EJEM
Econ.J.Emerg.Mark.

Economic Journal of Emerging Markets
Available at http://journal.uii.ac.id/index.php/jep

# Risk-adjusted and Bonferroni-adjusted seasonality in emerging Asian stock markets

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**Article Info**

***Article history:***
Received : 23 January 2020
Accepted : 10 March 2020
Published : 8 April 2020

***Keywords:***
emerging, risk-adjusted, Bonferroni adjusted, anomalies, market efficiency

***JEL Classification:***
G10, G11

**DOI:** 10.20885/ejem.vol12.iss1.art7

**Abstract**

Existing literature on market seasonality focuses mainly on returns anomalies with little or no attention to risk adjustment. This study investigates risk-adjusted, and Bonferroni adjusted day-of-the-week anomalies in nine emerging Asian stock markets. The data consist of the daily prices of nine stock indices from January 1997 to September 2019. The MSCI emerging market index was employed as a proxy of time-varying risk. **Findings/originality**: The results confirm the presence of day-of-the-week anomalies in emerging Asian markets, and the addition of the market risk proxy has failed to fade these patterns. Finally, after consideration of time-varying risk premium and applying Bonferroni Correction type adjustment, several market anomalies remain. However, both adjustments partially eliminate the significance of these patterns. The presence of these anomalies suggests that little of this can be accounted for the MSCI-EM stock price index. The results also confirm that systematic risk level varies from Monday to Friday.

## Introduction

Stock markets play a vital role in stimulating economic growth and the development of a country. Well-functioning stock markets facilitate the mobilization of financial resources and support industrial growth and commerce. Therefore, the stock markets have significant importance for both the investors and the industry. From the investor's point of view, stock investment is always risky, and investors are uncertain about their investment outcome (Ur Rehman, 2013). Since the last many decades, numerous foremost financial crashes forced the analysts in the financial community to consider beyond the financial and economic variables and take account of some emotional aspects of the investors that are strategically significant for such drastic fluctuations in the stock market. Significant fluctuations in the stock markets insist investors think beyond the efficient market hypothesis and to consider behavioral aspects of the investors that create such fluctuations. Indeed, several findings conflict with the Efficient Market Hypothesis in the literature, thereby creating anomalies. There are extensive studies that documented stock market anomalies suggesting that prices could depart from the fundamentals for a period (MClean & Pontiff, 2016; Stambaugh, Yu, & Yuan, 2012, 2015; Zhang, Lai, & Lin, 2017). It is an unexpected price behavior to be significantly and consistently lower/higher on specific calendar days, weeks, months, or at market closure time.

Such anomalies contradict the efficient market hypothesis (EMH) as it offers an opportunity for investors to earn returns consistently (Malkiel & Fama, 1970). For instance, in a

P ISSN 2086-3128 | E ISSN 2502-180X

recent study, Almujamed, Fifield, and Power (2018) investigates the weak form of the efficiency of the Kuwait Stock Exchange (KSE). The authors confirm the presence of patterns which may be useful for share price prediction (Nawaz & Mirza, 2012). However, such patterns may not contradict the EMH after taking account of the time-varying risk premium and transaction cost (Brooks & Persand, 2001). This possibility leaves us with the opportunity to appropriately incorporate the risk while quantifying the extent of market anomalies. In this study, the assumption of constant risk is relaxed by incorporating a time-varying risk premium. This is important if day-of-the-week phenomena are linked with correspondingly high (low) return volatility (Kiymaz & Berument, 2003). Furthermore, Sullivan, Timmermann, and White (2001) reported that nominal p-values for one distinct calendar become insignificant in the context of the full universe from which such rules were drawn. To avoid this data-mining process, this study compares the impact of Bonferroni adjustments on the significance level of these anomalies.

Given the importance of the stock markets, it becomes imperative that risks associated with stock market investments are minimized. Among different ways of reducing the risk, accurate prediction of the stock market is a widely applied method of risk reduction. Return predictability is unexplained by asset pricing models (i.e., CAPM) and thus establish anomalous patterns in stock prices. The presence of such patterns is due to market inefficiency or inadequacy of asset pricing models. Other main reasons for such patterns include the tax system (Dbouk, Jamali, & Kryzanowski, 2013), institutional structures (Hepsen, 2012), trading mechanisms, and culture (Bley & Saad, 2010). In the presence of such patterns, investors can make vigilant investment decisions based on predictable risks and returns of particular security (Berk O¸uzsoy & Güven, 2003).

Emerging stock markets are informationally inefficient (Fifield, Power, & Donald Sinclair, 2005; Xu, 2010). In emerging markets, several factors may breed such market patterns, including symmetric information, inadequate disclosures, a simple trading mechanism (Ajayi, Mehdian, & Perry, 2004). Relatedly, Brooks and Persand (2001) confirm the presence of senility five Asian financial markets. These reasons make emerging markets an ideal subject to investigate the risk-adjusted anomalies.

There is extensive literature on stock market anomalies, with most studies conducted in developed countries. Several researchers have documented the presence of day-of-the-week effects across the world (Mbululu & Chipeta, 2012; Rodriguez, 2012). However, a large proportion of the studies focused on returns patterns only and the risk adjustment on different days of the week. For instance, negative Monday and positive Friday returns are reported by French (1980). The presence of Monday and Friday affects the stock markets of Argentina, Brazil, Chile, Colombia, and Peru (Rodriguez, 2012). The presence of anomalies in mutual funds is linked with changing investors' sentiment and aggregate fear (Ben-Rephael, Kandel, & Wohl, 2012; Ederington & Golubeva, 2011).

The theory of efficient market hypothesis states that prices of securities in the stock market fully reflect all the available information in the market. Therefore, there are no chances of earning abnormal returns in the securities market (Reilly & Brown, 2012). Meanwhile, researchers have identified the factors that have led to contradicting the assumptions of the famous EMH theory. The seasonality or calendar effect in the stock market violates the assumptions of the efficient market hypothesis, and these anomalies exist in Kenya (Al-Khazali & Mirzaei, 2017). The calendar anomalies caused by a deviation in the behavior of stocks, which create obstacles, i.e., information is not adjusting quickly (Latif, Arshad, Fatima, & Farooq, 2011). Investors gain abnormal returns due to seasonal anomalies in a particular period of the year. The existence of these anomalies in the stock market proved that markets are not efficient (Malini, 2019). Arman and Lestari (2019)studied the impact of the Monday effect on the Indonesian stock exchange, particularly the banking sector. Their results showed consistent negative stock return, which

increases the probability of abnormal returns, hence, providing the evidence of anomalies contradicting the assumptions of EMH. The hypothesis of an efficient market is opposed by reporting a significant positive of KSE-100 index returns in the month of Ramadan (Khan, Nasir, & Rossi, 2017; Wasiuzzaman & Al-Musehel, 2018) analyzed the stock market efficiency via Ramadan effect on Karachi stock exchange (KSE-100). Relatedly, Chowdhury and Mostari (2015) reported that Eid-ul-Adha has a significant effect on stock return. The negative returns around events of Ashura and Eid Miladunabi were reported by (Al-Ississ, 2015; Majeed, Raheman, Sohail, Bhatti, & Zulfiqar, 2015). Kumar and Jawa (2017) confirm the presence of the Wednesday and December effect in the Indian stock market, thus; showing the informational inefficiency in the stock markets of India. Andrieş, Ihnatov, and Sprincean (2017) also confirmed the inefficiency of stock exchanges by detecting the presence of anomalies in the markets. Their empirical results indicated that stock exchanges of Central and European countries do not prove the assumptions of EMH. Relatedly, in a recent study, Gao (2019) studied January effect, Ex right day effect, Weekend effect, and reversal and momentum effect in the Sweden stock market. The results explored the existence of these anomalies in the Swedish stock markets, therefore, proving the EMH assumptions wrong. Moreover, the significance of calendar anomalies can also be observed in the Japanese stock markets during the Japanese bubble period, but after the crisis, these anomalies disappear (Khan & Rabbani, 2019). Similarly, Nairobi Securities exchange also gives the evidence against the efficient market hypothesis by confirming the presence of anomalies in the form of the weekend, day of the week, and monthly effect (Compton, Kunkel, & Kuhlemeyer, 2013; Kuria & Riro, 2013).

Further, the Amman stock exchange also provides evidence in favor of anomalies (Alrabadi & AL-Qudah, 2012). Moreover, Jebran and Chen (2017) found the significant impact of the week of the day effect, time of the month effect, turn of the month effect, and half of the month on the Islamic equity index of Pakistan. Besides, Baltic stock markets are also examined based on the "Halloween effect" and "Month effect," and the results indicated a significant influence of the Halloween effect in Estonia. In contrast, the Month effect was present in Estonia and Lithuania (Norvaisiene, Stankeviciene, & Lakstutiene, 2015). A study conducted on Shanghai and Shenzhen stock exchange for analyzing month effects proved the February effect being present in both of the markets (Su, Dutta, Xu, & Ma, 2011).

A significant part of these anomalies consists of calendar anomalies in different international stock markets, including the USA and Europe. Several past studies documented a significant positive Friday and significant negative Monday returns in the US stock market (French, 1980), and higher Wednesday returns in Hong Kong (Bayar & Kan, 2012). Further, Ahmed and Leng (2016) used ARCH and GARCH models to test seasonality in the shanghai stock market. The authors reported that the market is inefficient in weak form and exhibits patterns. Similarly, Mohanty (2018) analyzed seasonality among the different sectors of the Indian stock market. He found distinct seasonality in various sectors. Contrarily, Mbululu and Chipeta (2012) documented the Monday effect in the material sector only while the other eight sectors did not exhibit any patterns in the Johannesburg stock market.

Recently, Weigerding and Hanke (2018) explored the determinants of seasonality by using data of German stocks. By applying panel regression, the authors found that market liquidity is a major driver of the seasonality in returns. They also argue that the US macroeconomic news also has a significant impact on the German stock market. There are several pieces of evidence of seasonality in other markets including foreign exchange market (Tse, 2018), real estate (Bampinas, Fountas, & Panagiotidis, 2016), crude oil (Cheema & Scrimgeour, 2019; Quayyoum, Khan, Shah, Simonetti, & Matarazzo, 2019) and journal publications (Ausloos, Nedic, & Dekanski, 2016). Most of the researchers in literature focused on seasonality in return. Some studies focused on seasonality in the foreign exchange market.

This study is different and has three advantages from existing research. First, the objective of the study is more detailed. The existing research is mainly focused on the return's seasonality only and assumes constant risk across different days of the week. In this study, the assumption of constant risk is relaxed, and variation in risk is measured. Second, for risk-adjusted market anomalies in emerging markets, the MSCI-EM index is used as a proxy for market risk. Third, a Bonferroni correction is applied to calculate the corrected significance level. In most of the studies, adjustments for repeated testing of hypotheses is often overlooked, and the consequences can be inaccurate results and misleading inferences. Furthermore, to capture the pieces of evidence from emerging markets, the focus is on nine emerging Asian markets having a significant investment portion of MSCI.

The main conclusions include that most of the emerging Asian markets exhibit day-of-the-week anomalies. Even after risk adjustment and Bonferroni correction, several anomalies remain. The results also confirm that systematic risk level varies from Monday to Friday. Finally, the findings suggest that little of this can be accounted for MSCI-EM stock price index and Bonferroni adjustments.

## Methods

The closing values of Morgan Stanley Capital International (MSCI) emerging markets and nine emerging Asian markets are collected from DataStream from Jan-1997 to Sep-2019 (5,865 observations). The MSCI Emerging Markets Index captures 26 emerging markets (EM) countries. The emerging markets are divided into Asia (N=9), Americas (N=6) and Europe, Middle East & Africa (N=12). These classifications are made on several criteria, including size, accessibility, liquidity, and development. MSCI-EM is an index to measure equity performance in world emerging markets and represent 13% of global market capitalization. The index captures mid and large caps in 26 countries and weighted heavily in China (33%), South Korea (13.02%), Taiwan (11.35%) and India (9.16%). It is clear that, in terms of share in MSCI-EM, Asian countries represent a major proportion. MSCI updates the classifications, and some countries vary in each category from time to time.

**Table 1.** List of Emerging Asian Markets classified by MSCI

| No. | Country | Index |
|---|---|---|
| 1 | China | Shanghai Se A Share |
| 2 | India | Nifty 500 |
| 3 | Indonesia | IDX Composite |
| 4 | Korea | Korea Se Composite (KOSPI) |
| 5 | Malaysia | FTSE Bursa Malaysia KLCI |
| 6 | Pakistan | Karachi Se 100 |
| 7 | Philippines | Philippine Se I(PSEI) |
| 8 | Taiwan | Taiwan Se Weighed TAIEX |
| 9 | Thailand | Bangkok SET. |

Source: MSCI Emerging Markets Index (MSCI, 2019), available at https://www.msci.com/emerging-markets.

The daily continuously compounded returns $(R_{i,t})$ are computed by using equation 1:

$$R_{i,t} = \ln\left(\frac{P_t}{P_{t-1}}\right) \quad (1)$$

where $P_t$ represents the closing price of a given index on day *t*. The trading date is converted into day-of-the-week by using software R.

This paper applies the Augmented Dickey-Fuller (ADF) test to test the stationarity of the market returns. The results of the ADF test are reported in Table 2. They confirm that the returns data of all stock markets and MSCI-EM is stationary.

**Table 2.** Unit Root Test

| Index Returns | ADF test statistics |
|---|---|
| Shanghai Se A Share | -35.559*** |
| Nifty 500 | -70.227*** |
| IDX Composite | -67.004*** |
| Korea Se Composite (KOSPI) | -73.038*** |
| FTSE Bursa Malaysia KLCI | -31.975*** |
| Karachi Se 100 | -70.294*** |
| Philippine Se I(PSEI) | -67.060*** |
| Taiwan Se Weighed TAIEX | -74.013*** |
| Bangkok SET. | -49.795*** |
| MSCI | -60.398*** |

Notes: entries in *, **, and *** are significant at 10%, 5% and 1% significance levels, respectively.

To estimate the risk adjusted market seasonality, the analysis is alienated into three segments, which are given below. First of all, to test for difference in mean return across the various days in a week, the model is postulated in equation 2:

$$R_{it} = \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + \beta_5 D_{5t} + \varepsilon_t \quad (2)$$

where $R_{it}$ is the daily index returns. $D_1$, $D_2$, …, $D_5$ are five dummy variables for five trading days, i.e., from Monday to Friday respectively, $\varepsilon_t$ is an error term. The coefficients, namely $\beta_1$ to $\beta_5$, capture the mean returns for the particular day of the week.

We estimate the above equation for each country separately. Yet the time-varying risk factor is not considered in equation 2. The possibility of low/high returns on certain days might be explained by the corresponding variation in risk. In order to test the risk-adjusted market returns, returns of MSCI-Emerging index is included in the equation 2, which is a proxy for market risk. The model is postulated in equation 3:

$$R_{it} = \sum_{i=1}^{5} \beta_i D_{it}^i + \beta_i MSCI - EM_t + \varepsilon_{it} \quad (3)$$

where $MSCI - EM_t$ is return on MSCI emerging market index and used as a proxy of market risk.

If any significant dummy variable in equation 2 becomes insignificant after including $RME_t$ (equation 3), this would imply that the phenomenon may be due to seasonality in risk-return relationships rather than a genuine day-of-the-week effect. However, if the coefficients remain significant, there is a need to consider and identify other factors that might be leading to this effect.

The above equations estimate mean returns on each day with and without the market risk factor on any particular day in a week. In order to have the time-varying risk across each day of the week, we use slope dummy variables (day-of-the-week dummy variable multiplied with MSCI emerging markets index return). These interacted dummy variables help to identify seasonality in the risk-return relationship. Thus, the following time-varying risk equation is estimated:

$$R_{it} = \sum_{i=1}^{5} \beta_i D_{it}^i + \sum_{i=1}^{5} \beta_i [D_{it}^i MSCI - EM_t] + \varepsilon_{it} \quad (4)$$

In this case, a change in the significance of dummy variables from equation 2 to equation 4 means a risk-return seasonality, clarifying the existence of the day-of-the-week effect or vice versa.

## Results and Discussion

Table 3 shows the average returns of five days of the week, which are estimated from equation 2. The results reveal that other than South Korea (KOSPI), all other emerging Asian stock markets exhibit significant day-of-the-week effects. However, the Bonferroni type adjustment, the patterns in the markets of Malaysia and China disappear. Furthermore, after this adjustment, the Monday effect in Pakistan and Wednesday & Friday effects in Philippine also disappear. The results show, even after Bonferroni adjustment, a significant Monday effect in the stock markets of Indonesia and Thailand; Tuesday effect in Philippine; Wednesday effect in Indonesia, Pakistan, Taiwan and Thailand; and Thursday effect in India. Also, Friday effect is significant in the stock markets of Indonesia, Pakistan, and Thailand. Significant day-of-the-week impact in most of the markets confirms the results of Hau (2010).

**Table 3.** Days of the week effects in Emerging Asian Stock Markets

| Variable | China | India | Indonesia | Korea | Malaysia | Pakistan | Philippines | Taiwan | Thailand |
|---|---|---|---|---|---|---|---|---|---|
| Monday | 0.0007 | 0.0001 | -0.0011** | -0.0003 | -0.0008** | -0.0009* | -0.0001 | -0.0005 | *-0.0017*** |
| | (0.0004) | (0.0004) | (0.0005) | (0.0006) | (0.0004) | (0.0005) | (0.0005) | (0.0005) | (0.0005) |
| Tuesday | 0.0009 | 0.0005 | 0.0002 | 0.0003 | 0.0001 | 0.0005 | -0.0011*** | -0.0003 | -0.0004 |
| | (0.0005) | (0.0005) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| Wednesday | -0.0004 | -0.0001 | 0.0010** | 0.0006 | 0.0004 | 0.0016*** | 0.0007* | 0.0008** | 0.0009** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0003) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| Thursday | 0.0007 | 0.0015*** | 0.0006 | 0.0003 | 0.0000 | 0.0005 | 0.0005 | -0.0001 | -0.0002 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0003) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| Friday | -0.0008** | 0.0002 | 0.0011*** | 0.0001 | 0.0006* | 0.0010** | 0.0007** | 0.0005 | 0.0019*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0003) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| *After Bonferroni Correction* | | | | | | | | | |
| Monday | 0.0007 | 0.0001 | -0.0011* | -0.0003 | -0.0008 | -0.0009 | -0.0001 | -0.0005 | *-0.0017*** |
| | (0.0004) | (0.0004) | (0.0005) | (0.0006) | (0.0004) | (0.0005) | (0.0005) | (0.0005) | (0.0005) |
| Tuesday | 0.0009 | 0.0005 | 0.0002 | 0.0003 | 0.0001 | 0.0005 | -0.0011*** | -0.0003 | -0.0004 |
| | (0.0005) | (0.0005) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| Wednesday | -0.0004 | -0.0001 | 0.0010** | 0.0006 | 0.0004 | 0.0016*** | 0.0007 | 0.0008* | 0.0009* |
| | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0003) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| Thursday | 0.0007 | 0.0015*** | 0.0006 | 0.0003 | 0.0000 | 0.0005 | 0.0005 | -0.0001 | -0.0002 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0003) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| Friday | -0.0008 | 0.0002 | 0.0011** | 0.0001 | 0.0006 | 0.0010** | 0.0007 | 0.0005 | 0.0019*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0003) | (0.0004) | (0.0004) | (0.0004) | (0.0004) |
| DW stat | 1.9962 | 1.8256 | 1.7328 | 1.9053 | 1.9004 | 1.8278 | 1.7356 | 1.9312 | 1.8559 |

Notes: the model estimated is $R_t = \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + \beta_5 D_{5t} + \varepsilon_t$ Std. errors are in parentheses (computed using robust standard errors following Newey and West, (1987) and White (1980); *, **, and *** denote significance at the 10%, 5% and 1% levels respectively.

Table 4 shows that the evidence of the day-of-the-week effect in emerging Asian markets after the inclusion of MSCI- EM as a proxy for market risk. There are two dimensions of the results presented in Table 4. First is the comparison between two sections to check the role of Bonferroni adjustment. Second, the important one is to check the role of MSCI-EM index by comparing the lower sections of Table 4 with Table 3. By applying Bonferroni correction, it is found that nine significant effects completely vanished while the significance level of two effects declines. Comparing Table 4 with Table 3 found that the market beta (MSCI- EM Index) is statistically significant for eight out of nine stock markets and less than unity. It is to note that after the inclusion of MSCI-EM, the Wednesday effect in Indonesia, Taiwan, and Thailand disappears entirely, while the significance level of Friday effects in Indonesia and Pakistan declines from 95 % to 90%. However, this inclusion unable to remove the other anomalies, which are reported in Table 3. There are many market moments which are not explained by the efficient market hypothesis

(EMH). Our results are consistent with the weak form of efficiency that the current prices almost reflect the historical information (Malkiel & Fama, 1970). Fama (1991) accepts the existence of anomalies in the market. It is explained that anomalies are inconsistent with EMH.

**Table 4.** Days of the week effects with the inclusion of MSCI-EM as market risk proxy in Asian Emerging Stock Markets

| Variable | China | India | Indonesia | Korea | Malaysia | Pakistan | Philippines | Taiwan | Thailand |
|---|---|---|---|---|---|---|---|---|---|
| Monday | 0.0007* | 0.0002 | -0.0009** | -0.0001 | -0.0007** | -0.0009* | 0.0000 | -0.0004 | -0.0016*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0004) | (0.0004) | (0.0004) |
| Tuesday | 0.0009 | 0.0005 | 0.0002 | 0.0002 | 0.0000 | 0.0005 | -0.0012*** | -0.0004 | -0.0005 |
| | (0.0005) | (0.0005) | (0.0004) | (0.0003) | (0.0004) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Wednesday | -0.0004 | -0.0001 | 0.0008** | 0.0002 | 0.0002 | 0.0016*** | 0.0005 | 0.0005* | 0.0007* |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Thursday | 0.0007 | 0.0015*** | 0.0007* | 0.0004 | 0.0001 | 0.0005 | 0.0006* | 0.0000 | -0.0001 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Friday | -0.0009** | 0.0001 | 0.0008** | -0.0004 | 0.0004 | 0.0009** | 0.0005 | 0.0001 | 0.0016*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| MSCI_FM | 0.0275 | 0.1694*** | 0.5941*** | 0.8648*** | 0.3963*** | 0.1326*** | 0.4363*** | 0.6424*** | 0.5856*** |
| | (0.0220) | (0.0207) | (0.0260) | (0.0306) | (0.0251) | (0.0217) | (0.0189) | (0.0258) | (0.0221) |
| *After Bonferroni Correction* | | | | | | | | | |
| Monday | 0.0007 | 0.0002 | -0.0009* | -0.0001 | -0.0007 | -0.0009 | 0.0000 | -0.0004 | -0.0016*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0004) | (0.0004) | (0.0004) |
| Tuesday | 0.0009 | 0.0005 | 0.0002 | 0.0002 | 0.0000 | 0.0005 | -0.0012*** | -0.0004 | -0.0005 |
| | (0.0005) | (0.0005) | (0.0004) | (0.0003) | (0.0004) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Wednesday | -0.0004 | -0.0001 | 0.0008 | 0.0002 | 0.0002 | 0.0016*** | 0.0005 | 0.0005 | 0.0007 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Thursday | 0.0007 | 0.0015*** | 0.0007 | 0.0004 | 0.0001 | 0.0005 | 0.0006 | 0.0000 | -0.0001 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Friday | -0.0009 | 0.0001 | 0.0008* | -0.0004 | 0.0004 | 0.0009* | 0.0005 | 0.0001 | 0.0016*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| MSCI_FM | 0.0275 | 0.1694*** | 0.5941*** | 0.8648*** | 0.3963*** | 0.1326*** | 0.4363*** | 0.6424*** | 0.5856*** |
| | (0.0220) | (0.0207) | (0.0260) | (0.0306) | (0.0251) | (0.0217) | (0.0189) | (0.0258) | (0.0221) |
| DW stat | 2.0052 | 1.9441 | 1.8641 | 2.0646 | 1.9807 | 1.8430 | 1.9431 | 2.0765 | 1.9699 |

Notes: the model estimated is $R_{it} = \sum_{i=1}^{5} \beta_i D_{it}^{i} + \beta_i RME_t + \varepsilon_{it}$ Std. errors are in parentheses (computed using robust standard errors following Newey and West, (1987) and White (1980); *, **, and *** denote significance at the 10%, 5% and 1% levels respectively.

In Table 5, it is documented that the Monday and Friday effects in Indonesia disappear after taking account of the day-of-the-week seasonality in systematic risk factors. However, MSCI-EM unable to fade other day-of-the-week effects. The mean systematic risk level varies throughout the days in a week. For instance, the beta coefficients for China's stock market range from -0.1415 on Tuesday to .1243 on Friday. Likewise, the beta coefficients for Taiwan's stock market range from 0.5804 on Wednesday to 0.7079 on Monday. Similar variations are noted on different days-of-the-week in other emerging markets. The results reveal that emerging Asian markets do exhibit not only day-of-the-week anomalies but also have time-varying sensitivity to the MSCI-FM Index. It is to note that, after applying Bonferroni correction, 15 effects became insignificant, while the significance level of 3 coefficients declines from 99% to 95%, and significant of the Friday effect in Pakistan declines from 95% to 90% level. In conclusion, we find the existence of day-of-the-week anomalies in most of the emerging Asian markets, and any addition of the market risk proxy has a partially significant impact on the fading of these patterns.

The lack of development of emerging markets tends to mean that these markets are often characterized as being less liquid and more volatile than developed markets.

**Table 5.** Days of the week effects with the inclusion of interactive dummy variables with MSCI-EM in Asian Emerging Stock Markets

| Variable | China | India | Indonesia | Korea | Malaysia | Pakistan | Philippines | Taiwan | Thailand |
|---|---|---|---|---|---|---|---|---|---|
| Monday | 0.0007* | 0.0002 | -0.0009** | -0.0001 | -0.0007** | -0.0009* | 0.0000 | -0.0003 | -0.0015*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0004) | (0.0004) | (0.0004) |
| Tuesday | 0.0009* | 0.0005 | 0.0002 | 0.0002 | 0.0000 | 0.0005 | -0.0012*** | -0.0004 | -0.0005 |
| | (0.0005) | (0.0005) | (0.0004) | (0.0003) | (0.0004) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Wednesday | -0.0005 | -0.0001 | 0.0008** | 0.0003 | 0.0002 | 0.0016*** | 0.0005 | 0.0005* | 0.0007* |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Thursday | 0.0007 | 0.0015*** | 0.0007* | 0.0004 | 0.0001 | 0.0005 | 0.0006* | 0.0000 | -0.0001 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Friday | -0.0009** | 0.0001 | 0.0008** | -0.0004 | 0.0004 | 0.0009** | 0.0005 | 0.0001 | 0.0016*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| β*Monday | 0.0671* | 0.2208*** | 0.6342*** | 0.8643*** | 0.4472*** | 0.1430*** | 0.4540*** | 0.7079*** | 0.6506*** |
| | (0.0386) | (0.0532) | (0.0490) | (0.0572) | (0.0557) | (0.0442) | (0.0465) | (0.0514) | (0.0422) |
| β*Tuesday | -0.1415** | 0.0456 | 0.4803*** | 0.7966*** | 0.3750*** | 0.1516*** | 0.3636*** | 0.6327*** | 0.5807*** |
| | (0.0712) | (0.0696) | (0.0709) | (0.0436) | (0.0539) | (0.0432) | (0.0509) | (0.0440) | (0.0456) |
| β*Wednesday | 0.1153*** | 0.1590*** | 0.6365*** | 0.7946*** | 0.3425*** | 0.0711* | 0.3941*** | 0.5804*** | 0.5718*** |
| | (0.0374) | (0.0511) | (0.0494) | (0.0596) | (0.0325) | (0.0403) | (0.0370) | (0.0441) | (0.0458) |
| β*Thursday | -0.0472 | 0.2005*** | 0.5820*** | 0.8712*** | 0.3817*** | 0.1663*** | 0.4844*** | 0.6006*** | 0.5103*** |
| | (0.0482) | (0.0417) | (0.0483) | (0.0561) | (0.0308) | (0.0349) | (0.0372) | (0.0387) | (0.0413) |
| β*Friday | 0.1243*** | 0.1787*** | 0.6072*** | 1.0069*** | 0.4154*** | 0.1250*** | 0.4660*** | 0.6716*** | 0.5979*** |
| | (0.0474) | (0.0447) | (0.0532) | (0.0595) | (0.0392) | (0.0407) | (0.0443) | (0.0363) | (0.0524) |
| After Bonferroni Correction | | | | | | | | | |
| Monday | 0.0007 | 0.0002 | -0.0009 | -0.0001 | -0.0007 | -0.0009 | 0.0000 | -0.0003 | -0.0015*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0005) | (0.0004) | (0.0004) | (0.0004) |
| Tuesday | 0.0009 | 0.0005 | 0.0002 | 0.0002 | 0.0000 | 0.0005 | -0.0012*** | -0.0004 | -0.0005 |
| | (0.0005) | (0.0005) | (0.0004) | (0.0003) | (0.0004) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Wednesday | -0.0005 | -0.0001 | 0.0008 | 0.0003 | 0.0002 | 0.0016*** | 0.0005 | 0.0005 | 0.0007 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Thursday | 0.0007 | 0.0015*** | 0.0007 | 0.0004 | 0.0001 | 0.0005 | 0.0006 | 0.0000 | -0.0001 |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| Friday | -0.0009 | 0.0001 | 0.0008 | -0.0004 | 0.0004 | 0.0009* | 0.0005 | 0.0001 | 0.0016*** |
| | (0.0004) | (0.0004) | (0.0004) | (0.0004) | (0.0003) | (0.0004) | (0.0003) | (0.0003) | (0.0004) |
| β*Monday | 0.0671 | 0.2208*** | 0.6342*** | 0.8643*** | 0.4472*** | 0.1430*** | 0.4540*** | 0.7079*** | 0.6506*** |
| | (0.0386) | (0.0532) | (0.0490) | (0.0572) | (0.0557) | (0.0442) | (0.0465) | (0.0514) | (0.0422) |
| β*Tuesday | -0.1415 | 0.0456 | 0.4803*** | 0.7966*** | 0.3750*** | 0.1516*** | 0.3636*** | 0.6327*** | 0.5807*** |
| | (0.0712) | (0.0696) | (0.0709) | (0.0436) | (0.0539) | (0.0432) | (0.0509) | (0.0440) | (0.0456) |
| β*Wednesday | 0.1153** | 0.1590*** | 0.6365*** | 0.7946*** | 0.3425*** | 0.0711 | 0.3941*** | 0.5804*** | 0.5718*** |
| | (0.0374) | (0.0511) | (0.0494) | (0.0596) | (0.0325) | (0.0403) | (0.0370) | (0.0441) | (0.0458) |
| β*Thursday | -0.0472 | 0.2005*** | 0.5820*** | 0.8712*** | 0.3817*** | 0.1663*** | 0.4844*** | 0.6006*** | 0.5103*** |
| | (0.0482) | (0.0417) | (0.0483) | (0.0561) | (0.0308) | (0.0349) | (0.0372) | (0.0387) | (0.0413) |
| β*Friday | 0.1243** | 0.1787*** | 0.6072*** | 1.0069*** | 0.4154*** | 0.1250** | 0.4660*** | 0.6716*** | 0.5979*** |
| | (0.0474) | (0.0447) | (0.0532) | (0.0595) | (0.0392) | (0.0407) | (0.0443) | (0.0363) | (0.0524) |
| DW stat | 2.0057 | 1.9522 | 1.8680 | 2.0597 | 1.9825 | 1.8429 | 1.9473 | 2.0812 | 1.9748 |

*Notes: the model estimated is* $\boldsymbol{R_{it} = \sum_{i=1}^{5} \beta_i D_{it}^{i} + \sum_{i=1}^{5} \beta_i [D_{it}^{i} RME_t] + \varepsilon_{it}}$ *Std. errors are in parentheses (computed using robust standard errors following Newey and West, (1987) and White (1980)); *, **, and *** denote significance at the 10%, 5% and 1% levels respectively.*

## Conclusion

This study examines the risk-adjusted, Bonferroni adjusted day-of-the-week anomalies in nine emerging Asian stock markets, classified by the Morgan Stanley Capital International (MSCI). The data span from January 1997 to September 2019. The results confirm the presence of day-of-the-week effects both in average returns and systematic risk in six out of nine emerging Asian markets. More importantly, the results do not significantly change after incorporating the MSCI-EM price index. Even after the application of Bonferroni correction and relaxation of constant risk throughout the week, several significant day-of-the-week anomalies remain. The findings are consistent with those of Brooks and Persand (2001) and Malkiel and Fama (1970). The presence of these anomalies suggests that little of this can be accounted for MSCI-EM stock price index. Several missing risk factors may rationalize these anomalies. Missing factors can be default premium, unexpected inflation, fluctuating exchange rates, interest rates, or release of news at a certain time (Brooks & Persand, 2001).

One limitation of our study is that we estimated risk-adjusted anomalies in stock markets only. Future research can be extended by comparing it with other financial markets like foreign-exchange markets. As the further direction of the study, it might be interesting to know if the same results are obtained for individual stocks from this stock exchange. Despite limitations, the findings may have several implications for investors, particularly for institutional investors having direct exposure to these indices. Such institutional investors have large pools of funds with flexible investment decisions. From a theoretical point of view, the analysis reveals the market efficiency of emerging stock markets.

### Acknowledgments

The authors gratefully acknowledge the anonymous reviewers for their insightful comments and suggestions.

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