whether the mean monthly returns are significantly different from zero.

The trading strategy generates an annualized return of 4.2 percent using the 15-day full moon window for the sample period; the test result is statistically significant at the 5 percent level. Thus, we find evidence that investors can trade profitably on lunar phases. Note that the transaction cost of this trading strategy should be very moderate since we trade about 24 times a year and the cost of trading stock indices is relatively low in many markets. Figure 2 plots the average stock returns of full moon periods versus new moon periods for the global portfolio.

D. The Lunar Effect on Returns of Large Cap vs. Small Cap Stocks

In this section, we examine whether lunar effects are related to stock capitalization. This test is motivated by the empirical finding that institutional ownership is positively correlated with stock capitalization. Specifically, large capitalization stocks have a higher percentage of institutional ownership than small capitalization stocks. Since investment decisions of individual investors are more likely to be affected by sentiments and mood than those of institutional investors, we expect the lunar effect to be more pronounced in the pricing of small-cap stocks.

To assess the relation between lunar phases and stock capitalization, we form 10 stock portfolios based on market capitalization for stocks traded on NYSE +AMEX, NASDAQ, and NYSE+AMEX+NASDAQ, respectively. We estimate Equation (5) for each portfolio. The results in Table VI indicate that the lunar effect has the largest impact on the 9th decile[6] (the second-smallest) with a coefficient of –4.22 and the smallest impact on the 1st decile (the largest) with a coefficient of –2.9. Tests of market-cap ranked portfolios using stocks traded on NYSE, AMEX and NASDAQ yield similar results. Overall, the test results are consistent with our hypothesis that stocks with more individual investor ownership display a stronger lunar effect and thus provide further evidence that mood or sentiment affects asset prices.

E. The Lunar Effect on Trading Volume

It is not clear how lunar phases affect stock trading volume. In this section, we test the lunar effect on trading volumes by estimating the coefficients of the following regressions for each country for 15-day full moon periods:

$$avgvolume_{it} = \alpha_i + \lambda_i * Lunardummy_t + e_{it.} \quad (7)$$

where Avgvolume is daily trading volume normalized by average daily volume in the month. Test results are reported in Table VII. 20 out of 40 countries have higher trading volumes during full moon periods; 4 of the 20 positive coefficients are statistically significant at the 5 percent level; 3 of the 20 negative coefficients are statistically significant at the 5 percent level. The test results suggest little evidence that trading volumes are related to lunar phases in a systematic manner.

We estimate the rank correlation between the coefficients of the lunar effect on stock returns for individual countries (β_i) and the coefficients of the lunar effect on trading volume (λ_i) for these countries. The rank correlation is 0.27 and is statistically significant at the 10 percent level. This finding indicates that countries that experience a

[6] Liquidity is likely to have a first-order effect in pricing extreme small stocks rather than mood, and hence,

large lunar effect on stock returns also tend to experience a large lunar effect on trading volume.

F. The Lunar Effect is not a Manifestation of Other Calendar Anomalies

The tests reported in Subsections A, B, and C suggest that significantly different returns accrue to stocks during full moon vs. new moon periods. This section evaluates possible causes for these return differences other than lunar effects.

January Effect

The lunar effect found in this study is based on a measure of lunar phases using a lunar calendar. This effect is unlikely to be caused by the January effect[7], as lunar months do not correspond to calendar months. To test for the relation of our results and the January effect, we add a January dummy variable to our regression estimates of Equations (3) to (6). More specifically, we estimate the following equations for the 7-day window and the 15-day window, respectively:

$$R_{it} = \alpha + \beta * Lunardummy_t + \gamma_i * Countrydummy_i + \delta * Januarydummy_t + e_{it} \quad (8)$$

$$R_{it} = \alpha_i + \beta_i * cosine(2\pi d/29.53) + \gamma_i * Countrydummy_i + \delta * Januarydummy_t + e_{it}, \quad (9)$$

$$R_{it} = \alpha_i + \beta * Lunardummy_t + \delta * Januarydummy_t + e_{it}. \quad (10)$$

$$R_{it} = \alpha_i + \beta_i * cosine(2\pi d/29.53) + \delta * Januarydummy_t + e_{it}, \quad (11)$$

where Januarydummy is a dummy variable equal to one in the month of January and zero otherwise.

As shown in Table VIII, the January effect is extremely strong across all panel regressions and so is the lunar effect. Comparing these results with the findings for

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we expect a weaker lunar effect for stocks that are extremely small in capitalization.

equations that do not control for the January effect (Table V), we see that the lunar effect remains remarkably unchanged for all panels. These highly significant test statistics indicate that the January effect is not the driving force behind the observed lunar effect.

Day-of-Week Effect

If most full moon days fall on Monday, it is possible that the Monday effect may explain the observed lunar effect. We tabulate our sample to check on this possibility. Figure 3 shows that full moon days fall evenly on each day of the week in the sample. Hence, we conclude that the lunar effect on stock returns is not related to the Monday effect.

Calendar Month Effect

Ariel (1987) documents a monthly effect on stock returns. More specifically, he shows that the mean US stock return for days during the first half of a calendar month is higher than the mean stock return during the last half of the month. Thus, it is conceivable that the lunar effect shown in this paper may be a manifestation of this calendar month effect. To test for this possibility, we include a calendar dummy in Equations (3) and (5) and estimate the following regressions:

$$R_{it} = \alpha + \beta * Lunardummy_t + \gamma_i *Countrydummy_i + \delta* calendardummy_t + e_{it.} \quad (12)$$

$$R_{it} = \alpha + \beta * Lunardummy_t + \delta *calendardummy_t + e_{it,} \quad (13)$$

where Calendardummy is a dummy variable equal to one for the first half of a calendar month and zero otherwise. As shown in Table IX, the calendar month effect is not stable for the countries in our sample: 16 out of 48 countries actually have a calendar month effect opposite to that predicted. In comparison, the signs of the Lunardummy

[7] The January effect has been documented by Rozeff and Kinney (1976) and Reinganum (1983).

coefficients are very consistent for our sample countries: only 4 out of 48 countries have positive estimates. For all panels, the lunar effect is statistically significant at the 5 percent level. By contrast, the panel estimates of the calendar month effect are mostly insignificant. Comparing these results with those in Table V where the calendar month effect is not controlled for, we see again that the lunar effect is unchanged. These test statistics suggest that the calendar month effect cannot explain the observed lunar effect.

30-day Cycle Effect

To test whether the observed lunar effect in this study reflects a general pattern in stock returns, rather than a lunar-driven cycle, we shift the lunar phase by 1 to 29 days (as the average length of a lunar month is 29.53 days). That is, we start a 30-day cycle 1 to 29 days after the first full moon, and estimate the 30-day cycle effect for each specification, using the following PCSE regression with a 15-day window:

$$R_{it} = \alpha_i + \beta * 30daydummy_t + e_{it} \quad (14)$$

where 30daydummy is a dummy variable indicating the phase of a 30-day cycle. 30daydummy takes on a value of one for 7 days before the starting day + the starting day + 7 days after the starting day, and a value of zero otherwise.

The results in Table X show that the 30-day cycle effects for the cycles starting 1 to 7 days after the full moon and the cycles starting 24 to 29 days after the full moon have negative signs. Moreover, the statistical significance of the estimated 30-day cycle effect declines as these 30-day cycles deviate more from the lunar cycle. In fact, for the cycles starting 11 to 20 days after the full moon, the pattern is reversed. Figure 4 graphs the estimates of the 30-day cycle effect and shows that the documented lunar effect cannot arise from any 30-day cycles except for the ones that closely track the lunar cycle.

After evaluating possible explanations for our results, we conclude that the lunar effect on stock returns is independent of other calendar-related anomalies, such as the January effect, the day-of-week effect, or the calendar month effect. Our results are also robust to the non-lunar 30-day cycle explanation.

IV. Conclusion

This paper investigates the relation between lunar phases and stock returns for a sample of 48 countries. We find strong global evidence that stock returns are lower on days around a full moon than on days around a new moon. Constructing a lunar trading strategy, we find that the magnitude of this return difference is roughly 4.2 percent per annum. Note that these findings are based on investor mood, and are thus not consistent with traditional asset pricing theories that assume fully rational investors. The positive association we find between lunar phases and stock returns suggests that it may be valuable to go beyond a rational asset pricing framework to explore the psychological effects of investor behavior on stock returns.

Psychology literature has provided numerous theories on how mood affects perceptions and preferences. One theory is that mood affects perception through misattribution: attributing feelings to wrong sources leads to incorrect judgments (Frijda 1988; Schwarz and Clore 1983). Alternatively, mood may affect people's ability to process information. In particular, investors may react to salient or irrelevant information when feeling good (Schwarz 1990; Schwarz and Bless 1991). Finally, mood may affect preferences (Loewenstein 1996; Mehra and Sah 2000). This paper is only a first step towards confirming the effect of mood on asset prices. It would be interesting to better understand *how* mood affects asset prices. Hirshleifer (2001) points out a new direction in evaluating the impact of behavioral biases on economic decision-making, that is, to test them in the psychological laboratory. In a related vein, future work can examine asset market experiments that manipulate mood. For example, is trading behavior in experimental markets different when the markets are staged at different parts of the lunar cycle?

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Table I
Summary Statistics

This table reports the summary statistics for the 48 country stock indices. All sample periods end on July 31, 2001.

Country	Code	Starting Date	Number of Observations	Mean Daily Return	StdDev of Daily Return
ARGENTINA	TOTMKAR	1/88	3510	0.00350	0.03672
AUSTRALIA	TOTMKAU	1/73	7213	0.00040	0.01104
AUSTRIA	TOTMKOE	1/74	6355	0.00029	0.00859
BELGIUM	TOTMKBG	1/73	7124	0.00033	0.00821
BRAZIL	BRBOVES	1/72	2475	0.00790	0.07093
CANADA	TOTMKCN	1/73	7226	0.00033	0.00839
CHILE	TOTMKCL	7/89	3013	0.00087	0.01034
CHINA	TOTMKCH	1/91	2443	0.00157	0.02994
CZECH	CZPX50I	4/94	1750	-0.00047	0.01270
DENMARK	TOTMKDK	1/74	6377	0.00059	0.01089
FINLAND	TOTMKFN	1/88	3339	0.00071	0.01834
FRANCE	TOTMKFR	1/73	7264	0.00048	0.01111
GERMANY	TOTMKBD	1/73	7192	0.00032	0.00950
GREECE	TOTMKGR	1/88	3385	0.00097	0.01919
HONG KONG	TOTMKHK	1/73	7103	0.00058	0.01895
HUNGARY	BUXINDX	2/91	2629	0.00087	0.01761
INDIA	IBOMBSE	4/84	2903	0.00081	0.01894
INDONESIA	TOTMKID	4/84	2761	0.00020	0.02598
IRELAND	TOTMKIR	1/73	7103	0.00053	0.01087
ISRAEL	ISTGNRL	1/84	4179	0.00153	0.01438
ITALY	TOTMKIT	1/73	7445	0.00052	0.01341
JAPAN	TOTMKJP	1/73	7145	0.00023	0.01013
JORDAN	AMMANFM	11/88	2176	0.00031	0.00863
KOREA	TOTMKKO	1/75	3322	0.00032	0.02083
LUXEMBURG	TOTMKLX	1/92	2370	0.00062	0.01005
MALAYSIA	TOTMKMY	1/88	3349	0.00049	0.01652
MEXICO	TOTMKMX	1/88	3436	0.00132	0.01715
MOROCCO	MDCFG25	12/87	1820	0.00124	0.00930
NETHERLAND	TOTMKNL	1/73	7219	0.00040	0.00957
NEW ZEALAN	TOTMKNZ	1/88	3409	0.00024	0.01147
NORWAY	TOTMKNW	1/80	5419	0.00050	0.01419
PAKISTAN	PKSE100	12/88	2795	0.00040	0.01628
PERU	PEGENRL	1/91	2597	0.00165	0.01591
PHILIPPINES	TOTMKPH	9/87	3464	0.00061	0.01553
POLAND	TOTMKPO	1/94	1803	0.00006	0.02317
PORTUGAL	TOTMKPT	1/90	2858	0.00022	0.00932
RUSSIA	RSMTIND	9/94	1676	0.00257	0.03684
SINGAPORE	TOTMKSG	1/73	7128	0.00022	0.01443
SOUTH AFRICA	TOTMKSA	1/73	7170	0.00065	0.01353
SPAIN	TOTMKES	1/88	3623	0.00040	0.01158
SWEDEN	TOTMKSD	1/82	4903	0.00070	0.01348
SWITZ	TOTMKSW	1/73	7174	0.00032	0.00848
TAIWAN	TOTMKTA	9/87	3371	0.00044	0.02235
THAILAND	TOTMKTH	1/88	3349	0.00041	0.02012
TURKEY	TOTMKTK	1/88	3467	0.00258	0.02995
UNITED KINGDOM	TOTMKUK	1/65	8503	0.00048	0.01029
UNITED STATES	TOTMKUS	1/73	7216	0.00037	0.00982
VENEZUELA	TOTMKVE	1/90	2829	0.00159	0.02525

Table II
Lunar Phases and Stock Returns: G-7 Countries

This table reports country-by-country results from estimating regressions of daily stock returns on lunar phases. We first estimate the following regression for each country: $R_{it} = \alpha_i + \beta_i * Lunardummy_t + e_{it}$. Lunardummy is a dummy variable indicating the phase of a lunar cycle, specifically, the days around a full moon or a new moon. We define a full moon period as N days before the full moon day + the full moon day + N days after the full moon day (N = 3 or 7). Accordingly, we define a new moon period as N days before the new moon day + the new moon day + N days after the new moon day (N = 3 or 7). Lunardummy is equal to one during a full moon period and zero otherwise. We display the country β's for N =3 and N = 7 in columns 2 and 3, respectively. In column 4, we report the β coefficient for the following regression: $R_{it} = \alpha_i + \beta_i * \text{cosine}(2\pi d/29.53) + e_{it}$, where d is the number of days since the last full moon. T-statistics are reported in the parentheses. The daily returns are in basis points. P-values for the non-parametric tests are reported in the last row.

	7-Day Window N = 3	15-Day Window N = 7	Cosine Regression
CANADA	-3.58 (-1.22)	-3.87** (-1.96)	-1.70 (-1.22)
FRANCE	-1.24 (-0.33)	-3.46 (-1.33)	-1.46 (-0.79)
GERMANY	-4.43 (-1.34)	-3.77* (-1.68)	-2.50 (-1.57)
ITALY	3.23 (0.70)	-1.38 (-0.45)	0.00 (0.00)
JAPAN	-7.92** (-2.22)	-4.60 (-1.92)*	-3.43** (-2.02)
UK	-0.01 (0.00)	-3.85 (-1.72)*	-1.80 (-1.10)
US	-4.52 (-1.32)	-2.70 (-1.18)	-1.07 (-0.62)
Non-Parametric	0.0625	0.0078	0.0625

** indicates a 5% significance level using a two-tailed test
* indicates a 10% significance level using a two-tailed test

Table III
Lunar Phases and Stock Returns: Other Developed Countries

This table reports country-by-country results from estimating a regression of daily stock returns on lunar phases. We estimate the following regression for each country: $R_{it} = \alpha_i + \beta_i * \text{Lunardummy}_t + e_{it.}$ Lunardummy is a dummy variable indicating the phase of a lunar cycle, specifically, the days around a full moon. We define a full moon period as N days before the full moon day + the full moon day + N days after the full moon day (N = 3 or 7). Lunardummy is equal to one during a full moon period and zero otherwise. We display the country β's for N =3 and N = 7 in columns 2 and 3, respectively. In column 4, we report the β coefficient for the following regression: $R_{it} = \alpha_i + \beta_i * \text{cosine}(2\pi d_t/29.53) + e_{it,}$ where d is the number of days since the last full moon. T-statistics are reported in the parentheses. The daily returns are in basis points. P-values for the non-parametric tests are reported in the last row.

	7-Day Window N = 3	15-Day Window N = 7	Cosine Regression
AUSTRALIA	1.20 (-0.48)	-1.67 (-0.64)	-0.24 (-0.13)
AUSTRIA	-3.68 (-1.16)	-2.81 (-1.30)	-1.74 (-1.14)
BELGIUM	-1.02 (-0.35)	-2.34 (-1.20)	-0.74 (-0.54)
DENMARK	-5.34 (-1.22)	-2.79 (-1.02)	-2.42 (-1.25)
HONG KONG	-9.15 (-1.40)	-6.46 (-1.43)	-4.84 (-1.52)
IRELAND	-1.39 (-0.36)	-4.86* (-1.88)	-2.78 (-1.52)
NETHERLANDS	0.21 (0.08)	-4.43** (-1.96)	-1.93 (-1.21)
NORWAY	-3.20 (-0.95)	-1.70 (-0.44)	0.50 (0.18)
SINGAPORE	2.52 (0.44)	-8.51** (-2.49)	-5.39** (-2.21)
SPAIN	-8.18 (-1.57)	-3.18 (-0.83)	-2.15 (-0.79)
SWEDEN	-5.07 (-0.90)	-5.63 (-1.46)	-2.90 (-1.06)
SWITZERLAND	-2.63 (-0.47)	-2.87 (-1.43)	-1.60 (-1.12)
FINLAND	-2.72 (-0.92)	-2.11 (-0.33)	-4.37 (-0.97)
GREECE	-9.04 (-0.92)	-8.62 (-1.31)	-6.87 (-1.47)
LUXEMBURG	-7.04 (-1.07)	-5.76 (-1.39)	-3.57 (-1.22)
NEW ZEALAND	-3.22 (-0.54)	-5.01 (-1.29)	-2.64 (-0.94)
Non-Parametric	0.011	1.52e-5	0.0003

** indicates a 5% significance level using a two-tailed test
* indicates a 10% significance level using a two-tailed test

Table IV
Lunar Phases and Stock Returns: Emerging Market Countries

This table reports country-by-country results from estimating a regression of daily stock returns on lunar phases. We estimate the following regression for each country: $R_{it} = \alpha_i + \beta_i * \text{Lunardummy}_t + e_{it.}$ Lunardummy is a dummy variable indicating the phase of a lunar cycle, specifically, the days around a full moon. We define a full moon period as N days before the full moon day + the full moon day + N days after the full moon day (N = 3 or 7). Lunardummy is equal to one during a full moon period and zero otherwise. We display the country β's for N =3 and N = 7 in columns 2 and 3, respectively. In column 4, we report the β coefficient for the following regression: $R_{it} = \alpha_i + \beta_i * \text{cosine}(2\pi d_t/29.53) + e_{it}$ where d is the number of days since the last full moon. T-statistics are reported in the parentheses. The daily returns are in basis points. P-values for the non-parametric tests are reported in the last row.

	7 Day Window N = 3	15 Day Window N = 7	Cosine Regression
ARGENTINA	-24.93 (-1.31)	-20.37 (-1.64)	-12.4 (-1.41)
BRAZIL	-92.60* (-1.86)	-29.85 (-1.46)	-27.3 (-1.35)
CHILE	-19.06** (-3.48)	-6.48* (-1.72)	-6.71** (-2.52)
CHINA	-14.70 (-0.82)	-9.61 (-0.79)	-10.22 (-1.19)
CZECH	2.70 (0.31)	3.96 (0.65)	2.28 (0.53)
HUNGARY	-1.97 (-0.19)	10.22 (1.49)	3.03 (0.62)
INDIA	-9.12 (-0.91)	-8.41 (-1.20)	-7.03 (-1.40)
INDONESIA	-33.32** (-2.80)	-19.60** (-1.98)	-16.8** (-2.38)
ISRAEL	-10.82 (-1.62)	-17.98 (-1.60)	-6.78** (-2.16)
JORDAN	2.32 (0.45)	-1.25 (-0.34)	0.06 (0.21)
MALAYSIA	0.90 (0.10)	-7.43 (-1.30)	-1.16 (-0.28)
MEXICO	0.90 (0.10)	-14.27** (-2.44)	-9.98** (-2.41)
MOROCCO	-0.10 (-0.02)	-1.40 (-0.32)	-0.85 (-0.27)
PAKISTAN	-6.99 (-0.82)	-1.25 (-0.20)	-2.27 (-0.52)
PERU	8.99 (1.02)	-4.88 (-0.78)	-1.73 (-0.39)
PHILIPPINES	-6.39 (-0.82)	-1.80 (-0.34)	-1.63 (-0.43)
POLAND	-15.91 (-1.04)	0.99 (0.09)	-3.39 (-0.44)
PORTUGAL	-3.89 (-0.76)	-7.74** (-2.22)	-4.71* (-1.91)
RUSSIA	-53.16** (-2.13)	-19.33 (-1.07)	-22.00* (-1.73)
SOUTH AFRICA	-0.56 (-0.12)	-1.84 (-0.57)	-1.70 (-0.75)
SOUTH KOREA	-14.63 (-1.40)	1.92 (0.27)	-4.56 (-0.89)
TAIWAN	-3.12 (-0.28)	-5.43 (-0.71)	-1.98 (-0.36)
THAILAND	-5.19 (-0.52)	-2.45 (-0.35)	-2.13 (-0.43)
TURKEY	-29.36** (-2.02)	-13.05 (-1.28)	-13.89* (-1.92)
VENEZUELA	-4.97 (-0.38)	2.22 (0.23)	2.89 (0.43)
Non-Parametric	0.002	0.002	0.0005

Table V
Lunar Phases and Stock Returns: Joint Tests

Panels A and B report the estimates of a simple pooled regression: $R_{it} = \alpha + \beta * Lunardummy_t + \gamma_i * Countrydummy_i + e_{it.}$ and a country-specific fixed effect panel regression with panel corrected standard errors (PCSE): $R_{it} = \alpha_i + \beta * Lunardummy_t + e_{it}$ for the 7-day window and 15-day window, respectively. Panel C reports the estimates of a simple pooled regression and a country-specific fixed effect panel regression (PCSE) .The PCSE specification adjusts for the contemporaneous correlation and heteroskedasticity among country indices and for the autocorrelation within each country's stock index[8]. In all three panels, we display the β estimates of the simple pooled regression in column 2 and the β estimates of the panel regression in column 3. Panel C reports the β coefficient for the following regression: $R_{it} = \alpha_i + \beta_i * cosine(2\pi d_t/29.53) + e_{it,}$ where d is the number of days since the last full moon. T-statistics are reported in the parentheses. The daily returns are in basis points.

[8] We do not adjust for autocorrelation in stock returns in the 7-day window case.

Panel A: 7-day window		
	Simple Pooled Regressions	Panel
G7	-2.61* (-1.89)	-2.60 (-1.14)
Other Developed Markets	-3.75** (-2.99)	-3.75 (-1.47)
Emerging Markets	-13.33** (-4.94)	-13.35** (-3.55)
All Markets	-6.82** (-6.07)	-6.80** (-2.61)
Panel B: 15-day window		
	Simple Pooled Regressions	Panel (PCSE)
G7	-3.3** (-3.54)	-3.47** (-2.2)
Other Developed Markets	-4.18** (-4.96)	-4.38** (-2.38)
Emerging Markets	-6.78** (-3.87)	-7.09** (-2.42)
All Markets	-4.89** (-6.62)	-5.18** (-2.63)
Panel C: Cosine regressions		
	Simple Pooled Regressions	Panel (PCSE)
G7	-1.70** (-2.57)	-1.75* (-1.56)
Other Developed Markets	-2.53** (-4.23)	-2.69** (-2.05)
Emerging Markets	-5.75** (-4.63)	-6.24** (-3.08)
All Markets	-3.46** (-6.62)	-3.69** (-2.76)

** indicates a 5% significance level using a two-tailed test
*   indicates a 10% significance level using a two-tailed test

Table VI
Lunar Effect and Stock Sizes

This table reports results from estimating a regression of daily returns of market-cap ranked portfolios on lunar phases. The portfolios are constructed using stocks traded in all US markets, NYSE and AMEX, NASDAQ, respectively. Decile 1 corresponds to the largest market-cap stocks. We estimate the following regression for each portfolio: $R_{it} = \alpha_i + \beta_i * Lunardummy_t + e_{it.}$ Lunardummy is a dummy variable indicating the phase of a lunar cycle, specifically, the days around a full moon. We define a full moon period as N days before the full moon day + the full moon day + N days after the full moon day (N = 7). Lunardummy is equal to one during a full moon period and zero otherwise. We display each portfolio's β for N = 7 in columns 2, 3, and 4. T-statistics are reported in the parentheses. The daily returns are in basis points.

Decile Number	All US Markets	NYSE and AMEX	NASDAQ
1	-2.90* (-1.71)	-0.66 (-0.20)	-3.3* (-1.94)
2	-3.26** (-1.99)	-2.7 (-1.18)	-3.5** (-2.16)
3	-3.52** (-1.99)	-2.1 (-0.97)	-4.0** (-2.32)
4	-3.70** (-2.08)	-2.90 (-1.51)	-4.2** (-2.31)
5	-3.09* (-1.67)	-2.70 (-1.41)	-3.4* (-1.77)
6	-3.65* (-1.90)	-3.00 (-1.59)	-4.2** (-2.06)
7	-3.49* (-1.73)	-2.80 (-1.48)	-3.9* (-1.77)
8	-3.51* (-1.74)	-2.90 (-1.51)	-4.0* (-1.75)
9	-4.22** (-2.03)	-3.40* (-1.73)	-5.6** (-2.14)
10	-2.75 (-1.20)	-3.00 (-1.36)	-2.2 (-0.70)

Table VII
Lunar Phases and Trading Volumes

This table reports country-by-country results from estimating a regression of daily trading volume on lunar phases. We estimate the following regression for each country: $avgvolume_{it} = \alpha_i + \lambda_i * Lunardummy_t + e_{it.}$ Avgvolume is daily trading volume normalized by average monthly volume. Lunardummy is a dummy variable equal to one during a full moon period and zero otherwise. We define a full moon period as N days before the full moon day + the full moon day + N days after the full moon day (N = 7). We display the country λ's for N = 7 in columns 2 and 4, respectively. T-statistics are reported in the parentheses. We report the rank correlation of the coefficient of the lunar effect on stock returns and the coefficient of the lunar effect on trading volume and its P-values in the last row.

Country	λ	Country	λ
Canada	5.00 (0.06)	Indonesia	691.50** (2.91)
Germany	-65.60 (-0.41)	India	-83.20 (-0.66)
France	105.00 (0.81)	Philippines	854.20** (2.84)
Italy	107.10 (0.96)	Taiwan	-330.70** (-2.60)
Japan	-10.70 (-0.08)	Argentina	-174.90 (-1.14)
United States	8.50 (0.15)	Malaysia	102.70 (0.79)
United Kingdom	124.50 (1.56)	Mexico	-581.20** (-3.08)
South Africa	392.60 (1.47)	Thailand	-62.90 (-0.36)
Australia	-115.50 (-0.81)	Turkey	-142.70 (-1.17)
Belgium	24.70 (0.17)	Spain	-261.60** (-2.19)
Hong Kong	67.60 (0.53)	Finland	-18.90 (-0.08)
Ireland	1629.70** (2.87)	Greece	-197.50 (-1.09)
Netherlands	174.70* (1.72)	New Zealand	247.30 (1.19)
Singapore	135.20 (0.98)	Pakistan	254.40* (1.76)
Switzerland	154.10 (1.23)	Chile	-208.00 (-1.05)
Austria	-155.40 (-1.03)	Portugal	-366.80 (-1.05)

Denmark	733.00** (2.62)	Venezuela	-36.70 (-0.12)
Korea	-69.70 (-0.46)	China	-232.00 (-1.07)
Norway	-143.20 (-0.74)	Luxembourg	98.40 (0.18)
Sweden	201.30 (1.48)	Poland	0.60 (0.00)
Rank Correlation between the lunar effect on volume and return: 0.27 * (P-value: 0.087)			

Table VIII
Lunar Phases, Stock Returns and the January Effect

Panels A and B report the estimates of a simple pooled regression: $R_{it} = \alpha + \beta * Lunardummy_t + \gamma_i*Countrydummy_i + \delta*Januarydummy_t + e_{it.}$ and a country-specific fixed effect panel regression with panel corrected standard errors (PCSE): $R_{it} = \alpha_i + \beta * Lunardummy_t + \delta*Januarydummy_t + e_{it}$ for the 7-day window and 15-day window, respectively. Januarydummy is a dummy variable that takes a value of one in the month of January and zero otherwise. Panel C reports the estimates of a simple pooled regression and a country-specific fixed effect panel regression (PCSE). The PCSE specification adjusts for the contemporaneous correlation and heteroskedasticity among country indices and for the autocorrelation within each country's stock index[9]. In all three panels, we display β and δ estimates of the simple pooled regression and of the panel regression. Panel C reports β and δ coefficients for the following regression: $R_{it} = \alpha_i + \beta_i * \text{cosine}(2\pi d/29.53) + \delta*Januarydummy_t + e_{it,}$ where d is the number of days since the last full moon. T-statistics are reported in the parentheses. The daily returns are in basis points.

[9] We do not adjust for autocorrelation in stock returns in the 7-day window case.

Panel A: 7-day window				
	Simple Pooled Regressions		Panel	
	Lunardummy	Januarydummy	Lunardummy	Januarydummy
G7	-2.60* (-1.89)	12.62** (5.10)	-2.60 (-1.15)	12.64** (3.10)
Other Developed Markets	-3.78** (-3.02)	17.24** (7.65)	-3.77 (-1.47)	17.25** (3.76)
Emerging Markets	-13.39** (-4.96)	18.46** (3.77)	-13.40** (-3.69)	18.48** (2.82)
All Markets	-6.84** (-6.10)	16.54** (8.18)	-6.83** (-2.63)	16.52** (3.55)

Panel B: 15-day window				
	Simple Pooled Regressions		Panel	
	Lunardummy	Januarydummy	Lunardummy	Januarydummy
G7	-3.30** (-3.54)	11.10** (6.65)	-3.46** (-2.20)	11.06** (3.90)
Other Developed Markets	-4.19** (-4.98)	14.06** (9.30)	-4.38** (-2.38)	14.47** (4.36)
Emerging Markets	-6.80** (-3.88)	11.98** (3.81)	-7.24** (-2.57)	13.59** (2.66)
All Markets	-4.89** (-6.64)	12.63** (9.55)	-5.14** (-2.66)	13.33** (3.83)

Panel C: Cosine regressions				
	Simple Pooled Regressions		Panel	
	Lunardummy	Januarydummy	Lunardummy	Januarydummy
G7	-1.69** (-2.57)	11.10** (6.64)	-1.74 (-1.55)	11.06** (3.90)
Other Developed Markets	-2.53** (-4.25)	14.05** (9.30)	-2.70** (-2.05)	14.47** (4.36)
Emerging Markets	-5.76** (-4.64)	11.97** (3.81)	-6.24** (-3.09)	13.58** (2.66)
All Markets	-3.46** (-6.62)	12.63** (9.54)	-3.69** (-2.67)	13.33** (3.83)

Table IX
Lunar Phases, Stock Returns and the Calendar Month Effect

Panel A reports country-by-country results from estimating a regression of daily stock returns on lunar phases controlling for the calendar month effect. We estimate an equation: $R_{it} = \alpha + \beta * Lunardummy_t + \gamma_i * Countrydummy_i + \delta * calendardummy_t + e_{it.}$ for the 15-day window. Calendardummy is a dummy variable that takes a value of one for the first half of the calendar month and zero otherwise. Panel B reports the estimates of a simple pooled regression and a country-specific fixed effect panel regression (PCSE). The PCSE specification adjusts for the contemporaneous correlation and heteroskedasticity among country indices and for the autocorrelation within each country's stock index[10]. In both panels, we display β and δ estimates of the simple pooled regression and of the panel regression. The daily returns are in basis points.

Panel A: Individual Countries Results					
Country	Lunardummy	Calendardummy	Country	Lunardummy	Calendardummy
Canada	-3.93** (-1.99)	4.01** (2.03)	Israel	-12.14** (-2.73)	6.14 (1.38)
Germany	-3.84* (-1.71)	4.67** (2.08)	Morocco	-1.30 (-0.29)	-11.43** (-2.62)
France	-3.44 (-1.31)	-1.18 (-0.45)	Czech	3.80 (0.62)	5.16 (0.85)
Italy	-1.10 (-0.35)	-17.96** (-5.79)	Hungary	10.22 (1.49)	-1.15 (-0.17)
Japan	-4.52* (-1.88)	-4.33* (-1.80)	Jordan	-1.28 (-0.35)	2.58 (0.70)
United States	-2.74 (-1.18)	1.50 (0.64)	Pakistan	-1.42 (-0.23)	5.83 (0.94)
United Kingdom	-3.46 (-1.42)	3.31 (1.37)	Peru	-4.93 (-0.79)	-4.53** (-10.73)
Philippines	-1.76 (-0.33)	-2.00 (-0.37)	Russia	-20.79 (-1.15)	21.56 (1.19)
South Africa	-1.96 (-0.61)	6.49** (2.03)	Australia	-1.71 (-0.66)	2.36 (0.91)
Taiwan	-5.35 (-0.69)	-3.73 (-0.48)	Austria	-2.82 (-1.31)	0.16 (0.07)
Argentina	-20.32 (-1.63)	-12.01 (-0.96)	Belgium	-2.38 (-1.22)	2.48 (1.27)
Chile	-6.72* (-1.78)	4.66 (1.23)	Denmark	-2.80 (-1.03)	2.20 (0.81)
China	-10.15 (-0.83)	13.73 (1.13)	Hong Kong	-6.44 (-1.43)	-1.13 (-0.25)

[10] We do not adjust for autocorrelation in stock returns in the 7-day window case.

Indonesia	-19.34** (-1.96)	-9.93 (-1.17)	Ireland	-4.91* (-1.90)	3.23 (1.25)
Korea	1.89 (0.25)	8.45 (1.17)	Netherlands	-4.50** (-2.00)	4.70** (2.20)
Malaysia	-7.43 (-1.30)	2.78 (0.49)	Norway	-1.67 (-0.43)	8.52** (2.21)
Mexico	-14.27** (-2.44)	-3.53 (-0.60)	Singapore	-8.50** (-2.49)	-0.26 (-0.08)
Poland	0.89 (0.81)	6.51 (0.60)	Spain	-3.36 (-0.87)	4.79 (1.24)
Portugal	-7.91** (-2.27)	3.26 (0.93)	Sweden	-5.73 (-1.48)	4.13 (1.07)
Thailand	-2.48 (-0.35)	8.73 (1.25)	Switzland	-2.94 (-1.47)	4.44** (2.21)
Turkey	-13.04 (-1.28)	11.28 (1.10)	Finland	-2.16 (-0.34)	-9.15 (-1.44)
Venezuela	1.78 (0.18)	9.56 (1.01)	Greece	-8.66 (-1.31)	9.01 (1.37)
Brazil	-29.20 (-1.02)	-28.61 (-1.00)	Luxemburg	-6.02 (-1.46)	4.84 (1.17)
India	-8.57 (-1.22)	4.21 (0.60)	New Zealand	-5.05 (-1.28)	-1.45 (-0.37)

Panel B: Panel Results

	Simple Pooled Regressions		Panel	
	Lunardummy	Calendardummy	Lunardummy	Calendardummy
G7	-3.28** (-3.51)	-1.49 (-1.60)	-3.44** (-2.19)	-1.30 (-0.83)
Other Developed Markets	-4.22** (-5.01)	2.45** (2.90)	-4.41** (-2.40)	2.47 (1.34)
Emerging Markets	-6.82** (-3.90)	1.92 (1.09)	-7.25** (-2.56)	1.57 (0.55)
All Markets	-4.91** (-6.65)	1.33* (1.80)	-5.15** (-2.67)	1.24 (0.64)

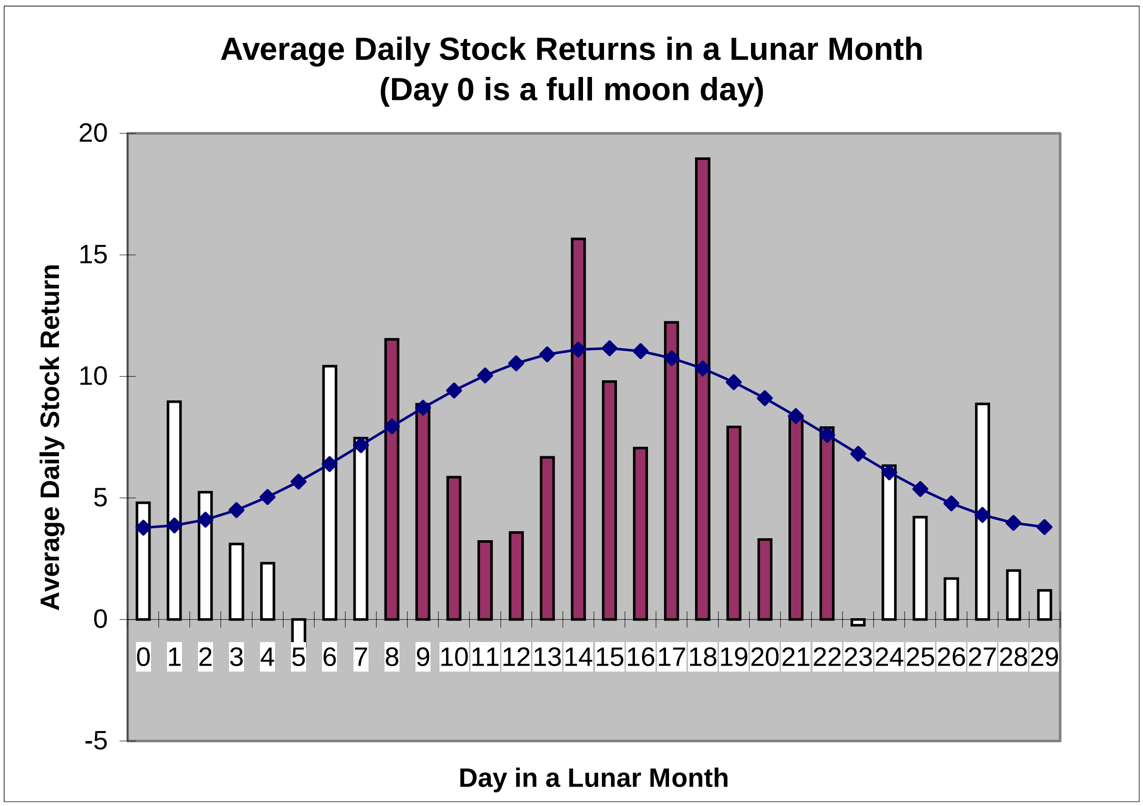
Table X
30-day Cycles and Stock Returns

This table reports the estimates of a country-specific fixed effect panel regression with panel corrected standard errors (PCSE): $R_{it} = \alpha_i + \beta * 30daydummy_t + e_{it}$ for a 15-day window when we shift lunar phases by N calendar days. More specifically, we start a 30-day cycle N days after the first full moon (N=1 to 29), and then estimate the 30-day cycle effect for each specification. 30daydummy takes on a value of one for 7 days before the starting day + the starting day + 7 days after the starting day, and a value of zero otherwise. The lunar cycle is represented by N=0. We display β in column 2 and column 4. T-statistics are reported in the parentheses. The daily returns are in basis points.

N	β	N	β
1	-3.79** (-1.96)	16	3.12 (1.61)
2	-3.18 (-1.65)	17	3.39* (1.75)
3	-2.72 (-1.41)	18	2.55 (1.32)
4	-3.16 (-1.64)	19	2.35 (1.22)
5	-3.30* (-1.71)	20	3.38* (1.75)
6	-3.12 (-1.62)	21	2.16 (1.12)
7	-0.59 (-0.31)	22	-0.08 (-0.04)
8	0.294 (0.15)	23	0.22 (0.11)
9	0.58 (0.30)	24	-1.14 (-0.59)
10	1.92 (0.99)	25	-1.91 (-0.99)
11	3.95** (2.04)	26	-4.24** (-2.19)
12	4.58** (2.37)	27	-5.27** (-2.73)
13	5.07** (2.62)	28	-4.85** (-2.51)
14	4.89** (2.53)	29	-4.53** (-2.34)
15	5.04** (2.61)	0	-5.18** (-2.63)

Figure 1
Average Daily Return of the Global Portfolio by Lunar Dates

This figure graphs, for each day of the lunar month, the average daily stock returns of an equal-weighted global portfolio of the 48 country stock indices in bars. Day 0 is a full moon day and day 15 is around a new moon day[11]. The line is the estimated sinusoidal model of the lunar effect on stock returns from the last row of Table V. More specifically, it is : $R_{it} = 7.47 - 3.69 * \text{cosine}(2\pi d/29.53)$, where d is the number of days since the last full moon.



[11] Day 15 is around new moon day since the length of a lunar month varies.

Figure 2
Average Daily Stock Returns of Global Portfolio by Lunar Windows

This figure plots the average daily stock returns of an equal-weighted global portfolio of the 48 country stock indices in a full moon period and a new moon period. The two bars on the left are average returns of a 15-day window; the two bars on the right are average returns of a 7-day window. All returns are in basis points.

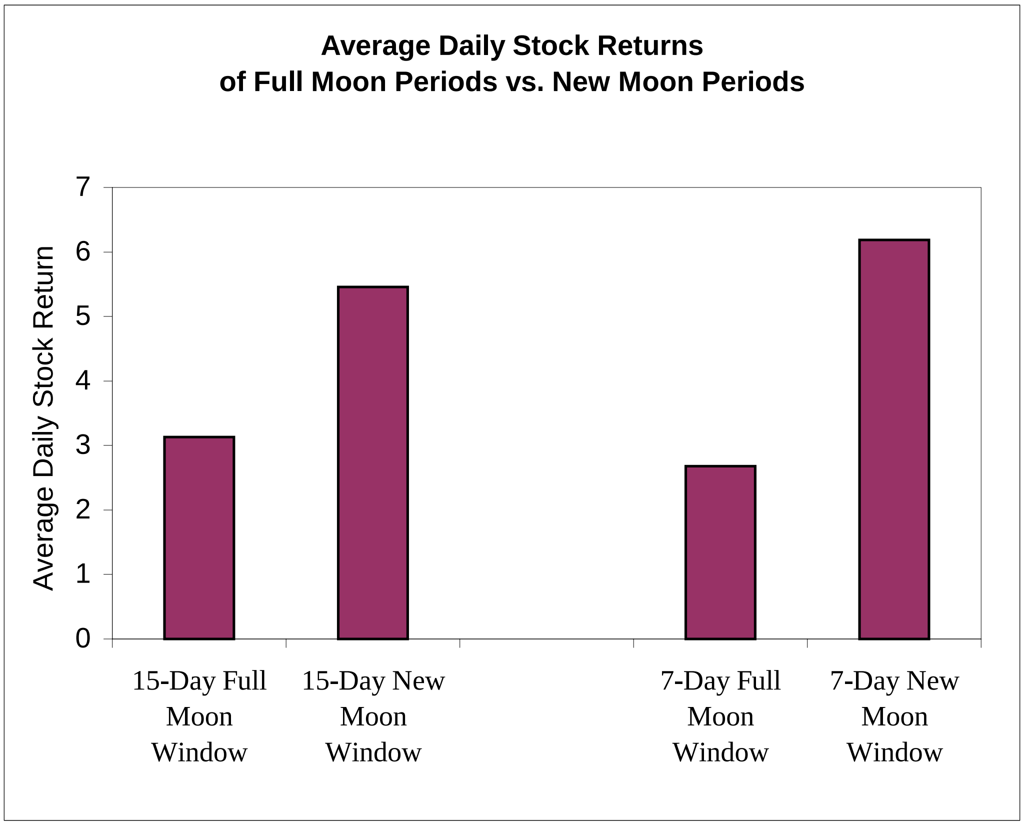


Figure 3
Distribution of Full Moon Days on Days of Week

This figure plots the number of full moon days on days of week in the sample.

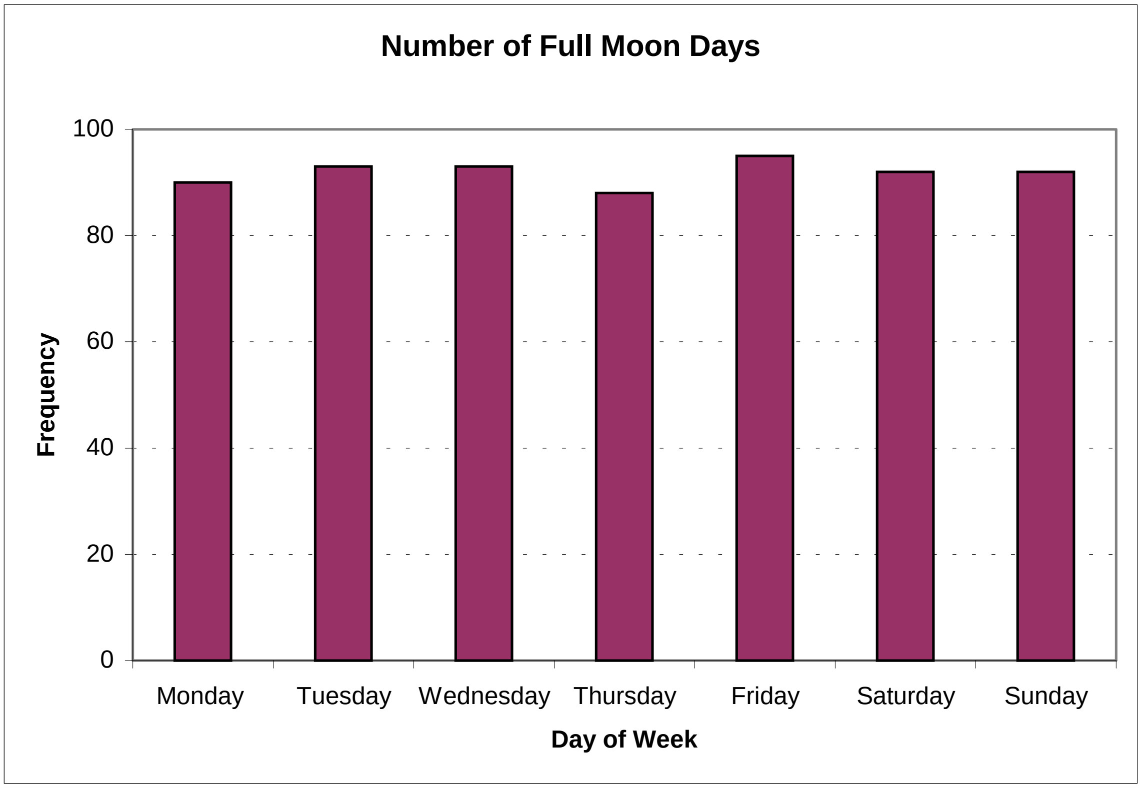


Figure 4
30-Day Cycles and Stock Returns

This figure graphs the estimates of a country-specific fixed effect panel regression with panel corrected standard errors (PCSE): $R_{it} = \alpha_i + \beta * 30daydummy_t + e_{it}$ for a 15-day window when we shift lunar phases by N calendar days. More specifically, we start a 30-day cycle N days after the first full moon (N=1 to 29), and then estimate the 30-day cycle effect for each specification. 30daydummy takes on a value of one for 7 days before the starting day + the starting day + 7 days after the starting day, and a value of zero otherwise. The lunar cycle is represented by N=0. The X-axis indicates 30-day cycles ordered by N. 0 represents the lunar month cycle. The Y-axis marks β estimates. The daily returns are in basis points.