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EMH, Random Walk Theory, and Predicting Stock Returns
for Firms Listed on the Korean Stock Market

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EMH, Random Walk Theory, and Predicting Stock Returns for Firms Listed on the Korean Stock Market

(Online submission Copy)
Abstract

We study capital market efficiency because results may infer that there are predictable properties of the time series of prices of traded securities on the organized market in Korea.

We examine the weak form of the efficient markets hypothesis to indicate its usefulness in terms of the results of this study. You will note from the results that the model identifies predictive short-term properties existing in the data of stock returns. We limit our conclusions to those firms and exchanges studied and the time period covered.
**Introduction and Purpose**

*Random Walk Theory* states that a wise investor who throws darts at the stock listings pages of the New York Times has as good a chance to outperform the market as any professional investor. The theory first set down by the mathematician Louis Bachelier (1900) received a modern interpretation by the economist Burton Malkiel in his well-known book, *A Random Walk down Wall Street*. Those who adhere to the theory consider it futile to search for shares of firms who are thought to be undervalued or to predict future movements in the prices and/or returns from these same securities. New developments reflect themselves in the prices of securities and random walk followers believe it impossible to predict these events and all that investors can do is to accept the hypothesis of “efficient capital markets”, often referred to as **EMH**.

Theorists (Fama, 1957, 1970, and Fama and French, 1989) define three different levels of efficiency according to the type of information reflected in share prices and/or returns. The three levels of market efficiency entitled “weak-form, semi-strong-form, and strong form” require different levels of information to test. The weak form efficiency test example examines the wide range of trading rules available to common investors. Some theorists try to convince with the weight of academic opinion that the weak-form of EMH is acceptable. We cannot predict the future of share prices and returns in any abnormally profitable way.

Fama (1970) defined the weak-form by focusing on three points:

1. tests for return predictability
2. event studies
3. tests of private (often referred to as insider) information

In this study, we focus on return predictability. Studies such as Lo and Mackinlay (1988) found positive autocorrelations for share prices. Conrad and Kaul (1993) after correcting for non

In this study, we will study daily returns for a huge number of firms listed on the Korean stock exchange and this markets time series contains properties, which one can measure, model and use for prediction. With enough time, patience and understanding of the mathematics of the underlying processes that give rise to a financial time series, forecasters can properly model these time series. The results permit management scientists, financial and economic forecasters to view time series of returns of listed securities as not random and having daily affects.

When these properties in security returns exist, one may identify and forecast patterns in financial data, and, in turn, investors may benefit from this information. Furthermore, the results will indicate that the weak form of the efficient markets hypothesis is in question when one must
make decisions concerned with investing in stock market securities. Daily variation is neither random nor stochastic and possibilities exist to predict daily patterns with some degree of accuracy. Although the literature on larger Asian stock exchanges is lengthy [Kato, K. (1990a and 1990b), Kubota, K. and Takahara, H. (2003), Moorkejee, R. and Yu, Q. (1999), Ray, B., Chen S. and Jarrett, J.E. (1997), and Rothlein, C.J. and Jarrett, J.E. (2002)], there is not much literature concerning the smaller Asian markets. This is in part due to their emerging status and the notion that index prices for these markets correlate with index prices of the larger Asian markets. Recently, a summary of the characteristics and problems faced by the smaller Pacific-Basin stock markets is summarized in Commerton-Forde and Ridge (2006) where they review the market microstructure of the ten Asia-Pacific stock exchanges. They contend that although the objectives of market efficiency and integrity are unanimously sought by exchanges, the path to achieving them is not clear. In this study, we examine data to indicate whether market efficiency (weak-form) presently exists in the four small members of this group.

**Methodology and Data Collection**

The predictive model for measuring the effects of changes in the day of the week on closing prices of a security is

\[
Y = \beta_0 + \beta_1 W_1 + \beta_2 W_2 + \beta_3 W_3 + \beta_4 W_4 + \beta_5 W_5 + \epsilon 
\]

(Model 1)

where \(Y\) = daily return for the security

- \(W_2\) = dummy variable for Tuesday (1 or 0 when not Tuesday)
- \(W_3\) = dummy variable for Wednesday (1 or 0 when not Wednesday)
- \(W_4\) = dummy variable for Thursday (1 or 0 when not Thursday)
- \(W_5\) = dummy variable for Friday (1 or 0 when not Friday)
- \(\epsilon\) = error term with mean of zero, and
\[ b_0 = \text{intercept of model}. \]

Note we borrow from the methodology employed by Jarrett and Kyper (2006) in their study of firms listed in United States Stock Exchanges and from Jarrett (2007) in his study on the Hong Kong Exchanges. We collected data on firms listed on the Stock Exchange of Singapore (SES) from 1975 through 1998. It was formed in 1973, when the termination of currency interchangeability between Malaysia and Singapore, caused the Stock Exchange of Malaysia and Singapore (SEMS) to separate into the SES and The Kuala Lumpur Stock Exchange Board (KLSEB). It merged with the Singapore International Monetary Exchange (SIMEX) on December 1, 1999, to form the Singapore Exchange (SGX). The data for the over four hundred listed firms of the SGX are from the Pacific Basin Financial Markets Research Center (PACAP) at the University of Rhode Island.

The Korean Stock Exchange (KSE) established in 1956 became the Korea Exchange (KE) in 2005 after years of merging service to integrate the trading of REITs creating of stock market indexes, cooperation with KOSDAQ (the Korea NASDAQ trading platform) and other activities making it a full market trading establishment. KE contains over eight hundred eighty listed firms for trading. Data for this exchange came from the same source (PACAP) for the years 1977 through 2001. From 1977 through 1998; Saturday trading existed for this exchange.

Based on the size of this exchanges and the number of trading days in a year, we concluded that there is sufficiently large enough sample sizes for extensive year by year analysis of the predictability of stock market returns. We concluded that sufficient data was available for an extensive analysis and no other sources of data were available for these markets in sufficient size. PACAP collects the data from the stock exchanges themselves so their data is the same as if
one were to follow the end of day data for each trading day of the year for each exchange. The methodology for reporting these data are thus the same as if the researchers collected the data themselves on a day-to-day basis. Since the KSE traded on Saturday (until 1999), we added another dummy variable $W_6$ in the model for years 1975 through 1999 for the Saturday trading day. The coefficient $b_6$ would be the regressive coefficient for $W_6$.

In addition, we considered a second predictive based on data available from our source as follows (Model 2):

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6(\text{trdvol}) + b_7(\text{trdval}) + \varepsilon$$

where $Y =$ daily return for the security  

$X_2 =$ dummy variable for Tuesday (1 or 0 when not Tuesday)  

$X_3 =$ dummy variable for Wednesday (1 or 0 when not Wednesday)  

$X_4 =$ dummy variable for Thursday (1 or 0 when not Thursday)  

$X_5 =$ dummy variable for Friday (1 or 0 when not Friday)  

(trdvol) = variable for volume of daily trade in units  

(trdval) = variable for value (in currency) of daily trade  

$\varepsilon =$ error term with mean of zero, and  

$b_0 =$ intercept of model.

The second permits further explanation of the sources of variation in daily stock market returns. Hence, our research will show if the sources of variation in daily returns are days of the weeks with and without other sources of variations in returns. Again, since the KE traded on Saturday
until 2000, the model contained another dummy variable $W_6$. Last, a summary of the characteristics of the data bases appear in the Appendix.

**Results**

Estimations for the ordinary least squares (OLS) models for the KE time series data sets produced results noted in Table 1 for the response variable daily returns (dretwd). For the Korean data, the tests for significance of the dummy variable for day of the week indicated some very important results. The computed p-values were for the most part very close to 0 for most of the coefficients of the dummy variables in each regression. Fifteen of the twenty-eight exceptions (28) occurred in four separate years, 1978, and 1984 through 1986. Hence, only thirteen instances of dummy variable coefficients were not significant out of a total 105 parameter estimates. The F-values for overall regression were significant at very small p-values for all years studied except 1986 and the DW statistics were sufficiently large to conclude that no serial autocorrelation is present. Again, these results indicate that for the KE that each day of the week has a separate regression resulting in five parallel lines when plotted on a time series graphs. The KE market included a Saturday trading day for years thought 1998 and it contained a parameter estimate that was significant except for year 1986. We cannot be certain as to the reasons for the change in 1986, but a brief review of South Korean financial history may explain the large deviation in that year. The Korean government in the mid-1980’s began to phase out the policy of tightly controlling the finance industry, banks kept on allocating large chunks of financial resources to *Chaebols*. These firms were conglomerates who started as general trading companies to build the industrial capacity in South Korean. Korean banks deemed the *Chaebols* as ‘better’ or preferred borrowers. By the mid-1980’s most *Chaebols* had grown very big and were able to generate substantial amounts of revenue. The sheer size of their assets and revenue
generating capacities made most Chaebols a relatively safe bet for the banks. On top of this, there existed an implicit understanding that the government would readily bailout a bank or a Chaebol whenever any of them got into trouble. This ‘perceived’ 100% insurance scheme had made the financial institutions negligent and the heavy borrowers irresponsible. There occurred a massive failure of governance of both the lenders and the borrowers. As a result the indebtedness of the corporate sector, especially that of the Chaebols, continued to grow and the vulnerability of the financial sector continued to increase in tandem with the former. This significant change in the Korean Economy may have affected changes in expectations in the Korean Stock markets and hence, resulted in differences in financial activity for that year and explain why the parameter estimates for the stock market did not behave in the way we thought.

With the major exception of 1986, the results we found were anticipated and fit into the following pattern existing for other markets in the Pacific-Basin. Moreover, plots of residuals (not shown here) did not produce evidence of a violation of the usual assumptions concerning the error term (i.e., linearity, homoscedasticity and serial correlation) of the OLS. Regression results are always subject to limitations on the sample study period and the elements (firms) under study. However, the compelling results indicate for the KE and its predecessor is that there is a day of the week effect on the returns of securities. We note further that the hypothesis that closing prices of securities for these firms in the KE follow random walks is in doubt. We do not dispute that these markets do not function well, and that competitive in which consistent abnormal profits based on public or historical information are rare.

Insert Table 1

In addition, Model 2 regressions (Table 2) indicate very similar results to that for Model 1 for the KE. Although two additional variables, trdvol and trdval (starting in 1995), included in the
regressions resulted for the most part in significant (though small) coefficients for the most part, the vast majority of coefficients for the daily dummy variables were significant at very small p-values. Only years 1978 and 1986 indicated different results than for all the other years studied. We can explain the deviation for 1986 in the same way that we explained the deviation in the same year for the Model 1 regressions for Korea. Again it is possible that the government financing policies of backing large conglomerates in the mid-1970- to the mid1980’s may have caused some of the difficulties in analyzing financial events during this period. In general, Model 2 regressions for Korea result in a similar interpretation as for Model 1. Coefficients for the dummy variable are predictable in stable times and the notion of the weak-form EMH is in doubt.

Insert Table 2

The conclusion for the DW statistics adds to the validity of the previous significance tests for the regression coefficients and tests for overall regression. These results indicate that for the SSE that each day of the week has a separate regression resulting in five parallel lines when plotted on a time series graphs. This is the result that we anticipated.

Plots of residuals (not shown here) did not produce evidence of a violation of the usual assumptions concerning the error term (i.e., linearity, homoscedasticity and serial correlation) of the OLS. Regression results are always subject to limitations on the sample study period and the elements (firms) under study. However, the compelling results indicate for the SSE that there is a day of the week effect on the returns of securities. We note further that the hypothesis that closing prices of securities for these firms in the SSE follow random walks is in doubt. We do not dispute that these markets do not function well, and that competitive in which consistent abnormal profits based on public or historical information are rare.
Conclusion

We noted that the weak-form of the EMH require that one examine and analyze the return predictability. By return, we refer to both the dividend yield and earning/price variables and other variables affecting the return to investments in firms. In this study, we show that for short-term changes (daily changes), the Korean stock market returns have predictable properties which lead to the conclusion that the weak-form EMH does not hold. This study is unique in that it explores original data from a source that keeps and manages this data base (PACAP). No other such studies of these data are available. However, the results are not consistently different from the results of larger stock markets. We expect that this stock exchange will continue to grow and become ever more competitive. However, the desire to be efficient in every sense of the word will be difficult.
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