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Market Efficiency and Predicting Stock Returns; Taiwan and Thailand Stock Exchanges

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Market Efficiency and Predicting Stock Returns;  
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ABSTRACT

If stock markets are efficient then it should not be possible to predict stock returns, namely, no explanatory variable in a stock market regression model should be statistically significant. Some researchers equate stock market efficiency with the non-predictability property. We explore whether this line of argument is or is not satisfactory and does or does not aid in furthering our understanding of how markets operate. We focus on one definition of capital market efficiency and on the experience of these principles in analyzing the performance of the two large Asian Stock Market exchanges, which are Taiwan and Thailand. We will see whether stock market returns (which include closing prices and dividends) will be predictable and whether there are explanations for short-term predictability.

KEYWORDS
Market Efficiency
Prediction
Stock Returns
G10, G1, G2

Purpose
Our purpose is to clarify the existence of time series characteristics of daily stock prices of securities marketed on the Taiwan Stock exchange (TSE) and the Stock Exchange of Thailand (SET). This study does not focus on index numbers of daily stock market prices but rather on the returns of traded securities because we wish to study capital market efficiency. Returns refer to both the closing prices of individual
securities and dividends associated with those securities. Furthermore, this study is important because of the theory of market efficiency and its application to short term forecasting of closing prices of traded securities for the Taiwan and Thailand exchanges.

For a very long time, management scientists, decision modelers and financial forecasters focus on the sources of variations in the behavior of returns for firms listed on the established financial markets. By the early 1970’s, a consensus emerged among financial economists and management scientists suggesting that stock market prices were basically unpredictable. Fame (1970) provided an early, definitive statement of this position. Historically, the random walk theory of stock prices was preceded by theories relating movements in the financial markets to the business cycle. A well-known example is the interest shown by John Maynard Keynes in the variation in stock returns over the business cycle. According to Skidelsky (1992) “Keynes initiated what was entitled an Active Investment Policy, which coupled investing in real assets (a revolutionary concept at the time) with constant switching between short-dated and long-dated securities, based on predictions of changes in interest rates (Skidelsky, p.26). Many studies of these phenomenon appeared in the financial time series literature after that time.

One important issue is the empirical analysis of financial time series to determine if returns on risky assets are serially independent. This is a requirement of the efficient market hypothesis in its weak form, i.e., the returns on securities fully reflect all the past stock price information. A precise formulation of an empirically refutable efficient market hypothesis must be model specific. Historically the majority of such
tests focused on the predictability of common stock returns. Hence, we classify most studies under the paradigm of the “random walk theory” of stock market prices.

**Introduction**

Fama (1955, 1970) began the study of these principles as a portion of the hypothesis involving capital market efficiency. Following Fama’s work many capital markets researchers devoted themselves to investigating the randomness of stock price movements. Their purpose was to demonstrate the efficiency of capital markets and later other studies demonstrated market inefficiencies by identifying systematic and permanent variations in stock market returns.

Using variance-ratio statistical tests, Lo and MacKinley (1988) rejected the hypothesis that prices follow random walks for daily and weekly returns. They found no empirical evidence against the random walk hypothesis for monthly returns. They determine, however, that portfolio returns of the New York Stock Exchanges (NYSE) and the American Stock Exchange (AMEX) stocks exhibit significant first-order serial correlations while security returns present negative first-order autocorrelation although statistically not significant. These results corroborated French and Roll (1986). Lo and MacKinley (1990) indicated a different serial correlation sign between portfolios and stock may explain by lead-lag positive serial correlation across securities. Poterba and Summers (1988) found negative serial autocorrelation in monthly returns for a NYSE value-weighted index during the period 1926-1985. Others (Lo and Mackinley(1988)) obtained different results for a different time period. Jarrett and Kyper (2005a) found that many time series of closing prices of U.S. stocks exhibited a unit root identified by the Augmented Dickey-Fuller test (1979).
Calendar or time effects do contradict the weak form of the efficient market hypothesis. The weak form refers to the notion that the market is efficient in past price and volume information and we do not predict stock return and price movements’ accurately using historical information. If no systematic patterns exist, stock prices are time invariant. By contrast, if variation in the time series of daily prices of securities markets exist, market inefficiency is present and investors may earn abnormal rates of return not in line with the degree of risk they undertook (Francis 1993). In addition, a large number of studies in the literature on predicting prices of traded securities confirm to some degree that patterns exist in stock market returns and prices. We know interest rates, dividend yields and a variety of macroeconomic variables exhibit clear business cycle patterns. The emerging literature concerning studies of United States securities include Balvers et al (1990), Breen et al (1990), Campbell (1987), Fama and French (1989) and Pesaran and Timmermann (1994, 1995), Granger (1992) provides a up to that time survey of methods and results. Studies in other places (the United Kingdom) include Clare et al (1994) Clare at al (1995), Black and Fraser (1995) and Pesaran and Timmermann (2000). Furthermore, Caporale and Gil-Alana (2002) pointed out that for US stock returns their degree of predictability depends on the process followed by the error term.

The expansion of time series analysis as a discipline permits one to analyze stock market prices in ways not heretofore explored. What is the predictability of the error term and is there predictability in daily stock market returns. Peculiar problems arise when daily patterns are present in stock price data. We know that stock prices possess
patterns known as daily effects. For example, Kato (1990a) results suggested that were patterns in stock returns in Japanese securities. He observed low Tuesday and high Wednesday returns within weekly prices. If a week did not have trading on a Friday, he would observe effects related to the Monday of the following week. The following Monday would have low returns indicating that transference of the pattern that would occur on the Friday if trading had occurred which it did not. A second study by Kato (1990b) found considerable anomalies on the Tokyo Stock Exchange, which is an organized exchange similar to the ones in North America.

Only a few studies focused on the investigation of time series components of equity prices and the predictability of these prices. Ray, Chen and Jarrett (1997) investigated a sample of 15 firms and found both permanent and temporary systematic components in individual time series of stock market prices of firms over a lengthy period of time. Moorkejee and Yu (1999) investigated the seasonality in stock returns on the Shanghai and Shenzen stock markets. They documented the seasonal patterns existing on these exchanges and the effects these factors have on risk in investing in securities listed on these exchanges. In addition they showed that risk in investing is related to the predictability of security prices. Rothlein and Jarrett (2002) also investigated the existence of seasonality present in Japanese stock prices, which affect the prices of these securities. They documented the evidence of seasonality in the prices of 55 randomly selected Japanese Stock exchange for a period of 18 years (1975 through 1992). In addition, they indicated the accuracy of forecasts or predictions of these firms’ prices are seriously decreased if one does not recognize the patterns in the time series.
Kubota and Takehara (2003) investigated whether the activity of financial firms creates value and/or risk to the economy within the asset-pricing framework. They used stock return data from non-financial firms listed in the first section of the Tokyo Stock Exchange. Their value-weighted index, which was solely composed of non-financial firms, was augmented with the index of the firms from the financial sector. In turn, they estimated the multivariate asset-pricing model with these two indices. We note that their procedure can simultaneously take into account the cross-holding phenomena among Japanese firms, especially between the financial sector and the non-financial sector. In conclusion their financial sector model helps explain the return and risk structure of Japanese firms during the so-called “double-bubble” period indicating some predictability in closing prices of Japanese securities.

Jarrett and Kyper (2005) indicated how patterns in monthly stock prices have predictable patterns. This study differs in that we examine the predictable patterns in the closing daily prices of stock prices. In goes further than the study of Caporale and Gil-Alana (2002) noted before because it attempts to determine the patterns in daily prices of listed securities. Jarrett and Kyper (2005b) indicated how patterns in monthly stock prices have predictable patterns. This study differs in that we examine the predictable patterns in the closing daily prices of stock prices. In goes further than the study of Caporale and Gil-Alana (2002) noted before because it attempts to determine the patterns in daily prices of listed securities. Caporale and Gil-Alana (2002) did test for unit roots in the stock market though unlike this study, they test this hypothesis within fractionally integrated alternatives. Fractional differencing is generally employed to predict long-
term rather than short-term properties of time series. Finally, Jarrett and Kyper (2006) studied the predictability of daily returns on more than 50 firms listed on American Stock Exchanges and concluded that daily variation exists and is predictable. Studies of the remaining Asian markets are less common. They often study the correlation of trade and stock returns for all Asian markets (Chen and Zhang, 1997, cross-autocorrelation in Asian stock markets (Chang, McQueen and Pinegar, 1999), or the analysis of the financial turmoil on Asian markets over a short period of time (Ho, Burridge, Cadle, and Theobald, 2000).

**Models to Detect Daily Variation**

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

\[ Y = b_0 + b_1 W_1 + b_2 W_2 + b_3 W_3 + b_4 W_4 + b_5 W_5 + \varepsilon \]  (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)

\( \varepsilon = \) error term with mean of zero, and

\( b_0 = \) 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 Jarrett (2008) in his study of the Hong Kong and Tokyo Exchanges. We collected data on firms listed on the TSE from 1975 through 2002. These data are from the Pacific Basin Financial Markets Research Center (PACAP) at the
University of Rhode Island. Also, we collected from the same source the time series for the SET from 1975 through 2002. The study period included the latest available data at the beginning of this study. Each year studied contained more than 300 hundred days of data for each firm for each included in the database. Taiwan (TSE) contained more than seven hundred and eighty firms and SET contained more than a thousand firms. Hence, we concluded that sufficient data was available for an extensive analysis. 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 is thus the same as if the researchers collected the data themselves on a day-to-day basis. Since the TSE traded on Saturday (until 2000), we added another dummy variable \( W_6 \) in the model for years 1975 through 2000 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):

\[
\begin{align*}
Y &= b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 \text{(trdvol)} + b_7 \text{(trdval)} \\
+ & \quad \varepsilon
\end{align*}
\]

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)

\( (\text{trdvol}) = \) variable for volume of daily trade in units

\( (\text{trdval}) = \) variable for value (in currency) of daily trade
\[ \varepsilon = \text{error term with mean of zero, and} \]
\[ b_o = \text{intercept of model.} \]

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 TSE traded on Saturday until 2000, the model contained another dummy variable \( W_6 \).

**The Results**

Estimations for the ordinary least squares (OLS) models for Taiwan time series data sets produced results noted in Table A for the response variable daily returns (dretwd). For the Taiwan 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 almost all of the coefficients of the dummy variables in each regression. The exceptions (13) include Thursday and Saturday in 1975, Saturday in 1977, Wednesday and Friday in 1978, Friday in 1979, Thursday in 1980, Wednesday in 1981, Tuesday in 1983, Saturday in 1985, Wednesday and Friday in 1986, Friday in 1993, Tuesday in 1995, Thursday in 1996, and Wednesday in 1998. The F-values for overall regression were significant at very small p-values for all years studied and the Durbin-Watson (DW) statistic were sufficiently large to reject the notion that no serial autocorrelation is present. The total exceptions were thus small in comparison to the number of tests of significance for the regression coefficients accomplished. 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 Taiwan Stock Exchange that each day of the week has a separate regression resulting in five (or six) parallel lines when plotted on a time series graphs. This is the result that we were hoping would occur.
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 least square regression. 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 TSE 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 TSE 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.

In addition, Model 2 regressions (Table B) indicate very similar results to that for Model 1. Although two additional variables, trdvol and trdval, 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 s at very small p-values. Sixteen out of 128 regression parameters produced p-values too large (greater than .10) to reject that hypothesis that the region parameter is equal to zero. All regression had significant F-values (.05 or less). The DW statistics again led to the conclusion that no autocorrelation was present in the data.

Table C contains the results of applying Model 1 to the data for years 1975 through 2002 for the SET. Recall that for the SET, Saturday was not a legal trading day. Our results for Model 1 differ for SET during two time periods of our study. From 1975 through 1990, large number of coefficients for the regression parameters contained large p-values. This indicates that for the most part daily variation was not a very important phenomenon in this market. However, after 1990, only 5 of the regression parameter tests had large p-values (greater than .05) for the \( t \)-statistics. The results for this period do indicate that daily variation an important factor in
predicting daily returns to securities. The *F-statistics* were also significant after 1990 at very small p-values. The DW statistics also added to the validity of the t and F tests noted. Model 2 regressions for the SET (Table D) produced results similar to the ones noted above in Table C. With the exception of 2004, the results indicate the daily influences on the returns to Thailand securities listed on the SET are very similar to the results noted in Table C. The inclusion of the trdvol and trdval variables did not alter the general conclusion of the earlier research noted in Tables C and for TSE in A and B. We should note some conclusion about the trading for the SET from 1975 through 1990. At this point, we have no apparent conclusion from our data why the patterns during this period.

The four Tables containing about eighty multiple regressions for very large samples produce evidence indicating that trading on these two large exchanges differed from day-to-day. Also, the Durbin-Watson (DW) statistics were such as to not reject the notion (hypothesis) that autocorrelation is present. This adds to the validity of the various significance tests associated with the p-values.

**Conclusions**

We document in this study those daily closing prices for a huge number of firms listed on two the Asian stock exchanges contain 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 time series, forecasters can properly model these time series. The results permit management scientists and financial forecasters to view time series of returns of listed securities are not random and do have daily affects. Hence, in this study, we indicate substantially the existence of time series components in closing prices of a randomly selected set of firms traded on these important Asian stock exchanges. The results corroborate results of a
number of earlier but less exhaustive studies. 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 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. We suggest, for purposes of prediction that forecasters predict systematic time series components of security returns. In addition, one cannot understate the importance of stock returns and portfolio risk. These factors coupled with recognition of systematic time series components (daily variation in this study) in stock prices can make one a better forecaster for prices of individual securities and contribute to the literature on capital market efficiency. One last question concerns the out-of sample trading profit opportunities. Finding in-sample profit opportunities can be thought of as a “data-mining” result, that is, if you fit many models a few will randomly have high coefficients of determination and/or statistically significant model coefficients. We suggest using parsimonious (least costly and simplest) models; the profitable opportunities should be greater than transaction costs that may include bid-ask spreads and commissions. If so, we can find profitable trading opportunities in rapidly growing markets in Asia. When the opportunity arises to examine data for Shanghai and other emerging Asian exchanges, we expect additional studies of those huge and growing markets. We are only limited by our ability to collect sufficient and reliable data.
* We thank the personnel and officers of PACAP for permitting use the data they gracially supplied. The purpose of this organization entitled the Sandra Ann Morsilli Pacific-Basin Capital Markets Research Center at the University of Rhode Island is to promote both research and teaching about the Pacific Basin Financial Markets.
References


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