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Seasonality in Outliers of Stock Returns for the Chinese Equities Markets

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ABSTRACT

We study a well developed data base containing financial information on the equity markets of the two principal Chinese Exchanges, i.e., Shanghai and Shenzhen. The analysis is similar to those performed before by others in studying anomalies in more traditional and well explored equity markets. The study concludes that (a) the daily and monthly anomalies differ for each Chinese equity market; (b) an extensive analysis of outliers in the market returns indicate possibilities for trading strategies and perhaps in the future when the markets become mature, options trading may be permitted; and the analysis and its results would aid in decision making as well. Last, the study is unique in that it explores the meaning of times series data of equity markets not studied in such detail in previous studies.
Introduction

Seasonality, market efficiency, and profitable trading strategies are all factors that relate to each other when investors determine decision rules for trading securities. Seasonality comes in several forms. Different seasons of the year are associated with varying swings of the equity markets and sometimes anomalies appear in the data on performance of Chinese Equity markets. These anomalies are the subject of many studies of North American and other developed markets in Japan and Europe. These anomalies in developed equity markets are summarized by Singal (2004) when he provides a good review of the literature and to his credit offers full trade-by-trade workouts in his sample period. For example, he looks at specific effects on certain types of equities. The “January Effect” and the “New December Effect” illustrate how, in developed markets, poor-performing small cap stock tend to go up in January and strong performing large caps tend to have a holiday rally in December. Singal continues to discuss the “Weekend Effect” where small caps tend to rise on Fridays and fall on Mondays. He speculates that this may arise because sellers are afraid to hold short positions in excessively risky securities over the weekend. Hence, they buy back and initiate again.

Some anomalies in Chinese equity markets were document previously (Weili, Xiaoming and Jihao, 2009). The January effect [Keim, 1983, Booth and Keim, 2000 and Galai, Kedar-Levy and Schreiber, 2008, hereafter referred to as GKS (2008), is well documented in developed and not well-developed equity markets. Furthermore, other months of the years could have anomalies as well although there is not much evidence of this except for Singal (2006) notion of the “New December” effect.. These last anomalies are related to the season of the year in which the month lies. One can also determine
outliers from the usual patterns of seasonality. Seasonality does refer to a single month but to climatic seasons which others have shown to exist in both developed and emerging markets. [For some illustrations, see Jarrett (2008) and Jarrett and Sun (2009) for Asian markets. Also see previous studies of daily returns in United States equity markets which include Balvers et al. (1990), Breen et al. (1990), Campbell (1987), Fama and French (1989) Francis (1993), Jarrett and Kyper (2005) and Pesaran and Timmermann (1995), Studies in other places (the United Kingdom) include Clare et al. (1994) Clare et al. (1995), Black and Fraser (1995) and Pesaran and Timmermann (2000)]

Outliers are statistically influential observations that produce different results than anticipated from the so-called historical pattern in the time series data of returns on income-earning assets. We focus on outliers because they are usually responsible for the observation of anomalies in equity markets. They influence one’s observation because they may be the cause of change in patterns of behavior or create new patterns of behavior in the time series of stock returns in equity markets.

In this study, we report an analysis not heretofore reported in the literature and for the data base collected. We study the Chinese equity markets in order to understand the predictable properties in these fast growing but volatile markets. Previous studies of the Chinese equity markets include Jarrett, Pan and Chen (2009) who studied the relationship between the economy of China and the equity markets of Shanghai and Shenzhen. In addition, Thomas (2001) discussed in detail the workings of the Shanghai equity market over its illustrious history offering insights into the characteristics of the equity market. His study included the behavior of both domestic and foreign investors in equity markets. The history discussed is of the twentieth century and not the twenty-first century. Others
(Eun and Huang, 2007; Ng and Wu, 2007; and Wang et al., 2004, Wang, Wu and Wang, 2007) investigated the rapid growth in the Chinese equity markets and why they became increasing important for investors in global markets. In addition, Bailey, Cai, Cheung and Wang (2006) studied the Shanghai Equity Market and determined some characteristics concerning order balances of individuals, and institutional investors. Last, studies of the time series behavior of stock returns in the equity market of China indicate that there is volatility clustering in the behavior of these markets and negative correlation with the New York Stock Exchange (Chow and Lawler, 2003) but considerable volatility clustering in the behavior of these markets (Fabozzi, Tunaru and Wu, 2004). Base on these last two studies. Our purpose, here, is to investigate the Chinese equity markets to explain and discover if certain anomalies noted in more developed equity markets are present or not in the Chinese markets. Do we know if seasonality in the outliers of the composite indexes for shares traded on these exchanges give rise to anomalies in the time series structure affecting decision concerning possible strategies for investing in firms listed on these markets? First, we collect the necessary data to create a lengthy enough data base to analyze and interpret. In turn, we analyze the data to determine if anomalies reported in mature equity markets of the West, i.e. the United States. We determine the effect of anomalies on outliers. Third, we examine whether the spread of the outliers are symmetrical or not and test to determine the shape of this distribution. Fourth, we produce a graphical analysis of the data on outliers to determine if the spread of outliers across time have anomalies. This is similar to determining if a monthly (or daily) effect exists in the time series data. Last, by dummy variable regression, we determine and estimate the magnitude of the monthly and daily effects on returns.
The Data Base

Following the study of Zhong, Gui and Lui (1999) for the Chinese Bourses (Shanghai and Shenzhen), we selected a newer and finer data base from the PACAP-CCER China Database developed by the Pacific-Basin Capital Markets (PACAP) Research Center at the University of Rhode Island (USA) and the SINOFIN Information Service Inc, affiliated with the China Center for Economic Research (CCER) of Peking University (China). The length of data was approximately six years resulting in a time period where analysis can lead to interpretable results (2004-2009). Smaller time periods such as two or three or even four years are usually too small to reduce the effects of disturbances in economic data and more specifically do not produce enough degrees of freedom such that one may identify significant events and factors.

One addition point concerns the types of shares included in the composite indexes. There are two types of stocks being issued in the equity markets; "A" shares and "B" shares. "A" shares are priced in the local renminbi yuan currency, while "B" shares are quoted in United States dollars. Initially, trading in “A” shares are restricted to domestic investors only while "B" shares are available to both domestic (since 2001) and foreign investors. However, after reforms were implemented in December 2002, foreign investors are now allowed (with limitations) to trade in “A” shares under the Qualified Foreign Institutional Investor (QFII) program which was officially launched in 2003. Currently, a total of 79 foreign institutional investors have been approved to buy and sell A shares under the QFII program. Quotas under the QFII program are currently US$30 billion. There has been a plan to eventually merge the two types of shares in the future A small number of degrees of freedom in sample data may not lead to determining ‘statistically significant’ events.
even when they exist. The composite index numbers include only A shares. The trading behavior of A and B may differ and hence, the analysis and its interpretation would also have to differ in this event. By studying composite indexes of A share only we reduce any confusion in the results and interpretation.

The Analysis

Following GKS (2008), we study the trimmed mean rate of return for firms (mean of the middle 90% of the data) for both the Shenzhen and Shanghai equity markets by month. We calculate the mean median and standard deviation by month for both equity markets. (The output from these calculations, we include in Table 1.) Daily rate of return across the months of the year (MOY) did show some variation. All this is consistent with GKS (2008) who believe and we concur that the mean returns of trimmed data better reflects the single summary statistic of the raw mean. The raw mean is heavily influenced by the skewness of the data and does not reflect as well the single most important characteristic of the data without the influence of extreme values. For example, the mean returns for the Shenzhen Composite Index ranged from negative value in December (-.0006) to a high (.0022) in February. For Shanghai, the low mean was in July (-.0007) and the high value in January (.0081). Similarly, the median for Shenzhen had a low (-.0015) in June and a high (.0021) in January. For Shanghai, the low median was in July (-.0008) and a high of (.0072) in January. In addition, we study rates of return across days of the week to determine if a persistent pattern exists in daily returns. Stated specifically, do the returns within the week’s time indicate that Mondays are like other Mondays; Tuesdays are like other Tuesdays; etc.? 

--Insert Table 1 about here--
Our main research question refers to whether the variations in mean and/or median returns across months or days of the week affect outliers. To begin, we define the outlier by using the M-estimation to distinguish the outlier from the body of the distribution in the same manner as GKS (2008). M-estimation is an iteration procedure design to find the robust estimate for location and can be extended to estimate the scale. These procedures generalize a ML (maximum likelihood) location estimate for a given distribution. Hence, the estimate becomes more robust as the sample size increases. For financial data, the Huber-M statistic is most suitable given the array of possible procedures [GKS (2008)]. M-Estimators generally eliminate outliers and modify non-extreme observations creating a body of a distribution non-informative for the purpose of analyzing rates of return as in this study. Furthermore, Huber-M estimator cuts negative and positive observations that exceed the absolute value of a parameter without distorting the body of a distribution. An elaborate description of this Huber-M estimator is included in Hoaglin, Mosteller and Tukey (1983). We follow GKS (2008) methods (see appendix) which uses a Huber standardized k-value of 2.496 to account for a large sample as in this study. (The Appendix contains a brief description of M-Estimation.)

Table 2 contains a report on the distribution of outliers across the months of the year (MOY) and days of the week (DOW). Note the variation in the positive and negative outliers across MOY. There are a total of 45 positive and only 18 negative outliers. This would indicate that the distribution of observations is not symmetric. Individual months differ quite dramatically with January having as many as twelve positive and three negative outliers. Compare this result with both September and October which have no outliers at all.
When we examine the 59 outliers for the DOW data, we note that 19 are for Monday (2 positive and 17 negative). The other four days of the week vary from nine to eleven with again more negative than positive outliers. A question now arises whether these values statistically differ or are they the same. The null hypotheses for statistical (Chi-Square) tests would be that (1) there is no difference in the outliers for MOY and (2) no difference across outliers for DOW.

One additional point, if we used a combined expected value (aggregated for positive and negative outliers) or separate expected values for positive and negative outliers we find some different results. The second set of results noted in Table 2 in both panels show different results. For the Shanghai composite index we find that no significant differences for the case of MOY negative counts and DOW positive counts. For the Shenzhen composite index, we find no significant differences for the MOY negative values. The DOW positive values are significant at $\alpha \leq 0.0576$. Hence, the results although useful do not point to the same conclusion as the cases of not having separate EV expected counts.

In Table 3, we examine of the Chi-Square results of the positive and negative outliers (and both) for MOY and DOW. We perform a separate analysis for positive, negative and both taken together. The null hypotheses are that outliers are uniformly distributed over the months of the year and days of the week. Note for the MOY Chi-Square analysis, one can reject the null hypothesis at any significance level ($\alpha > 0$), for the cases of positive, negative and both outliers taken together. In addition, the DOW Chi-Square Analysis
indicates that one can reject the null hypothesis at any significance level ($\alpha > 0$), for the cases of negative and positive outliers. The result for both taken together does differ as one finds the p-value at .2259 which is ordinarily too high for one to reject the null hypothesis at a reasonable level, i.e. $\alpha > .001$, or .01 or .05. These analyses results typify results reported for many equity markets across the world where one finds both MOY and DOW affects.

--Insert Table 3 about here--

**Analysis of Other Anomalies**

When Bar Graphs are drawn of the negative, positive outliers by MOY for each equity market, we observe the spread of outliers and their patterns from year to year. In Figure 1 for the Shanghai Equity Market, observe the large number of outliers for the month of January. This observation for the Shenzhen Market (Figure 2) is not true. For the month of January for the Shenzhen market we not also that the outliers are not skewed negatively in high proportions as for the Shanghai market. Both markets do exhibit large numbers of outliers in the months of May and June. Although the number of outliers is much smaller for Shanghai then for Shenzhen, we do observe that the outliers do not follow a rectangular pattern throughout the year. This is the observable result tested for in the previous Chi-Square analysis.

--Insert Figures 1 and 2 about here--
By drawing Bar Graphs by DOW, we observe the same pattern in the variation in outliers by DOW then what was concluded for the Chi-Square analyses of these data. Monday in both the Shanghai (Figure 3) and Shenzhen (Figure 4) included a much larger number of outliers then for the remaining days of the week. For Shanghai, the positive number of DOW outliers is much larger than for the negative number of DOW outliers. The remaining DOWs show a relatively even split between the number of positive and negative outliers for each DOW. Hence, Monday appears to be the day that the number of outliers is greater than for number of outliers for the remaining days.

--Insert Figures 3 and 4 about here--

One last point, we should point out the firms listed on the Shanghai and Shenzhen equity markets are not the same. Shenzhen contains many more small capitalization firms then are listed on the Shanghai market during the time period of this study. Hence, one would expect more variability and thus more outliers in the Shenzhen market. This of course, is a natural observation that should explain the larger number of outliers in the Shenzhen market.

Another way to examine and measure the effects of the MOY and DOW anomalies is through multiple regressions with Dummy variables for DOW or MOY for the predictor variables. If we study the regression of MOY versus the 11 dummy variables for each month {For example, February data would have one for February and 0 if not, for March the input would be 1 for the March dummy and 0 if not, etc, January data has zeros for all the dummy variables for the remaining months of the year. In the DOW study, Tuesday, Wednesday, Thursday and Friday would receive 1 for the dummy variable and zero if not
that day. Monday would be the case where all dummy variables are zero. Hence, conducting the dummy variable regressions would permit the identification of DOW and/or MOY effects. Previous studies noted before identified daily and seasonal components in the data of western and Japanese markets. Therefore, it is like that such effects may occur in the Chinese markets studied. Trading rules by investors and traders are often dependent on their ability to predict or not predict the seasonal and daily influences on stock return data. These rules are involved in option trading and vary due to whether the indicator to place a put or call is based on some volatility index and/or a certain time of the day (at opening or closing for example). At the moment there are no financial options in the Chinese markets, however, this could change as these equity markets become more sophisticated. Options trading are of the result of the maturity in equity markets.

**Regression Results**

Following the method of dummy variable regression employed previously by many others including GKS (2008), we estimate and place the results in Table 4 for both the Shanghai and Shenzhen equity markets as described by their composite indexes for the period studied. Panel (A) contains the analysis for the Shanghai market and Panel (B) for the Shenzhen market. In each Panel the results for monthly dummy regression model appears first followed by the daily dummy regression. Note each model contains the Durbin-Watson \( d \) statistics and their estimates of the serial correlation coefficients. As one observe the DW-\( d \) statistics are of such value to indicate that positive serial correlation does not exist in the time series data studied. Furthermore, the estimates of the serial correlation coefficients are tiny values and not larger than 0.06. This indicates the
absence of serial correlation (autocorrelation) contributing the value of the dummy regression results.

Observing the Shanghai dummy regression for MOY, only the month of July and the estimated intercept of the regression has a significantly small p-value indicating that the regression does not go through the origin. This may have a variety of interpretations but does require us to estimate the regression without an intercept. The estimated parameter value for July is 0.025891 and for the intercept is 0.11277. Hence, for Shanghai only, the regression indicates a seasonal variation or anomaly for July. Note, when all dummy variables have zero values, we are dealing with only January. If the hypothesis that the intercept = 0 is rejected at a reasonable significance level (i.e., $\alpha \leq 0.05$) then we say there is a January effect. For the DOW of Shanghai, small and significant p-values are found for the intercept, Thursday and Friday. The values are 0.000014, 0.002725 and 0.010481 respectively. Hence there is daily variation for those two days and possible other factors influence the daily return as measured by the composite index. Again, if all the daily Dummy Variables are equal to 0, then the rejection of the intercept is crucial as in this case. That is, we have shown a Monday effect since the intercept is not statistically equal to zero (p-value 0.000014).

Observe Panel (B) and one concludes that no MOY is associated statistically with the changes in the Shenzhen composite index. The analysis also shows that one cannot reject the hypothesis that the intercept is equal to zero. Recalling that this market contains much smaller firms than that of the Shanghai equity market, we may infer that smaller firms are more likely to have variation in returns related to other factors than the month of the year. Similarly, we find the DOW variation not significant statistically as well. Again, the
hypothesis that the intercept is equal to zero cannot be rejected at a reasonable statistical significance level.

**Conclusion**

First, we find that the Shanghai and Shenzhen equity markets behave differently from each other. This is significant because one needs to evaluate behavior in each equity market separately. Conclusions about Shanghai for instance, are not the same as for Shenzhen. Second Anomalies do exist in each market and their behavior is not the same in each of the two markets. Seasonal variation and daily variation in outliers of the composite index for Shanghai exists. This is not true for the Shenzhen equity market. DOW and variation in July exists for the Shanghai equity market but we cannot show the same result for Shenzhen. Since a composite index is a weighted mean variation between firms is not studied at this time. We do know for certain that the essential characteristics of the two Chinese equity markets are susceptible to environmental changes in both the Chinese (see Jarrett, Pan and Chen, 2009) and World economies. These equity markets are not large enough themselves to predict with a great deal of certainty the growth in the Chinese economy but they do indicate changes occurring within their influences. Third, we do conclude that the study of outliers is important to determine influences on markets. Both equity markets contain large and small size firms but the proportion of large size firms is much larger for the Shanghai markets. Further study is necessary to see if these markets are acting in the same or different ways than markets of Western Nations and Japan. Perhaps, they act more like the burgeoning markets of small Pacific-Basin nations. What is obvious is that markets must be studied on their own since they exist in different environments, list varying types and sizes of firms and their maturity level also vary
greatly. Last, this study does indicate the presence of anomalies in Chinese equity markets which may in part explain why they are not good predictors of change in the Chinese Macroeconomy.
References


APPENDIX

Following GKS (2008), the Huber M-estimator of location for a sample $X$ of $n$ observations $\{X: x_1, x_2, \ldots, x_n\}$ is the value of $l_k$ that satisfies $\sum \Psi_i = 0$, where

$$
\Psi_i = \begin{cases} 
\psi_i & \text{If } -k < +k \\
-k & \text{If } U_i \leq -k \\
+k & \text{If } U_i \geq +k
\end{cases}
$$

and,

$$U_i = \frac{X_i - l_k}{cS_k}$$

Where $c$ is a constant and $S_k$ is the scale estimate. That is, the Huber M-estimator assigns a value of $+k$ to standardized observations that exceed $+k$ and a value $-k$ for negative observations greater than $IkI$. 

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Figure 1

Negative, Positive and Total Outliers by Day - Shanghai Equity Market

Variable
C3
C2

Data

MOY

January
February
March
April
May
June
July
August
September
October
November
December

16
14
12
10
8
6
4
2
0
Figure 2

Negative, Positive and Total Outliers by Day - Shenzhen Equity Market

Variable
Positive
Negative
Data

MOY
January
February
March
April
May
June
July
August
September
October
November
December

90
80
70
60
50
40
30
20
10
0
Figure 3

Negative, Positive and Total Outliers by Day - Shanghai Equity Market
Figure 4

Negative, Positive and Total Outliers by Day - Shenzhen Equity Market

Data

DOW
Monday
Tuesday
Wednesday
Thursday
Friday

Variable
Positive
Negative
Founded in 1892, the University of Rhode Island is one of eight land, urban, and sea grant universities in the United States. The 1,200-acre rural campus is less than ten miles from Narragansett Bay and highlights its traditions of natural resource, marine and urban related research. There are over 14,000 undergraduate and graduate students enrolled in seven degree-granting colleges representing 48 states and the District of Columbia. More than 500 international students represent 59 different countries. Eighteen percent of the freshman class graduated in the top ten percent of their high school classes. The teaching and research faculty numbers over 600 and the University offers 101 undergraduate programs and 86 advanced degree programs. URI students have received Rhodes, Fulbright, Truman, Goldwater, and Udall scholarships. There are over 80,000 active alumnae.

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