Paradigms
Print ISSN 1996-2800, Online ISSN 2410-0854
2019, Vol. 13, No. 1 Page 126-133
DOI: 10.24312/1900016130119

Predictability of Asian Stock Market Returns using Markov-Switching Model

Zubash Jalil Malik[1] and Muhammad Zubair Mumtaz[2] *
School of Social Sciences & Humanities, National University of Sciences & Technology, Islamabad[1,2]
***Corresponding Author**: zubair@s3h.nust.edu.pk

Cite this paper: Malik, Z. J., & Mumtaz, M. Z. (2019). Predictability of Asian stock market returns using Markov-Switching model. *Paradigms, 19*(1), 126-133.

This study performs the predictability tests for eleven Asian stock markets using monthly data during the period lasting from January 1990 to December 2017. Asian stock market returns, as well as returns in the bear regime, are predicted by using the US stock market returns and bears. We employ the two-state Markov-Switching model to distinguish between the bull and bear regimes for both the USA and Asian stock markets. The predictive models are employed using the OLS and FGLS estimators. The results of predictability analysis show that the USA returns as well as the USA bears are important predictors of the Asian returns and bears. The forecasting exercise reinforces the predictability analysis, which shows that the predictive model can forecast the future quite well for most of the Asian countries. Effective policymaking and implementation are required to consider the characteristics of the market for the best use of the country so that investors can maximize their earnings.

***Keywords**:* Asian stock markets, Markov-switching, bears, predictive models

INTRODUCTION

The relationship between predictability and the business cycles is a pivotal area from a theoretical and an empirical point of view. Information relating to the future outcomes of any investment in stocks plays a vital role in decision making. Such information is, therefore, important for trading in the financial markets, which in turn has an impact on the dynamics of the economy (Allen & Gale, 1995).

The effective management and organization of the stock markets can stimulate investment and create opportunities to finance productive projects thereby mobilizing domestic savings, allocating capital efficiently, diversifying risk, and facilitating the exchange of goods and services, which generate economic activities (Caporale et al., 2004). There exists a strong relationship between stock market development and economic growth. However, sound knowledge of the stock markets followed by good policies can put the economy into acceleration.

Stock market development is associated with the long-run economic growth of a country (Levine & Zervos, 1996). This shows that being aware of the dynamics of the financial markets and exercising efficient policymaking, can, in fact, be an effective way of attaining better economic growth. Attempts have been made to determine the linkages and causal relationships between the stock markets (e.g., India, USA, and Japan). Levine & Zervos (1996) reported the non-existence of long-term co-integration between the stock markets of the USA and India. Alternatively, they found the existence of interdependence between some ASEAN countries, the USA, and Japan. These countries seem to be going towards a greater degree of integration either with USA, Japan, as well as amongst themselves, diminishing long-run diversification benefits. In addition, there seems to be an increasing co-integration amongst some ASEAN markets.

The purpose of this study is to examine the predictability of the returns of the Asian stock market by using the returns of the USA stock market. Additionally, the study employs a Markov-Switching model to identify the bear and bull regimes generally referred to as the stock market cycles. These stock market cycle dynamics are then employed to analyze whether the USA bear market is able to predict the Asian bear market. Furthermore, the Asian returns using USA bears; and Asian bears using USA returns are also predicted. Thus, connecting the predictability with the stock market cycles, this study poses questions such as: whether the USA stock market returns are able to predict the returns of the Asian markets? whether the bear market of the USA can predict the Asian returns? and whether the USA returns can predict the Asian bears or whether the USA bear market can predict the Asian bear markets?

The rest of the paper is organized as follows. The literature review is presented next. Then the following section elaborates on the two data sets that are used: the stock market returns and the filtered probabilities market being in the bear regime. An explanation of the derivation of the latter data series and the summary statistics are also given in this section. Next, the correlations between the predictor, the USA (returns series and the bear series) and the Asian (returns series and bear series) is calculated and analyzed. Following this are the endogeneity test results. Finally, the predictive model is presented, and the results are discussed. Lastly, the conclusions are drawn.

LITERATURE REVIEW

To predict the behavior of stock markets, prior studies (Bahrami, Shamshuddin, & Uylangco, 2018; Chen 2012; Demirtas & Zirek 2011; Campbell & Yogo 2006) used various financial and macroeconomic variables. Often, leading stock markets (e.g. the USA) are used to predict various international stock markets. Considering the large size of the USA stock market, it can be used to make predictions about other stock

markets. Thus, it would be appropriate to use the USA stock market to make predictions about the Asian markets, given that several types of research have proven that the USA macro-economy has some financial and economic implications upon Asian markets (Kim et al., 2011; Narayan & Narayan 2012).

The earlier studies (Demirtas & Zirek, 2011; Yang, Kolari, & Min, 2003) showed that the business cycle of the USA is synchronized with Asian economies business cycles. Furthermore, there seem to exist effects that spillover from the USA market onto some stock markets of the Asian countries (Choudhry, 2004; Li & Zhang, 2013). Hsiao et al. (2003) confirmed the evidence of causality which seems to be unidirectional initiating from the USA over to some economies of Asia. Chen (2009) investigated the predictability of the bear market of the USA by using various macroeconomic variables. Nevertheless, there is little evidence that could show that the bear markets can be predicted by using the bear and returns of the international stock market, and it seems to be an emerging concept. Ramchand and Susmel (1998) identified that some World markets and the USA market are correlated which is approximately 2.0 to 3.5 times higher (on average), considering that the USA market was in a state of high variance as compared to when it was in a low variance state. However, studies such as Brockman et al. (2010) indicated this fact that since the second half of the twentieth century, the co-movement across the stock market of the USA and the international stock markets has decreased and is further declining.

The empirical evidence also reflects that crises in the stock market spread globally through the asset holdings of international investors (Boyer, Tomomi, & Yuan, 2006). This indicates that if a country has a good diversification opportunity and ability to attract foreign portfolio investment into its stock market, it is effectively moving towards a scenario, where it is becoming more integrated with the global financial markets, and exposing itself to contagion effect. The US financial market may be one of the global-factor that seem to marshal many of the emerging markets of the Asian-Pacific region, there exists a causal relationship between them (Cheung & Mak, 1992). According to Levine & Zervos (1996), the stock market development is positive and robustly affect the long-run economic growth of a country.

Contagion effect is widely used in finance which refers to the possibility of the spread of an economic crisis or boom across countries. Financial contagion can cause financial volatility and can damage the financial system as well as the economy seriously. Chiang, Jeon and Li (2007) reported the existence of an increased contagion amongst Asian financial markets. Moreover, this correlation has continued to increase after the Asian crisis of 1997. They found the existence of financial contagion between developed and emerging countries and the USA. During the USA sub-prime crisis, emerging markets seem to be most influenced by the contagion effect. Bae, Karloyi and Stulz (2003) argued that the contagion effect is predictable and it depends upon financial variables.

McMillan (2016) evaluated the predictability of a range of international stock markets considering both local and global predictive factors. He argued that US returns have local predictive power for international stock returns. Ahmed and Rosser (1995) argued that the Pakistani stock market shows the presence of speculative bubbles. From this viewpoint, we observe that if the Pakistani stock market sways independently of the global scenario, it would seem that it is a very good diversification opportunity for investors. Recent literature has been trending towards such relationships between developed and emerging financial markets. Developed markets might prove to be better predictors of emerging markets better even than the exchange rate and oil price shocks (Narayan & Rehman, 2017). Thus, it is imperative that this relationship is further studied and analyzed. It would be useful for investors to have some information regarding the expected movement of the market, which increases the investors' confidence in the market and encourages investors to trade, ultimately putting the economy on a high gear and increased stability. Hence, statistics regarding the predictive power of the market returns and market bears can enhance the ability of the investors to appropriately time and manage investments in such markets that can be predicted.

Even though bear and bull market regimes have been statistically identified with regard to the Pakistan stock market, however, no attempt has been made to predict the bear probabilities with other major markets' returns or bear probabilities. This study intends to bridge the current gap in the literature, particularly for the Pakistan stock market and contribute to the existing literature. The study employs two series; the return series and the bear probability series, to predict whether the USA market phenomenon is able to predict Pakistan stock market dynamics. The study also performs similar regressions for ten other Asian countries and analyze their predictability patterns.

DATA AND METHODOLOGY

We predict the Asian stock market returns using the data during the period lasting from January 1990 to August 2017. The sample countries include Pakistan, China, Japan, India, Malaysia, Indonesia, Philippine, Thailand, Taiwan, Korea, and Singapore. The stock indices are obtained from the DataStream. The data relating to Singapore and China is only available from 1999 and 1992 onwards respectively. For the USA, the Wilshire-5000 is used as the market index. The stock market returns are derived from the following expression:

$$r_t = ln_{\ t} * 100 \qquad (1)$$

Where lnR_t is measured by taking log difference of monthly stock price indices. Each stock market index is utilized and the return series for the USA and each of the eleven countries are computed through the above-mentioned process. This return series is then employed to make analysis regarding the returns of the stock market for each country.

The summary statistics of this series are presented in Appendix 1. The results show that on average Pakistan's stock markets provide a return 1.31% per month which is the highest amongst all of the sample countries. The USA offers a return of 0.61% per month, on average. During the sample period, the maximum return registered by China whereas the minimum

return reported by the Pakistani stock market. This could imply that even though Pakistan reports the highest average returns as well as the minimum returns reflecting huge variations. The standard deviation is highest in the case of China and the lowest for the USA, and Pakistan is mid-way between the highest and the lowest value. With the exception of China and India, the return series of all the other countries are negatively skewed. All of the return series show excessive kurtosis. Additionally, the *p*-value of Jacque-Bara test is zero for all countries, which indicates the return series are not normally distributed.

Panel B (Appendix 1) shows the results of the Lagrange Multiplier (LM) test for Autoregressive Conditional Heteroscedasticity-ARCH effects. In the entire sample, there seem to be ARCH effects for all the countries except for Pakistan and Japan, this is consistent with literature since some countries return series do not follow random walk process (Hoque, Kim, & Pyun, 2007). Countries with ARCH effects, seem to exhibit volatility clustering, indicating that once the magnitude of the change in returns becomes large, it tends to remain large (whether this change is negative or positive). Panel C presents the time series properties of the returns using the Augmented Dickey Fuller-ADF test with an intercept only. The absolute values of the test statistics of all the countries are greater than the 1% critical values, therefore, the null hypothesis of non-stationarity is rejected. The ADF test suggests that the returns of all the countries are integrated of order zero in the full sample. The optimum lag length suggested by the Schwarz's Bayesian Information Criterion using at most the lag length of eight is employed. In this study, the data displays structural changes (it seems to shift between regimes), and it also has high kurtosis. In such a case the ADF test has a low power-of-test, indicating a greater probability of giving a wrong answer. Thus, we apply the Phillip-Perron unit-root test (Panel D) and the results show that the returns series are stationary. It means that the returns series are integrated of order zero. This is because the returns have already been calculated by taking the log difference of the stock prices for each country.

Employing the Markov-switching model, we obtain another series for each country. These are the bear filtered probabilities for each country, and they are used to analyze the predictive ability of the USA returns and the USA bears, with respect to each country.

The Filtered Probabilities of Bear Markets

Markov-switching models are very widely applied in social sciences. This technique is used for series that are believed to transition over a finite set of unobserved states, this allows the process to evolve differently in each state. This transition occurs according to a Markov process. The time of this transition from one state into another state is random. The duration between changes in states is also random. Therefore, these models can be used to understand the process that may govern the time at which; for example, the economy transitions from expansion to recession and vice versa. Similarly, it can be used to understand the stock market bull and bear regimes. Despite the fact that one cannot know with certainty in which state the process lies, the probabilities of being in each state can be computed. In case of a Markov process, what is of greater interest are transition probabilities.

Using the stock returns data, a Markov-switching model with two states is employed to identify the bear and bull market regimes (Chen, 2009). In this model, the mean of the returns is r_t, and it is subject to switching between regimes. This shows that the mean in the bull regime is different from the mean of the stock return during a bear regime. Also, the error variance is presumed to be different across both the regimes. Thus, a Markov-switching model of the stock returns with two states, and varying means and variances are defined as:

$$r_t = \mu_{st} + \epsilon_t \quad (2)$$

Where ϵ_t $i.i.d.(0, \sigma_{st}^2)$, μ_{st} is the regime dependent mean and σ_{st}^2 is the regime dependent variance of the returns r_t. If $s_t = m$, the market is then in regime m. These regimes are classified into the bear and bull. This is such that when $s_t = 0$, the market will be in bear regime; similarly when $s_t = 1$, the market will be in the bull regime. In the bull regime, market conditions are optimistic, prices tend to be rising, it is a low variance state, thus, encourages buying. The stock market trade in high volumes reflects that the public tends to view the economy as getting stronger. In the bear regime, market conditions are pessimistic, investors anticipate losses, prices tend to fall, it is a high variance state and the market boards on a downward spiral. The bear regime makes it tougher for the investor to pick a profitable investment. Hence, the study focuses on the bear regime and its effects.

	Bear Mean μ_0	Bear Variance σ_0	Bull Mean μ_1	Bull Variance σ_1	Transition Probabilities ρ^{00}	Transition Probabilities ρ^{11}	Expected Duration Bear	Expected Duration Bull
Pakistan	-0.6 (0.0)	15.3 (0.0)	1.5 (0.7)	5.4 (0.0)	0.6	0.8	2.5	8.1
China	-1.7 (0.6)	19.5 (0.0)	0.3 (0.3)	6.5 (0.0)	0.9	0.9	26.2	51.6
India	-1.9 (0.2)	12.9 (0.0)	0.9 (0.0)	6.5 (0.0)	0.9	0.9	28.1	105.9
Malaysia	-0.8 (0.4)	10.2 (0.0)	0.9 (0.0)	3.2 (0.0)	0.9	0.9	24.1	46.1
Indonesia	-1.2 (0.4)	13.1 (0.0)	1.4 (0.0)	5.6 (0.0)	0.9	0.9	20.7	64.4
Thailand	-0.5 (0.6)	12.3 (0.0)	0.6 (0.0)	4.6 (0.0)	0.9	0.9	15.9	24.5
Singapore	-0.6 (0.3)	7.1 (0.0)	1.0 (0.0)	2.7 (0.0)	0.9	0.9	14.2	15.2
Philippine	-0.2 (0.7)	10.4 (0.0)	1.2 (0.0)	4.7 (0.0)	0.9	0.9	49.6	59.6
Taiwan	-3.7 (0.0)	10.9 (0.0)	0.8 (0.5)	3.7 (0.0)	0.9	0.9	56.5	38.6
Korea	-0.4 (0.7)	13.8 (0.0)	0.4 (0.1)	5.5 (0.0)	0.9	0.9	21.9	93.1
Japan	-4.6 (0.0)	10.4 (0.0)	0.1 (0.6)	5.2 (0.0)	0.8	0.9	9.5	109.4
USA	-0.9 (0.2)	6.4 (0.0)	1.3 (0.0)	2.8 (0.0)	0.9	0.9	13.7	28.5

Following these regime specifications, the stock returns thus follow a two-state Markov-switching process, that has the following transition-probability matrix:

$$p = \begin{bmatrix} p^{00} & p^{01} \\ p^{10} & p^{11} \end{bmatrix} \quad (3)$$

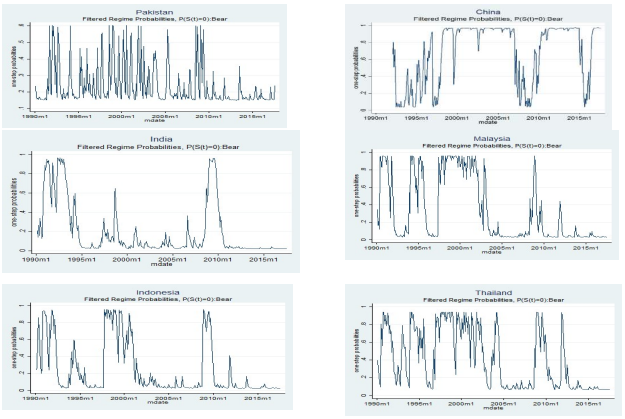
Where $p^{00} = p(s_t = 0 | s_{t-1} = 0)$ shows the probability that the market is in bear regime and $p^{11} = p(s_t = 1 | s_{t-1} = 1)$ reflects the probability that the market is in the bull regime. $p^{01} = 1 - p^{11}$ indicates the probability that the market is in bear regime and $p^{10} = 1 - p^{00}$ identifies the probability that the market is in the bull regime. The values of these probabilities that are closer to 1, signify a more persistent process, which is expected to remain in a given state for a long period of time. The filtered bear probabilities are calculated, once both the regimes have been statistically classified, using the two-state mean-variance switching Markov process. By obtaining filtered probabilities, the transition probabilities are calculated which shows the probability of the bull or bear in each month.

Markov-switching models' estimation is carried out by predicting the probabilities of unobserved states and updating the likelihood at each period, this is akin to the Kalman filter. While it can be seen that the Kalman filter is more concerned with making linear updates onto continuous latent variables, the filter that is developed in Hamilton (1989), is a non-linear algorithm which estimates probabilities of a discrete, latent variable being in one of the several states. Therefore, Hamilton (1989), is followed for the estimation of the Markov-switching model. This is done by an Expectation-Maximization (EM) algorithm which is a robust method to determine the reasonable starting values.

Table 1 exhibits the Markov-Switching model of r_t with two states for the USA and the Asian countries from January 1990 to August 2017. The mean and variance of r_t subject to regime switching is computed. During the bear regime, we see that the

Table 1: Markov-Switching model of the stock return series (r

Notes: This table reports the key statistics relating to the two-stage Markov-switching model for the USA and eleven Asian returns. The mean and the variance of returns (r_t) is subject to regime switching; μ_0 and σ_0 are the mean and variance of r_t in the bear regime whereas μ_1 and σ_1 correspond to the mean and variance of r_t in the bull regime. The parentheses contain the *p*-values. The transition probabilities, ρ^{00} and ρ^{11} relate to the bear and bull regimes, respectively. The expected duration of the two regimes is also provided in the last two rows.



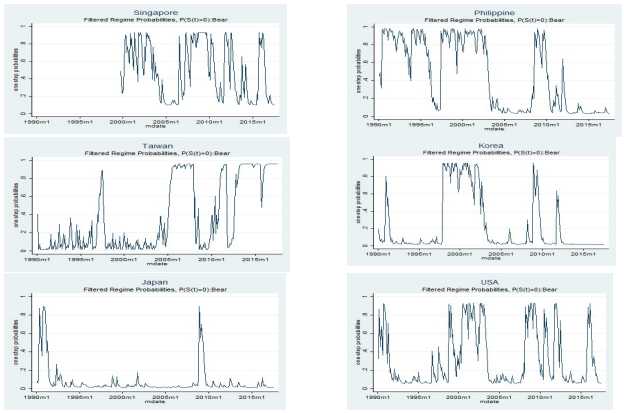


Figure 1: Filtered Probabilities of the Bear Markets

average returns of all the countries are less than the average returns during the bull regime. This phenomenon is consistent with prior studies (Psaradakis & Spagnolo, 2006; Moore & Wang, 2007; Walid et al., 2011). In the case of Pakistan, the average returns during a bull regime are 1.51% per month. These are the highest returns during a bull regime, amongst all the countries, followed by Indonesia, USA, Philippine, Singapore, Malaysia, India, Taiwan, Thailand, Korea, China, and Japan. However, the variance during the bull regime is highest for China, followed by India, Korea and then Pakistan. This shows that despite the fact that returns are highest for Pakistan, they still have high variance and can prove to be risky investments in this market. Singapore has the lowest variance of the returns during a bull regime, indicating that it is a safe investment. Overall, the bear market regimes are more volatile than the bull market regimes and this evidence is consistent with earlier studies (Chen 2009; Gander, 2011).

The transition probabilities for all the countries are quite high, indicating that the countries tend to remain in a regime once they have entered it. However, the transition probabilities of Pakistan are relatively less persistent, this phenomenon can be observed in the filtered probability (Fig. 1) where the Pakistan Stock Exchange shows sudden spikes of the bull regime and these spikes tend to go back into bear regime quickly. This behavior is consistent with previous studies (Ahmed and Rosser, 1995; Ali and Afzal, 2012), that this market tends to react to sudden triggers that may perhaps be manipulative maneuvers in the control of some big, influential players of the market.

The expected duration of the bull and bear regimes are relatively higher than expected, however, it is consistent with prior studies (Guidolin 2016; Maheu, McCurdy & Song, 2012). The expected duration of a bear and bull regimes in Pakistan is 2.5 and about 8 months respectively. These are the lowest durations amongst all the countries. This is consistent with the results of transition probabilities of Pakistan since the regimes tend to transition from a bull to bear and vice versa, relatively faster, than for any other country.

Appendix 2 presents the descriptive statistics and the preliminary analysis of the second series of data that will be used in the predictive model, i.e., the bear regime filtered probabilities. The summary statistics of the bear series are

presented in Panel A because it is used as a dependent variable in two versions of the predictive model. This series has the highest average value in the case of Pakistan and the lowest for Japan. The series is most volatile for Japan and least volatile in Pakistan. The ARCH LM test using twelve lags shows (Panel B) the results of ARCH in the series of the USA and all Asian countries except Pakistan. The ADF test suggests that series for Pakistan, Indonesia, Thailand, Taiwan, Japan, and the USA are stationary (Panel C), whereas the Phillip-Perron test indicates the stationarity for the series of all countries except Philippine and Taiwan.

The filtered probabilities of the bear regimes of the USA and the Asian countries are graphically presented in Figure 1. They clearly demonstrate the transitioning features of the markets and the stock market cycles. The graphs present as the market enters the bear regime then the probability approaches to 1. On the other hand, as the bull regime probability increases the blue line which tends to zero. In the case of Pakistan, the market is usually in a bull state, however, spikes indicate that it suddenly transitions from bull regime into the bear regime. This phenomenon can be explained by this movement of the stock market cycle of Pakistan. Japan, as can be seen from the graph is a fairly stable market, with regard to its regimes, it tends to remain in the bull regime, more than any of the other country. This figure is consistent with the expected duration which shows that Japan has the highest expected duration of the bull regime throughout the sample period. Japan seems to be very negligibly affected by the 1997 Asian crisis whereas the 2008 financial crisis did hit hard, however, Japan was able to recover from it quickly, unlike the USA and most of the rest of the Asian countries.

Correlation between the Returns and Bear Series

This section presents the results obtained by means of a correlation exercise conducted in order to examine the correlation between the USA and the Asian returns as well as the bear regime probabilities. The series of the predictor variables, the USA bears and the filtered bear regime probability of USA, are both lagged once. Appendix 3 presents the correlation coefficient and the corresponding *p*-values for the test which has the null hypothesis of no correlation.

In the sample, it seems that the lag USA returns are positively and significantly correlated with the returns of India and Indonesia only. There seems to be no correlation between the lag USA bear probabilities and the Asian returns. Similarly, the Asian bears are not correlated with the USA returns either, except for Singapore, Korea, and Japan. Finally, the results indicate that the USA bears are correlated with Asian bears. This means that a bear regime in the USA will tend to cause the Asian markets to transition into a bear regime as well, despite the USA returns and Asian returns not being correlated. All of the Asian bears are correlated with the USA bears positively except Pakistan and Taiwan. It would seem that if the USA market goes into a bear regime the market of Pakistan transitions to a bull regime, allowing for arbitrage opportunities and profitability. This further reinforces our findings that the Pakistan market moves almost independently of the external facts that the rest of the Asian markets sway to (Ali & Afzal, 2012). Overall, the results show greater evidence for a correlation between the USA bear markets and the Asian bear markets only, whereas the rest of the scenarios are mostly uncorrelated.

Endogenity Test

The endogeneity test is conducted prior to analyzing predictability exercise to verify whether the predictor, that is, the returns of the USA or the bear market probabilities of USA are exogenous in all the four scenarios of equation (5). The test is performed on each of the four specific forms for the eleven countries of Asia.

Following is the regression on which the endogeneity test is based:

$$\varepsilon_t = b_0 + b_1 u_t + w_t \qquad (4)$$

Where ε_t are the errors obtained through the predictive model, u_t are the errors obtained through the first-order autoregressive model of USA returns or USA bear market filtered probabilities, b_0 and b_1 are the estimated parameters, and w_t is the error term.

The endogeneity test investigates the null hypothesis that $b_1 = 0$. The stock returns of the USA or the filtered probabilities of the bear market of the USA are considered to be endogenous if the null hypothesis is rejected. The results are presented in Appendix 4. The endogeneity of the USA returns is measured through the Asian stock returns. Panel A shows that the USA returns are exogenous and not endogenous. While in Panel B, the USA bears are exogenous but not endogenous. Panel C reports that the USA returns are exogenous and not endogenous whereas Panel 4 posits that the USA bears are exogenous and not endogenous. Thus, the endogeneity exercise demonstrates that the independent variable (USA returns or USA bears) is not endogenous in all the versions of the predictive model. Therefore, we proceed with the estimation of the predictive model.

Nevertheless, given that there do exist correlations and that they are statistically different than zero, the predictability of the Asian markets is examined using the USA returns and the probabilities of USA bear market with the null of no predictability. The OLS, as well as the Feasible Generalized Least Squares (FGLS) methods of estimation, are employed. When there are heteroscedasticity and autocorrelation in the series, OLS does not remain as efficient, therefore, we also apply the FGLS estimation.

THE PREDICTIVE MODEL

The general form of the predictive regression model is expressed as:

$$Y_{it} = \alpha + \beta X_{US,t} + \varepsilon_t \qquad (5)$$

Where Y_t is either the returns of an Asian country or the filtered bear probabilities of an Asian country's market, $X_{US,t}$ are the returns of the USA (r_t) or the filtered bear probabilities of the bear; and ε_t is the error term. The null hypothesis is that $\beta = 0$.

Equation (5) is used with four different versions to make the predictability analysis: (a) an Asian country's market is

predicted using the USA returns, (b) an Asian country's market is predicted using the USA bear market probabilities, (c) an Asian country's bear market is predicted using the USA returns, and (d) an Asian country's bear market probability is predicted using the USA bear market probability.

The β is estimated using two estimation techniques (the OLS and the FGLS). The FGLS technique is used since the data has a lot of variation in it, in some cases it is non-stationary and in some cases there seem to exist heteroscedasticity. So instead of assuming the structure of heteroscedasticity, we may estimate the structure of heteroscedasticity from OLS, thus using FGLS, in an effort to obtain better results. The FGLS estimation is applied by first, taking the log of the square of the residuals from the predictive model. These logged-squared-residuals are then regressed onto the independent variable (the USA returns or the USA bears) to extract the sample-squared-residuals (esqhat). A new variable (omega) is then generated, by taking the exponentiation of the sample-squared-residuals (esqhat). Next, a weight (w) is generated, such that the weight (w) is, w=1/(omega) ^ 0.5, this weight (w) is then multiplied with the dependent as well as the independent variables to generate the weighted variables. Finally, the new weighted-dependent-variable is regressed onto the weighted-independent variable as well as the weight (w) to obtain the FGLS estimates. Table 2 reports the results of all the four different versions of Equation (5).

In Panel A, the predictability of the returns of Asian markets is tested by using the returns of the USA as a predictor. The returns of the USA are found to be a significant predictor for almost all the Asian stock market returns. The relationship is positive and significant for countries except for India. In all of the Asian countries, an increase in the stock market returns of the USA leads to a rise in the stock market returns of the Asian market in the next period. Amongst all of the Asian market returns examined, returns of Korea are found to be most sensitive to changes in the USA returns, which is consistent with reported literature. All of the Asian returns show the sensitivity of less than 1% to change in the USA returns. The stock market returns of India seem to show the least sensitivity. These results are consistent in both the OLS and the FGLS approaches. This is despite the fact that in the correlation exercise, there seemed to exist little evidence for correlation.

Panel B shows the results for the predictability of the returns of Asian markets by using the filtered probabilities of the USA. The USA bear market probabilities can predict the returns of India and Japan only whereas for the rest of the countries it is not a significant predictor. The coefficient is negative which implies that higher probability of the USA market being in the bear regime, decreases the returns of India and Japan. Panel C presents the findings of whether the Asian market bears can be predicted using the USA returns. The statistics show that the USA returns are unable to predict the Asian markets bear probability. Fig 1 shows significant and negative results for Singapore only, and that too of little magnitude, showing that an increase in the USA returns decreases the chances of the Singapore market being in the bear regime.

Panel D demonstrates as to whether the USA bear markets can predict the Asian bear markets, in this case, the bear filtered probabilities of the USA and the Asian countries are used. It can be seen from the results that the USA bear markets can, in fact, predict the Asian bear markets. The results are significant for all the countries, except India and China. Thus, showing that the USA bear is a strong predictor of the Asian.

Table 2: Empirical estimation of the predictive model

	Pakistan	China	India	Malaysia	Indonesia	Thailand	Singapore	Philippine	Taiwan	Korea	Japan
Panel A: USA returns predict Asian returns											
OLS	0.38*	0.38*	0.09	0.55*	0.81*	0.77*	0.66*	0.74*	0.72*	0.94*	0.62*
(*t*-statistic)	3.57	2.42	0.88	7.29	9.06	7.76	10.68	8.39	7.05	11.15	9.73
(*p*-value)	0.00	0.02	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FGLS	0.36*	0.32	0.06	0.54*	0.79*	0.72*	0.66*	0.72*	0.72*	0.91*	0.58*
(*t*-statistic)	3.46	1.84	0.62	6.71	8.44	6.52	10.46	7.77	6.80	9.94	8.51
(*p*-value)	0.00	0.07	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Panel B: USA bear predicts Asian returns											
OLS	-1.88	-3.25	-3.24*	-0.09	-1.73	0.68	-1.58	-1.20	-1.59	0.18	-2.81*
(*t*-statistic)	-1.18	-1.40	-2.22	-0.07	-1.20	0.43	-1.38	-0.85	-1.00	0.13	-2.71
(*p*-value)	0.24	0.16	0.03	0.94	0.23	0.66	0.17	0.40	0.32	0.90	0.01
FGLS	-2.01	-3.21	-2.94	0.28	-1.10	1.08	-1.40	-1.16	-1.33	0.10	-2.50*
(*t*-statistic)	-1.29	-1.42	-1.76	0.19	-0.63	0.64	-1.04	-0.75	-0.64	0.06	-2.01
(*p*-value)	0.20	0.16	0.08	0.85	0.53	0.53	0.30	0.46	0.52	0.95	0.05
Panel C: the USA returns predict Asian bear											
OLS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(*t*-statistic)	-0.25	1.00	0.06	-0.80	0.77	-0.07	-1.08	-0.53	0.72	-0.31	-0.65
(*p*-value)	0.80	0.32	0.95	0.426	0.44	0.94	0.28	0.60	0.48	0.76	0.52
FGLS	0.00	0.00	0.00	-0.01	0.00	0.00	-0.01*	0.00	0.00	0.00	0.00
(*t*-statistic)	0.03	0.83	-0.77	-1.14	-0.62	-0.55	-2.69	-0.20	0.70	-0.12	-0.12
(*p*-value)	0.98	0.41	0.44	0.25	0.54	0.58	0.01	0.85	0.49	0.91	0.91
Panel D: USA bear predicts Asian bear											
OLS	-0.05*	0.11	0.09	0.47*	0.31*	0.30*	0.69*	0.42*	-0.52*	0.56*	0.18*
(*t*-statistic)	-2.27	1.69	1.72	7.68	5.88	5.21	15.45	6.30	-8.08	11.21	6.89
(*p*-value)	0.02	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FGLS	-0.05	0.11	0.09	0.49*	0.37*	0.30*	0.67*	0.42*	-0.44*	0.66*	0.17*
(*t*-statistic)	-1.80	1.66	1.54	6.87	5.30	5.09	16.77	6.82	-7.62	7.18	5.68
(*p*-value)	0.07	0.10	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Table 7 reports the predictability of the eleven Asian markets returns and bears, by using the USA returns and USA bears. The period from January 1990 to August 2017 used. The standard OLS and the FGLS estimation methods are made use of to estimate β (Equation 1) in the four scenarios specified from Panel 1-4. The *t*-statistics associated with the null hypothesis that β=0, and the *p*-values are also reported. * shows statistical significance at the 5 percent level.

markets, Singapore is the most sensitive to change in the USA bear markets, whereas, Pakistan is the least sensitive. All the Asian countries show a positive relationship, however, contrary to expectation, results show a negative relationship in the case of Pakistan and Taiwan. This evidence suggests that an increase in the chances of the USA market being bear reduces the chances of Pakistan and Taiwan markets being bear. Nonetheless, for the rest of the Asian countries, the relationship

is positive which indicates that an increase in the chances of the USA market being bear increases the chances of these markets going bear.

CONCLUSIONS

The present study tests the predictability of the emerging stock markets of Asia using the returns of the USA and the filtered probabilities of the USA market being in the bear regime as the predictor. This study evaluates eleven Asian countries namely; Pakistan, China, India, Malaysia, Indonesia, Thailand, Singapore, Philippine, Taiwan, Korea, and Japan. The mean-variance Markov-switching models with two states are employed to generate the probabilities of bear regimes for each market. Four different versions of this predictive one-step-ahead model are regressed. Each different version examines whether the USA returns or bears are able to predict returns of Asian markets or bears of Asian markets. The predictive models are estimated using OLS and FGLS techniques. The FGLS approach accounts for the heteroscedasticity and persistence of the predictors and the ARCH effects. According to the predictive model, the USA returns are able to predict the returns of Asian markets. The USA bear market is also very well able to predict Asian bears. However, the USA bears are only able to predict returns of India and Japan whereas the returns of the USA can predict the bear market of Singapore only.

The policy implications of this study are quite wide and diverse. It can be concluded that Pakistan does exhibit bull and bear regimes in its market and that the switching between regimes has implications for the returns and the volatility of the market. Effective policymaking and implementation are required to consider the characteristics of the market for the best use of the country. Similarly, the bear regime probabilities show that the country tends to make sudden switches between the regimes and that the duration is relatively not as persistent as the other Asian markets and the USA. Furthermore, the transition probability is higher for the bull regime as compared to the bear regime. This means that once the country enters into the bear regime, it will come out of it faster than it will come out of the bull regime. Finally, we observe that the USA returns are able to predict Pakistan stock returns, even though the correlation exercise did not show evidence for correlation, this aspect of the market can further be explored and analyzed. The USA bears are able to predict the Asian bears, which is consistent with the correlation exercise.

REFERENCES

Ahmed, E., & Rosser, J. B. (1995). Non-linear speculative bubbles in the Pakistani stock market. *The Pakistan Development Review*, *34*(1), 25-41.

Ali, R., & Afzal, M. (2012). Impact of the duration of the global financial crisis on stock markets: Evidence from Pakistan and India. *Journal of Business Management and Economics, 3*(7), 275-282.

Allen, F., & Gale, D. (1995). A welfare comparison of intermediaries and financial markets in Germany and the US. *European Economic Review, 39*(2), 179-209.

Bae, K. H., Karolyi, G. A., & Stulz, R. M. (2003). A new approach to measuring financial contagion. *The Review of Financial Studies, 16*(3), 717-763.

Bahrami, A., Shamsuddin, A., & Uylangco, K. (2018). Out-of-sample stock return predictability in an emerging market. *Accounting & Finance, 58*, 727-750.

Boyer, B. H., Kumagai, T., & Yuan, K. (2006). How do crises spread? Evidence from accessible and inaccessible stock indices. *The Journal of Finance, 61*(2), 957-1003.

Campbell, J. Y., and M. Yogo. 2006. Efficient tests of stock return predictability. *Journal of Financial Economics, 81*(1), 27-60.

Caporale, G. M., Howells, P. G., & Soliman, A. M. (2004). Stock market development and economic growth: the causal linkage. *Journal of Economic Development, 29*(1), 33-50.

Chen, S. (2012). The predictability of aggregate Japanese stock returns: Implications of dividend yield. *International Review of Economics & Finance, 22*(1), 284-304.

Chen, S. S. (2009). Predicting the bear stock market: Macroeconomic variables as leading indicators. *Journal of Banking & Finance 33*(2), 211-223.

Cheung, Y. L., & Mak, S. C. (1992). The international transmission of stock market fluctuation between the developed markets and the Asian-Pacific markets. *Applied Financial Economics, 2*(1), 43-47.

Chiang, T. C., Jeon, B. N., & Li, H. (2007). Dynamic correlation analysis of financial contagion: Evidence from Asian markets. *Journal of International Money and Finance, 26*(7), 1206-1228.

Choudhry, T. (2004). International transmission of stock returns and volatility: Empirical comparison between friends and foes. *Emerging Markets Finance and Trade, 40*(4), 33-52.

Demirtas, K. O., & Zirek, D. (2011). Aggregate earnings and expected stock returns in emerging markets. *Emerging Markets Finance and Trade, 47*(3), 4-22.

Gander, J. P. (2011). Equity valuation under bull and bear market regimes in South East Asia firms: A switching regression approach. *Applied Economics, 43*(7), 837-844.

Guidolin, M. (2016). Modeling, estimating and forecasting financial data under the regime (Markov) switching. Retrieved from http://didattica. unibocconi. it/mypage/dw load.php.

Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica, 57*(2), 357-384.

Hoque, H. A., Kim, J. H., & Pyun, C. S. (2007). A comparison of variance ratio tests of the random walk: A case of Asian emerging stock markets. *International Review of Economics & Finance, 16*(4), 488-502.

Hsiao, F. S. T., M. W. Hsiao, & A. Yamashita (2003). The impact of the US economy on the Asia-Pacific region: Does it matter? *Journal of Asian Economics, 14*(2), 219-241.

Kim, S., J. W. Lee, & C. Y. Park (2011). Emerging Asia: Decoupling or recoupling. *The World Economy, 34*(1), 23-53.

Levine, R., & Zervos, S. (1996). Stock market development and long-run growth. *The World Bank Economic Review, 10*(2), 323-339.

Li, X., & B. Zhang (2013). Spillover and Co-jumps between the US and Chinese stock markets. *Emerging Markets Finance & Trade, 49*(2) 23-42.

Maheu, J. M., McCurdy, T. H., & Song, Y. (2012). Components of bull and bear markets: Bull corrections and bear rallies. *Journal of Business & Economic Statistics, 30*(3), 391-403.

McMillan, D. G. (2016). Stock return predictability and market integration: The role of global and local information. *Cogent Economics & Finance, 4,* 1-18.

Moore, T., & Wang, P. (2007). Volatility in stock returns for new EU member states the Markov regime switching model. *International Review of Financial Analysis, 16*(3), 282-292.

Narayan, S., & Rehman, M. U. (2017). Diversification opportunities between Emerging and Frontier Asian (EFA) and developed stock markets. *Finance Research Letters, 23*, 223-232.

Narayan, S., & Narayan, P. K. (2012). Do US macroeconomic conditions affect Asian stock markets? *Journal of Asian Economics, 23*(6), 669-679.

Psaradakis, Z., & Spagnolo, N. (2006). Joint determination of the state dimension and autoregressive order for models with Markov regime switching. *Journal of Time Series Analysis, 27*(5), 753-766.

Ramchand, L., & Susmel, R. (1998). Volatility and cross correlation across major stock markets. *Journal of Empirical Finance, 5*(4), 397-416.

Walid, C., Chaker, A., Masood, O., & Fry, J. (2011). Stock market volatility and exchange rates in emerging countries: A Markov-state switching approach. *Emerging Markets Review, 12*(3), 272-292.

Yang, J., Kolari, J. W., & Min, I. (2003). Stock market integration and financial crises: The case of Asia. *Applied Financial Economics, 13*(7), 477-486.

Appendix 1: Summary statistics of the USA and the eleven Asian stock markets returns (r_t)

	Pakistan	China	India	Malaysia	Indonesia	Thailand	Singapore	Philippine	Taiwan	Korea	Japan	USA
Panel A: Descriptive Statistics												
Mean	1.31	0.80	1.13	0.34	0.81	0.18	0.20	0.59	0.02	0.29	-0.17	0.61
SE(mean)	0.49	0.71	0.45	0.36	0.44	0.48	0.38	0.43	0.49	0.44	0.32	0.25
Max	35.68	94.04	41.71	27.98	32.16	39.78	18.15	35.77	42.41	32.39	16.39	11.44
Min	-53.88	-46.96	-23.07	-28.79	-39.56	-32.04	-20.63	-33.44	-47.90	-39.04	-24.48	-27.65
SD	8.88	12.45	8.16	6.59	8.07	8.72	5.51	7.88	8.87	8.00	5.85	4.48
Skewness	-1.05	1.68	0.22	-0.20	-0.68	-0.06	-0.11	-0.11	-0.41	-0.20	-0.43	-1.26
Kurtosis	10.30	15.58	4.74	7.14	7.22	5.82	4.70	6.54	8.65	5.83	4.49	8.15
CV	6.75	15.64	7.20	19.12	9.97	49.41	27.42	13.25	361.99	-27.30	-33.91	7.34
JB prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Observations	331	307	331	331	331	331	215	331	331	331	331	331
Panel B: ARCH (12)												
Statistic	10.23	104.21	43.58	88.12	67.59	46.36	60.62	26.64	26.46	42.82	9.58	37.31
Prob	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.65	0.00
Panel C: ADF Test												
Statistic	-5.09	-5.23	-6.44	-5.21	-6.37	-5.65	-5.05	-7.03	-8.79	-5.45	-6.63	-5.66
Prob	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Panel D: Phillip-Perron Test												
Statistic	-17.04	-17.44	-16.15	-16.36	-14.74	-16.69	-13.49	-16.15	-16.46	-16.85	-16.15	-18.05
Prob	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes: The descriptive statistics for the 12 counties are reported in Table 1. Panels 1 presents the preliminary analysis relating to the full and the forecasting samples. Panel 2 elaborates the LM test statistics using 12 lags. The time series properties of stock returns are tested using the ADF test in Panel 3. The conventional ADF test was conducted with an intercept only. The size of optimal lag length relies on the Schwarz criterion (SC) with a maximum of 8 lags. Panel 4 describes the Phillip-Perron unit-root test statistic.

Appendix 2: Filtered Probabilities of Bear Markets: Descriptive Statistics

	Pakistan	China	India	Malaysia	Indonesia	Thailand	Singapore	Philippine	Taiwan	Korea	Japan	USA
Panel A: Descriptive Statistics												
Mean	0.24	0.68	0.20	0.33	0.24	0.40	0.49	0.46	0.37	0.22	0.07	0.32
Skewness	1.85	-0.760	1.72	0.76	1.31	0.44	0.12	1.14	0.61	1.37	4.00	0.91
Kurtosis	5.37	1.89	4.54	1.80	3.11	1.53	1.41	1.21	1.58	3.14	18.71	2.22
CV	0.52	0.52	1.45	1.12	1.31	0.83	0.64	0.86	1.05	1.49	2.16	0.96
JB prob.	0.00	0.00	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00
Panel B: ARCH (12)												
Statistic	15.06	164.26	278.56	191.46	251.25	151.10	65.65	221.96	229.67	226.13	174.70	170.28
Prob	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Panel C: ADF Test												
Statistic	-5.36	-2.96	-3.33	-3.14	-3.41	-4.374	-2.70	-3.25	-3.82	-2.34	-6.02	-3.65
Prob	0.00	0.14	0.06	0.10	0.05	0.00	0.24	0.07	0.02	0.41	0.00	0.03
Panel D: Phillip-Perron Test												
Statistic	-10.95	-3.23	-2.92	-3.29	-3.49	-4.27	-3.93	-2.40	-2.52	-2.90	-5.02	-4.54
Prob	0.00	0.02	0.04	0.02	0.01	0.00	0.00	0.14	0.11	0.05	0.00	0.00

Notes: The table contains the descriptive statistics for the filtered bear market probabilities only. The ARCH test (at twelve lags); and the ADF test (with an intercept-only; lag length determined SC by the maximum lag of eight) are presented. The Phillip-Perron test for unit-root is presented in Panel D.

Appendix 3: Correlation between the USA returns (and bears) and Asian (returns and the bear markets)

Returns	LagUSA	LagUSA_Bear	Bear markets	LagUSA	LagUSA_Bear
Pakistan	0.0292	0.0281	Pakistan_Bear	-0.0044	-0.1372*
	0.5972	0.6115		0.9370	0.0126
China	-0.0076	-0.0667	China_Bear	0.0738	0.1248*
	0.8947	0.2438		0.1971	0.0288
India	0.3158*	-0.0583	India_Bear	-0.0354	0.1124*
	0.0000	-0.0583		0.5217	0.0414
Malaysia	0.0381	-0.0056	Malaysia_Bear	-0.0874	0.3752*
	0.4903	0.9188		0.1131	0.0000
Indonesia	0.1527*	-0.0062	Indonesia_Bear	-0.0406	0.3188*
	0.0054	0.9111		0.4624	0.0000
Thailand	0.1047	0.0764	Thailand_Bear	-0.0337	0.2674*
	0.0575	0.1664		0.5419	0.0000
Singapore	0.1034	-0.0539	Singapore_Bear	-0.2014*	0.6811*
	0.1305	0.4314		0.0030	0.0000
Philippine	0.0927	0.0144	Philippine_Bear	-0.0748	0.3179*
	0.0926	0.7947		0.1752	0.0000
Taiwan	0.0283	-0.0336	Taiwan_Bear	0.0937	-0.3921*
	0.6091	0.5429		0.0891	0.0000
Korea	-0.0248	0.0283	Korea_Bear	-0.1126*	0.5071*
	0.6542	0.6079		0.0409	0.0000
Japan	0.0941	-0.1070	Japan_Bear	-0.1873*	0.3496*
	0.0878	0.0521		0.0006	0.0000

Notes: This table presents the correlation analysis between USA returns and bears, and the returns and the bear markets of Asia. The results suggest no correlation between variables. LagUSA and LagUS_Bear denote the USA returns and the probability that the USA market is bear, respectively. Both are lagged once.

Appendix 4: The Endogeneity Test

	Pakistan	China	India	Malaysia	Indonesia	Thailand	Singapore	Philippine	Taiwan	Korea	Japan
Panel A: USA returns predict Asian returns											
b_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-Statistic	0.00	0.00	-0.05	-0.01	-0.03	-0.02	-0.02	-0.02	0.00	0.00	-0.02
p-value	1.00	1.00	0.96	1.00	0.98	0.99	0.99	0.99	1.00	1.00	1.00
Panel B: USA bear predicts Asian returns											
b_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-Statistic	0.00	-0.01	0.01	0.01	0.01	0.01	0.03	0.01	-0.01	0.02	0.03
p-value	1.00	0.99	1.00	1.00	1.00	1.00	0.98	0.99	1.00	1.00	1.00
Panel C: the USA returns predict Asian bear											
b_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t-Statistic	0.00	-0.01	0.01	0.01	0.01	0.01	0.03	0.01	-0.01	0.02	0.03
p-value	1.00	0.99	1.00	1.00	1.00	1.00	0.98	0.99	1.00	1.00	1.00
Panel D: USA bear predicts Asian bear											
b_1	0.04	-0.19	-0.10	-0.15	-0.19	-0.10	-0.13	-0.15	0.17	-0.10	-0.07
t-Statistic	0.94	-1.32	0.98	-1.17	-1.68	-0.86	-1.27	-1.04	1.25	-1.76	-1.34
p-value	0.35	0.19	0.33	0.24	0.10	0.39	0.21	0.30	0.21	0.08	0.18

Notes: The endogeneity of the predictor (the USA returns or the USA bears) is tested. The endogeneity test is based on the regression $\varepsilon_t = b_0 + b_1 u_t + w_t$, where ε_t captures residuals from the predictive regression models (Equation 1) and u_t is the residual series from the first-order autoregressive model of the USA stock return (or filtered probabilities that the USA market is bear); b_0 is the intercept; and w_t is the error term. The endogeneity test examines the null hypothesis that $b_1 = 0$. The USA stock returns or filtered probabilities are endogenous if the null is rejected.