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Essays in Chinese Financial Markets

Chang Xia
Graduate Center, City University of New York

ESSAYS IN CHINESE FINANCIAL MARKETS

by

CHANG XIA

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Dr. Christos Giannikos

Date

Chair of Examining Committee

Dr. Wim Vijverberg

Date

Executive Officer

Dr. Christos Giannikos

Dr. Barry Ma

Dr. Sebastiano Manzan

Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

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Adviser: Professor Christos Giannikos

Chapter 1 adopted the constraint dummy variables regression model in Cao, Harris and Wang (2007) to examine seasonality in the returns, volatility, and turnover of Shanghai 'A', Shanghai 'B', Shenzhen 'A', and Shenzhen 'B' composite indexes in the Chinese Stock Market. Daily data of four composite indexes (Shanghai 'A', Shanghai 'B', Shenzhen 'A', and Shenzhen 'B') was collected: the opening index value, the closing index value, the maximum index value, the minimum index value and the volume traded. Volatility (a realized volatility that is based on the daily trading range), trading volume, and three return series of the four indexes were regressed on the 1st lag term and 26 dummy variables. The dummy variables include 5 day effect dummies, 12 month effect dummies and 9 holiday effect dummies. For trading volume, both a linear trend and a quadratic trend were included to capture the non-linear secular growth in this variable over time. Chapter 1 analyzed both the full and split samples. Chapter 1 found a weekend effect, an April effect, and a Tuesday effect in the Chinese Stock Market. Similar seasonality patterns existed in Shanghai 'A' and Shenzhen 'A' markets. However, Shanghai 'B' and Shenzhen 'B' markets had very different seasonality patterns. In contrast to the previous findings, only minimal and inconsistent Spring Festival effects were found in the full sample Shanghai 'A' market and in the second period in the split sample Shenzhen 'A' market. Only minimal and inconsistent Labor Day and National effects were found in 'B' markets. There were no other

holiday effects in the Chinese Stock Market. Monthly seasonality patterns were more prominent in ‘B’ markets than in ‘A’ markets.

Chapter 2 applied a variant of the Fama-French (1993) model in the monthly returns on all component stocks of the CSI300 Index from January 2006 to December 2011 and identified three risk factors in the returns on those 300 stocks. Both value-weighted and equal-weighted monthly returns of nine portfolios formed on firm size and book-to-market equity were regressed on the value-weighted monthly returns of a market portfolio of stocks and on two Fama-French benchmark factors (mimicking portfolio for firm size and mimicking portfolio for book-to-market equity). Chapter 2 confirmed the relative suitability of the modified Fama-French 3-factor model in CSI300 component stocks. Chapter 2 identified the same three risk factors as Fama-French (1993) did: an overall market factor, a factor linked to firm size and a factor linked to book-to-market equity. The overall market factor captured most of the time-series variations in stock returns. By adding the two factors linked to firm size and book-to-market equity into the time-series regressions, additional variation was captured. The size effect was much stronger and more consistent than the book-to-market equity effect in the stock returns, which is in contradiction to Fama-French (1993), where the book-to-market equity effect was much stronger. Small-size portfolios tended to have higher returns than big-size portfolios. The book-to-market equity had a relatively weaker power than firm size in explaining returns.

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Chapter 1

Seasonality in Returns, Volatility and Turnover of A-shares and B-shares Markets in China

1.1 Introduction

Seasonality or calendar anomalies are well documented and known as the best examples of inefficiencies in financial markets. There is plenty of evidence of such seasonality for the well-established stock markets in the developed economies, as well as in some emerging markets. The stock market in the People's Republic of China (hereinafter referred to as "China") poses an interesting study because China has become the world's second largest economy by nominal GDP and purchasing power parity after the United States. The Chinese Stock Market is relatively new and less developed, and it has experienced rapid changes in its short history. Moreover, the Chinese Stock Market has obvious differences from the conventional markets in North America and Europe. Many unique institutional features exist, notably the existence of the domestically traded local currency A-share market, which until the end of 2002 was accessible only to domestic investors; and the hard-currency B-share market, which until early 2001 was accessible only to foreign investors. The uniqueness of the Chinese Stock Market thus allows us to gain insight into whether institutional and inherent Chinese cultural factors play a significant role in determining the pricing behavior in the stock market.

China's economy has experienced dramatic changes in many aspects by introducing the policy of market-oriented reforms and by shifting from a centrally planned economy to a more market-oriented economy since the 1990s. Meanwhile, as an emerging market, the Chinese Stock

Market (Shanghai Stock Exchange and Shenzhen Stock Exchange) has experienced tremendous, rapid growth and development since 1990. The Chinese Stock Market has a number of unique features, such as separation of markets, institutional segmentation between domestic and foreign investors, different classes of shares, prohibition of short selling, and prohibition of day trading, and etc. In order to analyze the Chinese Stock Market, it is worthwhile studying the Shanghai Stock Exchange and Shenzhen Stock Exchange for constructing a model and conducting econometrics analysis.

Mainland China has two stock exchanges: the Shanghai Stock Exchange (SHSE), which was established in December 1990, and the Shenzhen Stock Exchange (SZSE), which was founded in July 1991. Both the SHSE and SZSE are relatively young. There were no laws for regulation of securities until 1999. The Chinese Stock Market demonstrates many features which are typical for emerging markets. Generally, the SHSE is dominated by larger-cap companies, while the SZSE lists small joint ventures and export-oriented companies. The Chinese Securities Regulatory Committee (CRSC) supervises the new stock listing and daily trading activities of both exchanges.

There are many different classes of shares in the Chinese Stock Market: A-shares, B-shares, H-shares, N-shares, L-shares and S-shares. A-shares in mainland China-based companies are quoted in Chinese Currency RMB and are traded in both the SHSE and the SZSE. Originally, trading in A-shares was solely restricted to domestic investors. Since 2002, foreign investors are allowed to trade A-shares under a tightly-regulated structure known as the Qualified Foreign Institutional Investor (QFII) system. B-shares in mainland China-based companies are quoted in foreign currency (Shanghai B-shares trade in U.S. dollars, while Shenzhen B-shares trade in Hong Kong dollars) and traded on either the Shanghai or Shenzhen Stock Exchange. In contrast to A-shares, B-Shares are eligible for foreign investment. B-shares were limited to foreign investment until 19 February 2001, when the China Securities Regulatory Committee began permitting the exchange of B shares via the secondary market to domestic citizens. H-shares, N-shares, L-shares, and S-shares are listed respectively in Honk Kong, New York, London, and Singapore; they are denominated in foreign currencies respectively, which are not included in this analysis.

A company can issue A-shares and B-shares at the same time. However, a company can only choose one stock exchange to be listed: either the SHSE or SZSE.

The purpose of this chapter is to better understand and grasp the Chinese Stock Market's stock returns, price volatility, liquidity, and mechanism. The study of liquidity is important since liquidity of equity investments provides investors an ideal investment channel. Different investors can take different expected return and risk according to their own preferences for risk, return, and flexibility to the portfolio. This chapter provides some insights into it, at least in a broad selection sense.

In the second section, a brief literature review is introduced. Section 3 describes the data used in the analysis. Section 4 introduces the methodology. Section 5 presents the empirical results, and Section 6 presents the conclusion and further analysis opportunity.

1.2 Literature Review

Gao and Kling (2005) found significant daily and monthly effects in the Shanghai and Shenzhen markets from 1990-2001, with the highest average returns occurring on Friday and during February. Hong and Yu (2006) developed a theory of seasonality based on heterogeneous beliefs combined with short-sale constraints. Hong and Yu also found that both the turnover and prices of speculative' stocks in the Chinese Stock Market are lower two months before the Spring Festival holiday (Chinese Lunar New Year). Abadir and Spierdijk (2005) investigated a 'festivity' effect in a range of countries and found that during 1991-2004, weekly returns in the Shanghai Composite index are higher before and after the Spring Festival holiday than other times of the year. A comprehensive study by Mitchell and Ong (2006) found evidence of holiday effects and higher returns during the following six months after the Spring Festival holiday (from February to June). Cao, Harris and Wang (2007) found a very significant Spring Festival holiday effect. For New Year's Day, Labor Day, and National Day, there is little evidence of significant seasonality. There is weak evidence of monthly seasonality, after controlling for holiday effects.

1.3 Data

Daily data from Dec 19th 1995 to April 8th 2013 was collected from Wind Financial Terminal[1] and provided by Shanghai Wind Information Co., Ltd. for Shanghai 'A', Shanghai 'B', Shenzhen 'A', and Shenzhen 'B' composite indexes. This yields a total of 4186 observations. The data set includes the opening index value (P_t^o), the closing index value (P_t^c), the daily maximum index value (P_t^{h}), the daily minimum index value (P_t^{l}) and the daily volume traded (V_t). The time period utilized is not the longest sample available in history. I chose the start date of December 19, 1995 due to the fact there were very few listed companies in the two Exchanges' early years. In addition, in the early years, the two exchanges lacked regulation and were underdeveloped.

Based on the data collected, I constructed three return series, a realized volatility, and trading volume from Dec 20th, 1995 to April 8th, 2013, which yielded a total of 4185 observations. Three return measures are constructed in order to examine the seasonality in different perspectives.

[1] As an alumna of universities in China, I received an official account of Wind Financial Terminal by Shanghai Wind Information Co., Ltd for use within my dissertation.

There are three different daily return measures in this analysis. The first one is close/open return defined as:

$$r_t^{c/o} = \ln(P_t^o / P_{t-1}{}^c) \qquad (1)$$

The second is open/close return defined as:

$$r_t^{o/c} = \ln(P_t^c / P_{t-1}{}^o) \qquad (2)$$

The close/close return (the most commonly used return in most empirical studies) is defined as:

$$r_t^{c/c} = \ln(P_t^c / P_{t-1}{}^c) \qquad (3)$$

Besides three measures of returns, volatility, and volume traded are also included in the analysis. Adopting the methodology from Zhiguang Cao, Richard D. F. Harris, and Anxing Wang (2007), the volatility is a realized volatility based on the daily trading range:

$$\sigma_t = \ln(P_t^h / P_t^o) * \ln(P_t^h / P_t^c) + \ln(P_t^l / P_t^o) * \ln(P_t^l / P_t^c) \qquad (4)$$

The measure of volume traded is defined as:

$$v_t = \ln(V_t) \qquad (5)$$

Table 1.1 reports summary statistics for the three return series, the volatility series, and the volume traded series for all four markets. Returns in the Chinese Stock Market are volatile in comparison with those of more developed markets and notably more leptokurtic (measured by Kurtosis). As to the three measures of returns, the B-shares are more volatile than the A-shares in Shenzhen Exchange without exception; the B-shares are also more volatile in the Shanghai Exchange except the close/open return. Interestingly, B-shares in Shenzhen Exchange are much more leptokurtic than other markets. These results are different from the findings by Zhiguang

Cao, Richard D. F. Harris and Anxing Wang (2007) in that the 'B' markets are more volatile but less leptokurtic than the 'A' markets in both Shanghai and Shenzhen.

Table 1.1 Summary Statistics of Shanghai and Shenzhen Exchange

Panel A: Shanghai 'A' Market					
	$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t
Mean	0.00032	-0.00011	0.00074	0.00016	21.41447
SD	0.01749	0.00755	0.02398	0.00029	1.34624
Skewness	-0.21631	-0.91799	-0.05204	7.08292	-0.08557
Kurtosis	7.69929	58.76504	7.04061	80.85385	2.03377
Bera-Jarque	3883	542849	2849	1091918	168
Panel B: Shanghai 'B' Market					
	$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t
Mean	0.00040	-0.00015	0.00095	0.00025	17.28207
SD	0.02267	0.00666	0.03341	0.00059	0.99452
Skewness	0.10432	3.35419	0.20611	7.22486	0.04631
Kurtosis	7.42508	80.02265	8.46570	73.72946	3.20664
Bera-Jarque	3422	1042325	5239	908747	9
Panel C: Shenzhen 'A' Market					
	$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t
Mean	0.00049	-0.00044	0.00141	0.00019	21.09833
SD	0.01925	0.00762	0.02707	0.00036	1.15074
Skewness	-0.42594	-2.54832	-0.20177	5.92088	-0.11680
Kurtosis	6.78217	64.67366	6.61246	53.40814	2.24700
Bera-Jarque	2621	667789	2304	467536	108
Panel D: Shenzhen 'B' Market					
	$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t
Mean	0.00021	-0.00044	0.00086	0.00025	17.27279
SD	0.03444	0.02696	0.04192	0.00060	1.10724
Skewness	-28.43719	-57.40483	-15.58395	9.17235	-0.62328
Kurtosis	1402.09400	3575.13300	637.30990	133.69200	3.72933
Bera-Jarque	341896839	2227346878	70329010	3037077	364

Notes: The table reports the mean, standard deviation, skewness coefficient, excess kurtosis coefficient and Bera-Jarque statistic for close/close returns, close/open returns, open/close returns, volatility, and log volume traded for the Shanghai A, Shanghai B, Shenzhen A, and Shenzhen B markets. The sample period is December 20, 1995 to April 8, 2013. The Bera-Jarque statistic has a chi-squared distribution with two degrees of freedom under the null hypothesis that returns are normally distributed.

All four markets are notably more volatile when they are open (as measured by the open/close return) than when they are closed (as measured by the close/open return), which is contrary to the findings of Zhiguang Cao, Richard D. F. Harris and Anxing Wang (2007). For all Shanghai ‘A’, Shanghai ‘B’, Shenzhen ‘A’, and Shenzhen ‘B’ markets, the open/close returns are the highest among the three measures of returns, and the close/open returns are negative. More trading activities occurred in A-shares than B-shares in both the Shanghai and Shenzhen Stock Exchange on average.

Mandelbort (1963) and Fama (1963) developed the idea of high kurtosis and fat tail, and they found that asset returns among many financial time series displayed higher kurtosis and fatter tail compared to normal distribution. In order to see the high kurtosis and fat tail characteristics more straightforwardly, I did a simulation of normal distribution curves for the three return series in the Shanghai ‘A’ market and ‘B’ market, as well as the Shenzhen ‘A’ market and ‘B’ market, and compared to the normal distribution which has the same mean and standard deviation respectively. As Figures 1.1 through 1.4 show, all three returns of the four markets exhibit fat tail or long tail when compared to normal distribution. For every return series, its distribution intersects with the left part of normal distribution at least 2 times, indicating a longer left tail and more raised vertex. This means the return series are less volatile than normal distribution most of the time. For all four markets, the close/open return series have a longer left tail than right tail, indicating the probability of extreme loss is greater than extreme gain. Of note, the Shenzhen ‘B’ market in all three returns series displayed a significantly longer left tail.

Figure 1.1 Time Series Plot for Shanghai 'A'

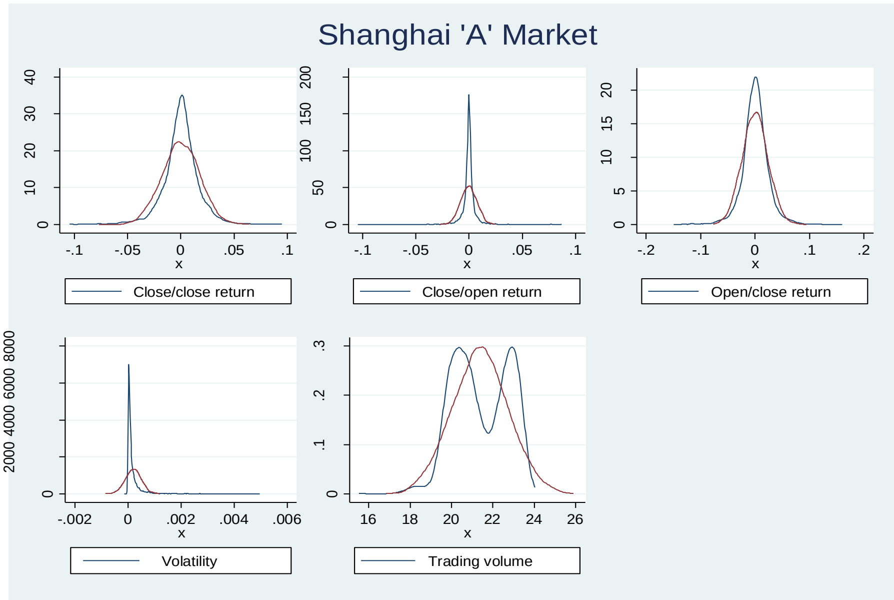


Figure 1.2 Time Series Plot for Shenzhen 'A'

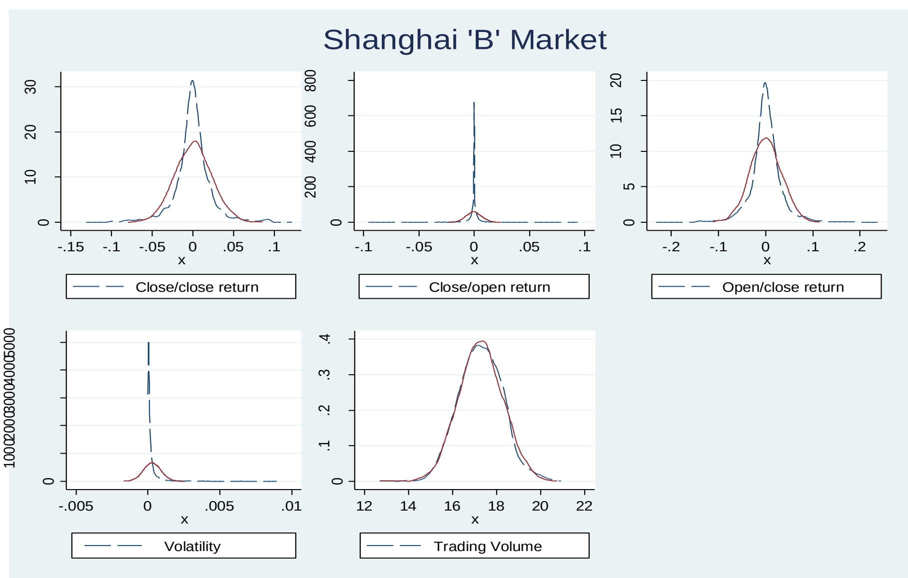


Figure 1.3 Time Series Plot for Shanghai 'B'

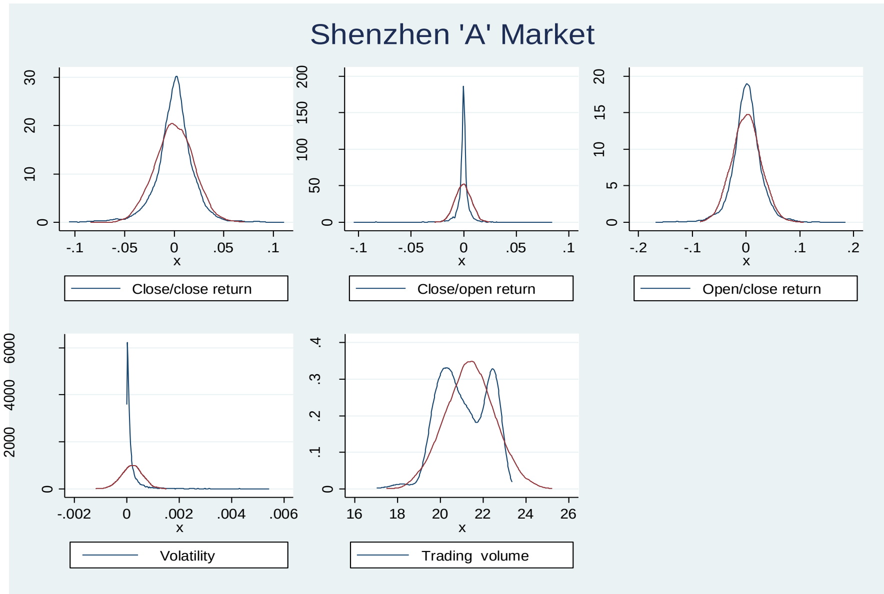
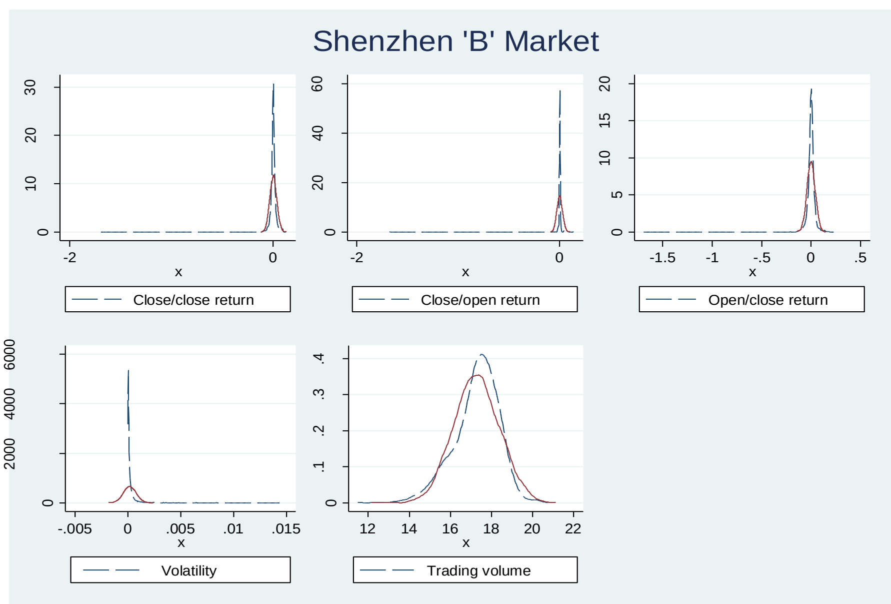


Figure 1.4 Time Series Plot for Shenzhen 'B'



From Table 1.2, all time-series have very small test statistics. Null hypothesis is rejected. All time-series do not have unit root.

Table 1.2 Unit Root Test

Unit Root Test					
	$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t
Shanghai 'A' Market	-67.087	-56.802	-43.037	-43.032	-6.989
Shenzhen 'A' Market	-63.453	-50.937	-41	-42.999	-8.43
Shanghai 'B' Market	-58.545	-54.896	-37.535	-41.428	-15.399
Shenzhen 'B' Market	-98.466	-234.608	-64.921	-38.528	-14.276
Interpolated Dickey-Fuller					
	1%		5%		10%
critical value	-3.43		-2.86		-2.57

In Table 1.3, the three measures of return series are all correlated, while the open/close return and close/close return are the most correlated among the four markets. The close/open and close/close return are the least correlated among all markets except for the Shenzhen 'B' Market.

Table 1.3 Within-Market Correlations

Correlations in Shanghai 'A' Market						Correlations in Shanghai 'B' Market					
	$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t		$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t
$r_t^{c/c}$	1.00					$r_t^{c/c}$	1.00				
$r_t^{c/o}$	0.39	1.00				$r_t^{c/o}$	0.27	1.00			
$r_t^{o/c}$	0.74	0.42	1.00			$r_t^{o/c}$	0.76	0.34	1.00		
σ_t	-0.12	-0.14	-0.13	1.00		σ_t	-0.09	-0.05	-0.09	1.00	
ν_t	0.06	-0.02	0.12	0.14	1.00	ν_t	0.12	0.04	0.18	0.31	1.00
Correlations in Shenzhen 'A' Market						Correlations in Shenzhen 'B' Market					
	$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t		$r_t^{c/c}$	$r_t^{c/o}$	$r_t^{o/c}$	σ_t	ν_t
$r_t^{c/c}$	1.00					$r_t^{c/c}$	1.00				
$r_t^{c/o}$	0.34	1.00				$r_t^{c/o}$	0.79	1.00			
$r_t^{o/c}$	0.74	0.42	1.00			$r_t^{o/c}$	0.86	0.69	1.00		
σ_t	-0.12	-0.13	-0.13	1.00		σ_t	-0.07	0.02	-0.05	1.00	
ν_t	0.08	0.01	0.14	0.12	1.00	ν_t	0.05	0.00	0.11	0.19	1.00

It's important to check the correlation across different markets, which might provide a hint to the seasonality patterns of all four markets. Shenzhen 'A' and Shanghai 'A' markets are highly correlated in the three returns, volatility, and trading volume. Therefore, in the following analysis, I placed the Shenzhen A' and Shanghai 'A' markets together for comparison and the Shenzhen 'B' and Shanghai 'B' markets in another comparison group.

Table 1.4 Cross-Markets Correlations

Close/close return correlations in 4 Markets				
	Shanghai 'A'	Shanghai 'B'	Shenzhen 'A'	Shenzhen 'B'
Shanghai 'A'	1.00			
Shanghai 'B'	0.62	1.00		
Shenzhen 'A'	0.90	0.62	1.00	
Shenzhen 'B'	0.41	0.52	0.40	1.00
Close/open return correlations in 4 Markets				
	Shanghai 'A'	Shanghai 'B'	Shenzhen 'A'	Shenzhen 'B'
Shanghai 'A'	1.00			
Shanghai 'B'	0.58	1.00		
Shenzhen 'A'	0.92	0.55	1.00	
Shenzhen 'B'	0.16	0.20	0.16	1.00
Open/close return correlations in 4 Markets				
	Shanghai 'A'	Shanghai 'B'	Shenzhen 'A'	Shenzhen 'B'
Shanghai 'A'	1.00			
Shanghai 'B'	0.59	1.00		
Shenzhen 'A'	0.90	0.60	1.00	
Shenzhen 'B'	0.46	0.63	0.46	1.00
Volatility correlations in 4 Markets				
	Shanghai 'A'	Shanghai 'B'	Shenzhen 'A'	Shenzhen 'B'
Shanghai 'A'	1.00			
Shanghai 'B'	0.46	1.00		
Shenzhen 'A'	0.85	0.39	1.00	
Shenzhen 'B'	0.33	0.62	0.31	1.00
Volume correlations in 4 Markets				
	Shanghai 'A'	Shanghai 'B'	Shenzhen 'A'	Shenzhen 'B'
Shanghai 'A'	1.00			
Shanghai 'B'	0.61	1.00		
Shenzhen 'A'	0.96	0.60	1.00	
Shenzhen 'B'	0.69	0.81	0.66	1.00

1.4 Methodology

In order to analyze the daily, monthly, pre-holiday and post-holiday effects, this chapter mainly adopted the methodology introduced in Zhiguang Cao, Richard D. F. Harris, and Anxing Wang (2007), which estimated a dummy-variable regression for each time series. There are 26 dummy variables in total, which includes 5 day effect dummies, 12 month effect dummies and 9 holiday effect dummies. The regression equation is specified in (6). I also included the 1st lag into the regression, specified in (7). Specifically, $D_{1,t}$, … ,$D_{5,t}$ are day effect dummy variables representing the days of the week from Monday to Friday. $M_{1,t}$, … ,$M_{12,t}$ are month effect dummy variables representing months of the year from January to December. $H_{1,t}$, … ,$H_{4,t}$ are holiday effect dummy variables representing the business day before each of the four holidays during which the Chinese Stock Market is officially closed. These four holidays are the Spring Festival (which varies from year to year and is based on the lunar calendar), Labor Day (May 1st), National Day (October 1st), and New Year's Day (January 1st) respectively. $H_{5,t}$, … ,$H_{8,t}$ are holiday effect dummy variables representing the business day following each of these holidays respectively. Finally, $H_{9,t}$ is a holiday effect dummy variable representing the day that is neither the business day before nor after a public holiday. For each of the five variables described in Section 2 (three return series, volatility and volume traded), the unrestricted general regression models are given by:

$$\mathrm{y}_t = \alpha + \sum_{i=1}^{5} d_i D_{i,t} + \sum_{i=1}^{12} m_i M_{i,t} + \sum_{i=1}^{9} h_i H_{i,t} + \varepsilon_t \qquad (6)$$

$$\mathrm{y}_t = \alpha + \sum_{i=1}^{5} d_i D_{i,t} + \sum_{i=1}^{12} m_i M_{i,t} + \sum_{i=1}^{9} h_i H_{i,t} + l\mathrm{y}_{t-1} + \varepsilon_t \qquad (7)$$

y_t represents the three return series, volatility, and trading volume.

The above regression equations are not estimable directly. To solve this problem, this chapter uses the solution offered by Suits (1984) by imposing the following constraint, same as Zhiguang Cao, Richard D. F. Harris, and Anxing Wang (2007).

$$\sum_{i=1}^{5} d_i \overline{D_i} = \sum_{i=1}^{12} m_i \overline{M}_i = \sum_{i=1}^{9} h_i \overline{H}_i = 0 \qquad (8)$$

Where $\overline{D}_i = \mathrm{n}_i^D \Big/ \sum_{j=1}^{5} \mathrm{n}_j^D \quad \overline{M}_i = \mathrm{n}_i^M \Big/ \sum_{j=1}^{12} \mathrm{n}_j^M \quad \overline{H}_i = \mathrm{n}_i^H \Big/ \sum_{j=1}^{9} \mathrm{n}_j^H$

n_i^D is the number of observation that $D_{i,t} = 1$, and the same rule applies to $\overline{M}_i, \overline{H}_i$

However, the restriction given above can be incorporated in the equation (8), which results in the following regression equations.

$$\mathrm{y}_t = \alpha + \sum_{i=1}^{5} d_i \tilde{D}_{i,t} + \sum_{i=1}^{12} m_i \tilde{M}_{i,t} + \sum_{i=1}^{9} h_i \tilde{H}_{i,t} + \varepsilon_t \quad (9)$$

$$\mathrm{y}_t = \alpha + \sum_{i=1}^{5} d_i \tilde{D}_{i,t} + \sum_{i=1}^{12} m_i \tilde{M}_{i,t} + \sum_{i=1}^{9} h_i \tilde{H}_{i,t} + l\mathrm{y}_{t\text{-}1} + \varepsilon_t \qquad (10)$$

where $\tilde{D}_{i,t} = \left[D_{i,t} - \frac{\mathrm{n}_i^D}{\mathrm{n}_1^D} D_{1,t} \right], 2 \le i \le 5 \quad \tilde{M}_{i,t} = \left[M_{i,t} - \frac{\mathrm{n}_i^M}{\mathrm{n}_1^M} M_{1,t} \right], 2 \le i \le 12 \quad \tilde{H}_{i,t} = \left[H_{i,t} - \frac{\mathrm{n}_i^H}{\mathrm{n}_1^H} H_{1,t} \right], 2 \le i \le 9$

Thus, the equations are estimable. In addition, the advantage of re-specifying the regression in (9) and (10) is that the relevant standard errors will be automatically obtained. To estimate equation (9) and (10) and identify all parameters, the first category from each classification needs to be excluded. However, there are two methods to identify the parameters for the excluded category in each classification: the first is calculating from the restriction given by (8); the second is excluding the second or third category from each classification in regression in (9) and (10), then the previous excluded parameters are identified. The two regressions will then yield the complete set of parameter estimates together with associated standard errors and t-statistics. For trading volume v_t, both a linear trend and a quadratic trend are included to capture the non-linear, secular growth in this variable over time. The linear trend is date and tr2 is the square of date. This chapter estimates the model by OLS with Newey and West's (1987) robust estimates of the standard errors, thus heteroscedasticity and any residual serial correlation are adjusted.

1.5 Results

1.5.1 Model without 1st lag: replication of Cao, Harris and Wang (2007)

Table 1.5-1.8 presents the results of the dummy variable regression analysis for the four markets. The estimated parameters in the table are grouped by classification (day of the week, month of the year, and holiday) for the three return series, volatility, and volume traded. The tables do not report t-statistics due to clarity. However, the significance at the 1%, 5%, or 10% level is indicated by '***', '**' and '*' respectively. Three return series, volatility, and trading volume of the four markets are regressed on the 26 dummy variables from Dec 20th 1995 - Jan 20th 2006[2]. The time horizon in Cao, Harris and Wang (2007) is from November 25th 1994 to January 20th 2006. As mentioned in the methodology section, the regression equation is as follows:

$$y_t = \alpha + \sum_{i=1}^{5} d_i D_{i,t} + \sum_{i=1}^{12} m_i M_{i,t} + \sum_{i=1}^{9} h_i H_{i,t} + \varepsilon_t \quad (6)$$

Table 1.5 reports the results for the Shanghai 'A' market. All returns are higher on Monday than Friday, accompanied with significantly higher volume on Monday as well, so there is a weak weekend effect. There is a negative Thursday effect in close-open and open-close returns. There is an April effect for both volatility and volume. No holiday effect exists.

[2] The earliest date of complete data from Wind Financial Terminal is Dec 20th 1995.

Table 1.5 Replication Shanghai 'A'

Regression Results for Shanghai 'A' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
d_1	0.00408		0.00120		0.00775	*	-0.00010	*	0.14255	**
d_2	-0.00081		-0.00024		-0.00153	*	0.00002	*	-0.02817	**
d_3	0.00155	**	0.00026		0.00107		-0.00001		-0.01411	
d_4	-0.00158	**	-0.00020	*	-0.00048		0.00000		0.01706	
d_5	0.00085		-0.00054		-0.00059		0.00001		0.02988	**
m_1	-0.00923		0.00101		-0.02102		0.00004		-0.17131	
m_2	0.00073		-0.00008		0.00167		0.00000		0.01359	
m_3	0.00129		0.00031		0.00227		-0.00005	***	0.06860	
m_4	0.00161		0.00056		0.00254		-0.00003	**	0.30825	**
m_5	-0.00006		-0.00032		-0.00007		0.00005		0.13236	
m_6	0.00176		0.00125		0.00301		0.00004		0.20096	
m_7	-0.00141		0.00017		-0.00340	**	0.00001		0.00636	
m_8	-0.00098		-0.00043		-0.00206		0.00000		-0.14098	
m_9	-0.00114		-0.00014		-0.00185		-0.00002		-0.16952	
m_{10}	-0.00035		0.00097		-0.00170		0.00001		-0.06636	
m_{11}	0.00014		-0.00012		0.00008		-0.00002		-0.10227	
m_{12}	-0.00134		-0.00116		-0.00111		-0.00001		-0.19147	
h1	0.12690		0.03247		0.11070		-0.00400		0.69798	
(before Spring Festival)										
h2	-0.00221		-0.00057		-0.00193		0.00007		-0.01217	
(before Labor Day)										
h3	0.00097		0.00101		-0.00003		-0.00003		-0.21515	
(before National Day)										
h4	-0.00235		0.00051		-0.00481		-0.00005		-0.16444	
(before New Year's Day)										
h5	0.00261		0.00170		0.00470		0.00018	*	0.09117	
(after Spring Festival)										
h6	-0.00254		0.00200		-0.00786		-0.00005		0.02123	
(after Labor Day)										
h7	-0.00160		-0.00044		-0.00298		-0.00002		-0.32160	**
(after National Day)										
h8	0.00174		-0.00038		0.00345		-0.00005		-0.19921	
(after New Year's Day)										
h9	-0.00002		-0.00009		0.00010		0.00000		0.01517	
(regular working day)										
_cons	0.00033		0.00042	**	0.00023		0.00013	***	0.00063	***
trend									-6.23E-08	**
tr2									19.539085	

Table 1.6 Replication Shenzhen 'A'

Regression Results for Shenzhen 'A' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
d_1	0.00219		0.00026		0.00419		-0.00009		0.13121	***
d_2	-0.00043		-0.00005		-0.00083		0.00002		-0.02593	***
d_3	0.00150	**	0.00015		0.00121		-0.00001		-0.01163	
d_4	-0.00179	**	-0.00014		-0.00060		-0.00001		0.01506	
d_5	0.00040		-0.00068	*	-0.00130		0.00001		0.03416	***
m_1	-0.01193		-0.00253		-0.02389		0.00053		0.93715	
m_2	0.00095		0.00020		0.00189		-0.00004		-0.07434	
m_3	0.00137		0.00039		0.00226		-0.00007	***	0.00649	
m_4	0.00136		0.00042		0.00195		-0.00005		0.24665	**
m_5	0.00011		-0.00048		0.00036		0.00010		0.17635	
m_6	0.00128		0.00132	*	0.00234		0.00005		0.24267	*
m_7	-0.00070		0.00012		-0.00206		0.00003		0.04752	
m_8	-0.00110		-0.00031		-0.00256		0.00000		-0.07103	
m_9	-0.00122		-0.00012		-0.00162		-0.00003		-0.08233	
m_{10}	0.00129		0.00092		0.00154		0.00005		0.03097	
m_{11}	0.00004		0.00023		-0.00024		-0.00003		-0.05091	
m_{12}	-0.00279	*	-0.00188		-0.00351	*	-0.00003		-0.28782	**
h1	0.03033		-0.01427		-0.10203		-0.01052		-4.53119	
(before Spring Festival)										
h2	-0.00053		0.00025		0.00178		0.00018		0.07904	
(before Labor Day)										
h3	-0.00008		0.00062		-0.00378		-0.00004		-0.16073	
(before National Day)										
h4	-0.00007		0.00188		-0.00013		-0.00005		-0.14618	
(before New Year's Day)										
h5	0.00092		0.00083		0.00252		0.00017		0.00853	
(after Spring Festival)										
h6	-0.00195		0.00208		-0.00674		-0.00005		0.00120	
(after Labor Day)										
h7	-0.00160		-0.00003		-0.00336		-0.00008		-0.38754	**
(after National Day)										
h8	0.00199		-0.00009		0.00301		-0.00007	**	-0.16484	
(after New Year's Day)										
h9	-0.00004		-0.00012		0.00007		0.00000		0.01391	
(regular working day)										
_cons	0.00040		0.00001		0.00079		0.00016	***	19.88091	***
trend									0.00036	
tr2									0.00000	

Table 1.7 Replication Shanghai 'B'

Regression Results for Shanghai 'B' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
d_1	0.00290		-0.00078		0.00979		-0.00030	**	-0.04980	
d_2	-0.00057		0.00015		-0.00193		0.00006	**	0.00984	
d_3	0.00157	*	-0.00023		0.00088		-0.00001		-0.01605	
d_4	0.00002		-0.00010		0.00180		0.00002		0.03392	*
d_5	0.00020		0.00005		0.00017		0.00000		0.05344	***
m_1	-0.04225	*	-0.00554	*	-0.06786	*	0.00111	**	-0.36132	
m_2	0.00335	*	0.00044	*	0.00538	*	-0.00009	**	0.02866	
m_3	0.00281		0.00117		0.00484		-0.00004		0.11846	
m_4	0.00014		-0.00019		0.00054		-0.00010	***	0.14715	
m_5	0.00309		0.00018		0.00474		-0.00005		0.05542	
m_6	-0.00038		0.00006		0.00055		0.00011		0.15502	
m_7	-0.00441	**	-0.00030		-0.00862	**	0.00005		-0.01242	
m_8	-0.00041		-0.00039	*	-0.00027		0.00015	*	0.21851	
m_9	-0.00106		-0.00057		-0.00162		-0.00005		-0.23489	
m_{10}	-0.00282		0.00033		-0.00508		-0.00004		-0.24844	*
m_{11}	-0.00100		-0.00006		-0.00250		-0.00008	**	-0.22433	*
m_{12}	0.00063		-0.00027		0.00170		0.00003		-0.15043	
h1	-0.14993		0.00291		-0.14480		-0.00308		5.29440	
(before Spring Festival)										
h2	0.00262		-0.00005		0.00253		0.00005		-0.09235	
(before Labor Day)										
h3	0.00217		0.00091		0.00219		-0.00006		-0.25122	
(before National Day)										
h4	-0.00036		-0.00023		0.00124		-0.00017		-0.21631	
(before New Year's Day)										
h5	-0.00539		0.00008		-0.00672		0.00014		0.10141	
(after Spring Festival)										
h6	-0.00339		0.00010		-0.00321		-0.00003		0.02907	
(after Labor Day)										
h7	0.00152		-0.00032		0.00080		-0.00007		-0.04976	
(after National Day)										
h8	-0.00335		-0.00059		-0.00637		-0.00011		-0.16025	
(after New Year's Day)										
h9	0.00011		0.00000		0.00016		0.00001		0.01168	
(regular working day)										
_cons	0.00029		0.00028	**	0.00029		0.00025	***	15.55917	***
trend									0.00175	***
tr2									0.00000	***

Table 1.6 reports the results for the Shenzhen 'A' market. Similar to the Shanghai 'A' market, all returns are higher on Monday than Friday and accompanied with significantly higher volume on

Monday. There is a very strong negative December effect in close-close, open-close returns, and volume. No holiday effect exists.

Table 1.8 Replication Shenzhen 'B'

Regression Results for Shenzhen 'B' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
d_1	0.00637		-0.00611		0.00048		0.00001		-0.09529	
d_2	-0.00171	*	0.00079	**	-0.00172		0.00007	**	0.00326	
d_3	0.00036		-0.00028		-0.00189		0.00002		-0.01969	
d_4	0.00015		-0.00031		0.00060		-0.00003		-0.00129	
d_5	0.00143	*	-0.00009		0.00174		0.00001		0.04623	**
m_1	-0.12256		-0.09512		-0.14405		0.00002		-1.12207	
m_2	0.00161		0.00010		0.00270		-0.00011	**	-0.16631	
m_3	0.00442		0.00160		0.00749		0.00000		0.01342	
m_4	0.00020		-0.00014		0.00091		-0.00007	*	0.37394	*
m_5	0.00378		0.00010		0.00569		0.00003		0.16450	
m_6	0.00108		0.00173	*	0.00187		0.00027	*	0.36650	*
m_7	-0.00354	*	-0.00017		-0.00700		0.00006		0.23404	
m_8	-0.00206		-0.00036		-0.00362		0.00005		0.15667	
m_9	-0.00168		-0.00074	*	-0.00230		-0.00010	**	-0.27532	*
m_{10}	-0.00296	*	0.00036		-0.00604	*	-0.00008	*	-0.22092	
m_{11}	0.00119		-0.00005		0.00206		-0.00003		-0.31032	*
m_{12}	-0.00130		-0.00126	*	-0.00115		-0.00004		-0.20044	
h1	0.09712		0.10450		0.43755		0.00018		1.90675	
(before Spring Festival)										
h2	-0.00175		-0.00081	*	-0.00486		0.00002		-0.20013	
(before Labor Day)										
h3	0.00409		0.00023		0.00280		-0.00004		-0.30282	**
(before National Day)										
h4	0.00383		0.00094		0.00956		-0.00014		-0.04922	
(before New Year's Day)										
h5	-0.00367		-0.00050		-0.00303		0.00021		-0.02046	
(after Spring Festival)										
h6	-0.00756	*	0.00072		-0.01085		-0.00011	*	0.07604	
(after Labor Day)										
h7	0.00055		-0.00031		0.00235		-0.00001		-0.04854	
(after National Day)										
h8	-0.00257		0.00029		-0.00520		-0.00003		-0.09928	
(after New Year's Day)										
h9	0.00001		-0.00001		-0.00003		0.00000		0.00923	
(regular working day)										
_cons	0.00063		0.00080	***	0.00046		0.00028	***	15.36756	***
trend									0.00128	***
tr2									0.00000	***

Table 1.7 reports the results for the Shanghai ‘B’ market. There is no weekend effect. Close-close and open-close returns are higher on Monday than Friday, while close-open returns and volume are higher on Friday than Monday. There is a very strong and consistent negative January effect, negative July effect, and positive February effect in returns. No holiday effect exists. Table 1.8 reports the results for the Shenzhen ‘B’ market. A Tuesday effect exists in returns and volatility. There are very strong and consistent negative October effects in returns and volatility. Weak Labor Day effect is identified whereby the close-close returns and volatility are significantly lower than average. No other holiday effect exists.

Table 1.9 Comparison of Results

Comparsion of Results								
	The results of this paper				Cao, Harris and Wang (2007)			
Effect	Shanghai 'A'	Shenzhen 'A'	Shanghai 'B'	Shenzhen 'B'	Shanghai 'A'	Shenzhen 'A'	Shanghai 'B'	Shenzhen 'B'
Weekend	yes	yes			strong	strong		
Thursday	yes					yes		
January			strong					
February			strong					
March					yes	yes		yes
July			strong				yes	yes
October				strong				
December		strong				yes		yes
Labor Day				yes				
Spring Festiveal					strong	strong	strong	strong

Note: For simplicity, the table includes selected effect instead of including all the daily, monthly, and holiday effects.

Not only are the descriptive results different from Cao, Harris and Wang (2007), but also the regression results in this chapter. Table 1.9 exhibits the detailed differences. There is no holiday effect in all four markets except a weak Labor Day (May 1st) effect in the Shenzhen ‘B’ market in this chapter. There is a weak weekend effect in the Shanghai and Shenzhen ‘A’ markets. A strong monthly seasonality pattern exists in the Shanghai ‘B’ market. This contrasts with the findings in Cao, Harris and Wang (2007), which identified a significant Spring Festival effect in all markets and a strong weekend effect in 'A' markets. The weekend effect in Cao, Harris and Wang (2007) showed stock returns on Mondays are significantly lower than those of the previous Friday. Stock returns on Mondays are higher than Friday in this chapter. A strong monthly seasonality pattern has been identified in 'B' markets while Cao, Harris and Wang (2007) did not find any. The reason for such differences may be due to the differences in the time horizons between this chapter and Cao, Harris and Wang (2007) or other factors.

1.5.2 Model with 1st lag: full sample

In this section, three return series, volatility, and volume traded are regressed on 26 dummy variables and the 1st lag. From Table 1.10, most of the time-series have lower AIC and BIC in the model with 1st lag. In most time series, a model with 1st lag outperforms a model without 1st lag. The regression results without 1st lag are in the appendix. In the following analysis, I include 1st lag for all the time series in order to be consistent. As mentioned in the methodology section, the regression equation is as follows. The time horizon is from Dec 20th 1995 to April 8th 2013. After adding the 1st lag, the seasonality patterns changed.

$$\mathrm{y}_t = \alpha + \sum_{i=1}^{5} d_i D_{i,t} + \sum_{i=1}^{12} m_i M_{i,t} + \sum_{i=1}^{9} h_i H_{i,t} + l\mathrm{y}_{t\text{-}1} + \varepsilon_t \quad (7)$$

Table 1.11 and Table 1.12 report the results for the Shanghai 'A' market and Shenzhen 'A' market. A strong weekend effect exists in returns and volatility in Shanghai 'A' and Shenzhen 'A'. Returns are lower than average and volume is significantly higher than average on Tuesday for both 'A' markets. There is a consistent strong positive April effect in returns and volume in both 'A' markets. Only a weak Spring Festival effect exists in the Shanghai 'A' market.

Table 1.10 Model Selection Using Information Criterion

Model Selection Using Information Criterion for Shanghai 'A' Market				
	No lag		With 1st lag	
	AIC	BIC	AIC	BIC
$r_t^{c/c}$	-21980.38	-21828.24	-21972.85	-21814.37
$r_t^{c/o}$	-29005.77	-28853.63	-29035.56	-28877.09
$r_t^{o/c}$	-19336	-19183.86	-20029.36	-19870.89
σ_t	-56204.83	-56052.69	-56446.39	-56287.91
ν_t	8290.646	8455.467	1048.052	1212.867
Model Selection Using Information Criterion for Shanghai 'B' Market				
	No lag		With 1st lag	
	AIC	BIC	AIC	BIC
$r_t^{c/c}$	-19797.35	-19645.21	-19850.52	-19692.04
$r_t^{c/o}$	-30045.47	-29893.33	-30140.41	-29981.93
$r_t^{o/c}$	-16560.15	-16408.01	-17720.18	-17561.7
σ_t	-50433.14	-50281	-50735.05	-50576.58
ν_t	10681.62	10846.44	4796.196	4967.35
Model Selection Using Information Criterion for Shenzhen 'A' Market				
	No lag		With 1st lag	
	AIC	BIC	AIC	BIC
$r_t^{c/c}$	-21176.2	-21024.05	-21177.56	-21019.08
$r_t^{c/o}$	-28930.15	-28778.01	-29022.01	-28863.54
$r_t^{o/c}$	-18319.69	-18167.55	-19129.46	-18970.98
σ_t	-54548.62	-54396.47	-54829.97	-54671.49
ν_t	8272.167	8436.988	-345.1996	-180.385
Model Selection Using Information Criterion for Shenzhen 'B' Market				
	No lag		With 1st lag	
	AIC	BIC	AIC	BIC
$r_t^{c/c}$	-16309.28	-16157.14	-16309.4	-16150.92
$r_t^{c/o}$	-18388.09	-18235.95	-18380.71	-18222.23
$r_t^{o/c}$	-14660.76	-14508.62	-15011.74	-14853.27
σ_t	-50283.46	-50131.31	-50663.69	-50505.21
ν_t	10462.8	10627.62	5737.381	5908.535

Table 1.13 and Table 1.14 report the results for the Shanghai ‘B’ market and Shenzhen ‘B’ market. The Shanghai ‘B’ market and Shenzhen ‘B’ market have different seasonality patterns, except a strong weekend effect exists in returns, volatility, and volume in both markets. There are negative January and positive February effects in returns in Shanghai ‘B’; however, the

Shenzhen ‘B’ market has negative August effect in returns. There is no holiday effect in both markets except a weak National Day effect in Shenzhen ‘B’’.

Table 1.11 Full Sample with 1st Lag for Shanghai ‘A’

Regression Results for Shanghai 'A' Market Dec 20th 1995- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		v_t	
1st lag	0.00392		0.09711		0.39272	***	0.24426	***	0.90702	***
d_1	0.00664	**	0.00178		0.01023	***	-0.00014	***	0.04411	
d_2	-0.00131	**	-0.00035		-0.00202	***	0.00003	***	-0.00872	
d_3	0.00134	**	0.00013		0.00083		0.00000		0.00730	
d_4	-0.00158	***	-0.00011		-0.00056		0.00001		0.01872	**
d_5	0.00079	*	-0.00040		-0.00052		0.00000		-0.00835	
m_1	-0.01074		-0.00193		-0.01092		-0.00016		-0.00758	
m_2	0.00085		0.00015		0.00087		0.00001		0.00060	
m_3	0.00053		0.00017		0.00054		-0.00002		0.00826	
m_4	0.00220	**	0.00091	**	0.00209	**	-0.00001		0.04060	***
m_5	-0.00047		-0.00084		0.00011		0.00003		0.00709	
m_6	0.00026		0.00030		0.00010		0.00003		-0.00191	
m_7	0.00000		0.00031		-0.00017		-0.00001		0.00499	
m_8	-0.00129		-0.00045		-0.00141		0.00000		-0.01606	
m_9	-0.00092		0.00026		-0.00109		-0.00002		-0.02195	*
m_{10}	-0.00016		0.00056		-0.00062		0.00000		-0.00388	
m_{11}	-0.00009		-0.00027		0.00003		-0.00001		-0.00585	
m_{12}	-0.00014		-0.00055		0.00019		-0.00002		-0.01926	
h1	0.14483		0.06564	**	0.11627		-0.00095		2.52149	**
(before Spring Festival)										
h2	-0.00253		-0.00114	**	-0.00203		0.00002		-0.04398	**
(before Labor Day)										
h3	0.00254		0.00088		0.00196		0.00000		-0.01681	
(before National Day)										
h4	0.00046		0.00071		0.00069		-0.00002		0.00014	
(before New Year’s Day)										
h5	0.00113		0.00063		0.00028		0.00005		0.02675	
(after Spring Festival)										
h6	0.00063		0.00176		-0.00185		-0.00002		0.01037	
(after Labor Day)										
h7	-0.00013		-0.00010		-0.00084		0.00004		0.01393	
(after National Day)										
h8	0.00199		0.00024		0.00242		-0.00003		0.04203	
(after New Year’s Day)										
h9	-0.00018		-0.00007		-0.00012		0.00000		-0.00034	
(regular working day)										
_cons	0.00031		-0.00010		0.00045		0.00012	***	1.80813	***
trend									0.00006	***
tr2									0.00000	

Table 1.12 Full Sample with 1st Lag for Shenzhen 'A'

Regression Results for Shenzhen 'A' Market Dec 20th 1995- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.04704	**	0.15522	**	0.42139	***	0.26177	***	0.93323	***
d_1	0.00520	*	0.00153		0.00741	**	-0.00014	***	-0.00156	
d_2	-0.00103	*	-0.00030		-0.00146	**	0.00003	***	0.00031	
d_3	0.00152	**	0.00004		0.00106		0.00000		0.00703	
d_4	-0.00192	***	0.00001		-0.00084		0.00000		0.01448	**
d_5	0.00044		-0.00053	**	-0.00134	**	0.00001		-0.00610	
m_1	-0.02192		-0.00476		-0.02061		-0.00009		0.07204	
m_2	0.00174		0.00038		0.00164		0.00001		-0.00571	
m_3	0.00047		0.00019		0.00047		-0.00003		0.00213	
m_4	0.00198	*	0.00078	**	0.00187		-0.00001		0.03408	***
m_5	-0.00021		-0.00083		0.00040		0.00006		0.00812	
m_6	-0.00037		0.00026		-0.00069		0.00004		0.00815	
m_7	0.00042		0.00017		0.00054		0.00000		-0.00328	
m_8	-0.00137		-0.00048		-0.00145		0.00000		-0.00649	
m_9	-0.00111		0.00024		-0.00130		-0.00003		-0.01848	*
m_{10}	0.00040		0.00052		0.00001		0.00000		0.00861	
m_{11}	-0.00006		0.00008		-0.00014		-0.00002		-0.01109	
m_{12}	-0.00101		-0.00081		-0.00063		-0.00003		-0.01840	*
h1	0.18325		0.05910		0.15695		-0.00444		2.49667	
(before Spring Festival)										
h2	-0.00320		-0.00103		-0.00274		0.00008		-0.04355	**
(before Labor Day)										
h3	0.00066		0.00033		-0.00039		0.00000		-0.02216	
(before National Day)										
h4	-0.00011		0.00116		-0.00006		-0.00004		-0.00958	
(before New Year's Day)										
h5	0.00111		0.00032		0.00051		0.00003		0.03345	
(after Spring Festival)										
h6	0.00137		0.00163		-0.00079		-0.00003		-0.00025	
(after Labor Day)										
h7	-0.00109		-0.00001		-0.00135		0.00001		0.00312	
(after National Day)										
h8	0.00218		0.00043		0.00232		-0.00006	**	0.04088	
(after New Year's Day)										
h9	-0.00011		-0.00007		-0.00005		0.00000		0.00044	
(regular working day)										
_cons	0.00047		-0.00037	***	0.00082	**	0.00014	***	1.33113	
trend									0.00001	***
tr2									0.00000	***

Table 1.13 Full Sample with 1st Lag for Shanghai 'B'

Regression Results for Shanghai 'B' Market Dec 20th 1995- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.12022	***	0.15768	***	0.49324	***	0.27015	***	0.86969	***
d_1	0.00614		0.00006		0.01107	**	-0.00035	***	-0.27560	***
d_2	-0.00121		-0.00001		-0.00219	**	0.00007	***	0.05446	***
d_3	0.00160	**	-0.00027		0.00113		-0.00001		-0.01815	
d_4	-0.00063		0.00017		0.00112		0.00000		0.02324	*
d_5	0.00071		-0.00023		-0.00060		-0.00001		0.00795	
m_1	-0.03445	**	-0.00022		-0.04005	**	0.00042		-0.02250	
m_2	0.00273	**	0.00031		0.00318	**	-0.00003		0.00179	
m_3	0.00111		0.00032		0.00119		-0.00003		0.01617	
m_4	0.00101		0.00056		0.00085		-0.00006	**	0.04334	**
m_5	0.00084		-0.00059		0.00111		0.00006		0.01775	
m_6	-0.00123		-0.00027		-0.00147		0.00007		-0.00794	
m_7	-0.00145		-0.00005		-0.00161		0.00000		0.00740	
m_8	-0.00136		-0.00047	*	-0.00134		0.00006		0.00668	
m_9	-0.00062		0.00003		-0.00057		-0.00004		-0.03512	
m_{10}	-0.00186		0.00031		-0.00214		-0.00003		-0.02937	*
m_{11}	0.00008		0.00015		-0.00028		-0.00004		-0.01056	
m_{12}	0.00075		0.00001		0.00104		-0.00001		-0.03251	
h1	0.01670		0.04936		0.03350		-0.00517		0.80046	
(before Spring Festival)										
h2	-0.00029		-0.00086		-0.00058		0.00009		-0.01396	
(before Labor Day)										
h3	0.00295		0.00086		0.00272		0.00001		-0.00405	
(before National Day)										
h4	0.00028		0.00001		0.00088		-0.00010	*	0.00264	
(before New Year's Day)										
h5	-0.00459	**	-0.00008		-0.00714		0.00004		0.00152	
(after Spring Festival)										
h6	0.00135		0.00155		0.00165		0.00000		-0.03399	
(after Labor Day)										
h7	-0.00018		-0.00057		-0.00127		0.00004		0.04664	
(after National Day)										
h8	-0.00057		0.00032		-0.00118		-0.00011	*	0.07021	
(after New Year's Day)										
h9	-0.00003		-0.00004		0.00006		0.00000		-0.00111	
(regular working day)										
_cons	0.00035		-0.00013		0.00048		0.00018	***	2.09220	***
trend									0.00009	***
tr2									0.00000	***

Table 1.14 Full Sample with 1st Lag for Shenzhen 'B'

Regression Results for Shenzhen 'B' Market Dec 20th 1995- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.04099		0.00221		0.28646		0.30031	***	0.82276	***
d_1	0.00772	*	-0.00469	*	0.00603		-0.00026	**	-0.13304	*
d_2	-0.00152	*	0.00093	*	-0.00119	**	0.00005	**	0.02532	*
d_3	0.00112		0.00018		-0.00095		0.00001		-0.02279	
d_4	0.00000		0.00027		0.00118		-0.00002		0.00703	
d_5	0.00158	**	0.00013		0.00108		0.00000		0.02119	
m_1	-0.05763		-0.03478		-0.05685		0.00059	**	0.15270	
m_2	0.00457		0.00276		0.00451		-0.00005	**	-0.02619	
m_3	0.00246		0.00071		0.00333		0.00000		0.01695	
m_4	0.00085		0.00072		0.00097		-0.00005	**	0.06984	***
m_5	0.00147		-0.00049		0.00206		5.3E-05		0.0307	
m_6	0.00027		0.00102		-2.7E-05		0.00011		0.02131	
m_7	-0.00154		6.8E-07		-0.00228		9.3E-06		0.01546	
m_8	-0.00222	**	-0.00046		-0.0029	**	1.7E-05		-0.00383	
m_9	-0.00184		-0.00029		-0.00242		-4.9E-05	**	-0.05019	**
m_{10}	-0.00151		0.00021		-0.00237		-4.4E-05	*	-0.01626	
m_{11}	0.00091		-1.6E-05		0.00121		-7.9E-06		-0.02897	
m_{12}	0.00002		-0.00063		0.00051		-2.2E-05		-0.02754	
h1	0.08479		0.07418		0.17203		-0.00115		1.71891	
(before Spring Festival)										
h2	-0.00148		-0.00129		-0.00300		0.00002		-0.05049	
(before Labor Day)										
h3	0.00503	**	0.00039		0.00548	**	0.00000		-0.01594	
(before National Day)										
h4	0.00356		0.00117		0.00565	**	-0.00007		-0.04062	
(before New Year's Day)										
h5	-0.00519	*	-0.00225		-0.00592		0.00008		-0.00529	
(after Spring Festival)										
h6	-0.00087		0.00272	*	-0.00157		-0.00004		0.00156	
(after Labor Day)										
h7	-0.00047		-0.00040		0.00023		0.00004		0.04833	
(after National Day)										
h8	0.00228		0.00327		0.00087		-0.00005		0.00959	
(after New Year's Day)										
h9	0.00029		0.00039		0.00016		0.00000		0.00043	
(regular working day)										
_cons	0.00020		-0.00044		0.00061		0.00017	***	2.73986	***
trend									0.00019	***
tr2									0.00000	***

1.5.3 Model with 1st lag: Sub-sample Analysis

1.5.3.1 First period Dec 20th 1995 – Jan 20th 2006

Table 1.15 First period regression results for Shanghai ‘A’

Regression Results for Shanghai 'A' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.00450		0.15114		0.38732	***	0.18850	***	0.85429	***
d_1	0.00405		0.00173		0.01070	**	-0.00013	**	0.10780	
d_2	-0.00080		-0.00034		-0.00212	**	0.00003	**	-0.02130	
d_3	0.00153	**	0.00029		0.00159	*	-0.00001		0.00891	
d_4	-0.00158	**	-0.00024		-0.00082		0.00001		0.02555	**
d_5	0.00086		-0.00051		-0.00037		0.00001		0.01145	
m_1	-0.00928		0.00068		-0.01397		0.00004		0.22642	
m_2	0.00074		-0.00005		0.00111		0.00000		-0.01796	
m_3	0.00129		0.00025		0.00117		-0.00004	***	0.01809	
m_4	0.00161		0.00049		0.00158		-0.00003	*	0.05308	**
m_5	-0.00005		-0.00027		0.00041		0.00004		0.01903	
m_6	0.00175		0.00107		0.00153		0.00003		0.01599	
m_7	-0.00140		0.00014		-0.00202	*	0.00001		0.00735	
m_8	-0.00097		-0.00036		-0.00106		0.00001		-0.02130	
m_9	-0.00113		-0.00011		-0.00117		-0.00002		-0.03226	
m_{10}	-0.00034		0.00080		-0.00125		0.00001		-0.00284	
m_{11}	0.00015		-0.00009		0.00036		-0.00001		-0.01025	
m_{12}	-0.00141		-0.00099		-0.00092		-0.00001		-0.03255	
h1	0.12704		0.03247		0.06158		-0.00339		1.64882	
(before Spring Festival)										
h2	-0.00222		-0.00057		-0.00107		0.00006		-0.02876	
(before Labor Day)										
h3	0.00097		0.00087		0.00012		-0.00003		-0.04155	
(before National Day)										
h4	-0.00226		0.00043		-0.00264		-0.00004		-0.02058	
(before New Year’s Day)										
h5	0.00259		0.00137		0.00223		0.00016	*	0.03585	
(after Spring Festival)										
h6	-0.00253		0.00174		-0.00669		-0.00004		-0.01745	
(after Labor Day)										
h7	-0.00159		-0.00038		-0.00220		0.00000		-0.01456	
(after National Day)										
h8	0.00173		-0.00031		0.00311		-0.00004		0.03687	
(after New Year’s Day)										
h9	-0.00002		-0.00007		0.00007		0.00000		0.00034	
(regular working day)										
_cons	0.00032		0.00036	**	0.00014		0.00011	***	2.85271	***
trend									0.00009	**
tr2									0.00000	

Table 1.16 First period regression results for Shenzhen 'A'

Regression Results for Shenzhen 'A' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.02527		0.22877	**	0.40092	***	0.25204	***	0.91387	***
d_1	0.00221		0.00108		0.00727	*	-0.00012	**	0.06343	
d_2	-0.00044		-0.00021		-0.00144	*	0.00002	*	-0.01253	
d_3	0.00150	**	0.00017		0.00156		-0.00001		0.01096	
d_4	-0.00182	**	-0.00018		-0.00115		-0.00001		0.01829	*
d_5	0.00045		-0.00065	*	-0.00102		0.00001		0.01594	
m_1	-0.01162		-0.00200		-0.01540		0.00040		0.36690	
m_2	0.00092		0.00016		0.00122		-0.00003		-0.02911	
m_3	0.00134		0.00028		0.00121		-0.00005	***	0.00780	
m_4	0.00134		0.00032		0.00118		-0.00003		0.03495	***
m_5	0.00012		-0.00036		0.00067		0.00007		0.01760	
m_6	0.00122		0.00101	*	0.00091		0.00004		0.02452	
m_7	-0.00067		0.00008		-0.00104		0.00003		-0.00752	
m_8	-0.00106		-0.00023		-0.00121		0.00000		-0.00504	
m_9	-0.00120		-0.00009		-0.00117		-0.00002		-0.02015	
m_{10}	0.00126		0.00064		0.00068		0.00004		0.02095	
m_{11}	0.00005		0.00020		0.00001		-0.00002		-0.01513	
m_{12}	-0.00276		-0.00139		-0.00213	*	-0.00002		-0.02871	**
h1	0.03375		-0.01402		-0.09653		-0.00936		1.26137	
(before Spring Festival)										
h2	-0.00059		0.00024		0.00168		0.00016		-0.02200	
(before Labor Day)										
h3	-0.00001		0.00045		-0.00178		-0.00004		-0.03256	
(before National Day)										
h4	-0.00010		0.00121		-0.00015		-0.00004		-0.01549	
(before New Year's Day)										
h5	0.00084		0.00055		0.00062		0.00014		0.03192	
(after Spring Festival)										
h6	-0.00190		0.00149		-0.00615		-0.00005		-0.03075	
(after Labor Day)										
h7	-0.00155		0.00002		-0.00154		-0.00005		-0.02117	
(after National Day)										
h8	0.00197		0.00000		0.00292		-0.00005	*	0.04215	
(after New Year's Day)										
h9	-0.00004		-0.00009		0.00004		0.00000		0.00066	
(regular working day)										
_cons	0.00039		0.00001		0.00047		0.00012	***	1.71760	***
trend									0.00002	
tr2									0.00000	

From Table 1.15 and Table 1.16, similar patterns exist in both ‘A’ markets for this timeframe. The 1st lag is more significant in the Shenzhen ‘A’ market. There are only weak weekend effects in returns and volatility in both ‘A’ markets, and the volume is significantly higher than average in April. A positive Wednesday effect and negative Thursday effect exist in close-close returns. Neither monthly seasonality pattern nor holiday effect exists in any ‘A’ markets.

From Table 1.17 and Table 1.18, different patterns exist in the Shanghai and Shenzhen ‘B’ markets, but the 1st lag is consistently significant. In the Shenzhen ‘B’ market, strong weekend effects exist in all three returns and volatility while there are no weekend effects in the Shanghai ‘B’ market returns. The Shenzhen ‘B’ market has a significant negative Tuesday effect in returns. The negative Tuesday effect also exists in the Shanghai ‘B’ market, but it is insignificant. The Shanghai ‘B’ market displays strong January and February effects in all returns and volatility while no such effects in returns in the Shenzhen ‘B’ market. The Labor Day effect exists only in the Shenzhen ‘B’ market. One common thing is that close-close and open-close are significantly lower than average in July and October in the Shanghai and Shenzhen ‘B’ markets.

Table 1.17 First period regression results for Shanghai 'B'

Regression Results for Shanghai 'B' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.13621	***	0.30841	**	0.52897	***	0.21718	***	0.83496	***
d_1	0.00207		-0.00056		0.00783		-0.00037	***	-0.41808	***
d_2	-0.00041		0.00011		-0.00155		0.00007	***	0.08262	***
d_3	0.00165	*	-0.00029		0.00188		-0.00002		-0.02481	
d_4	-0.00019		-0.00003		0.00129		0.00002		0.04580	**
d_5	0.00021		0.00008		-0.00072		-0.00001		0.02078	
m_1	-0.03827	*	-0.00446	*	-0.04404	**	0.00087	**	0.45811	
m_2	0.00304	*	0.00035	*	0.00349	**	-0.00007	**	-0.03634	
m_3	0.00236		0.00078		0.00182		-0.00003		0.04194	
m_4	0.00010		-0.00015		0.00018		-0.00008	***	0.04266	
m_5	0.00283		0.00011		0.00297		-0.00004		0.02170	
m_6	-0.00053		0.00003		-0.00081		0.00008		0.00363	
m_7	-0.00379	**	-0.00021		-0.00411	**	0.00004		0.01446	
m_8	-0.00038		-0.00027	*	-0.00043		0.00011		0.03840	
m_9	-0.00091		-0.00041		-0.00047		-0.00004		-0.05564	
m_{10}	-0.00258	*	0.00018		-0.00298	*	-0.00003		-0.03241	
m_{11}	-0.00078		-0.00003		-0.00098		-0.00006	**	-0.04074	
m_{12}	0.00053		-0.00018		0.00094		0.00002		-0.03338	
h1	-0.15382		-0.00429		-0.18126		-0.00239		1.88073	
(before Spring Festival)										
h2	0.00268		0.00007		0.00316		0.00004		-0.03281	
(before Labor Day)										
h3	0.00211		0.00076		0.00171		-0.00005	*	-0.01317	
(before National Day)										
h4	-0.00056		-0.00018		0.00048		-0.00013		0.00476	
(before New Year's Day)										
h5	-0.00525		-0.00002		-0.00670		0.00011		0.01127	
(after Spring Festival)										
h6	-0.00341		0.00011		-0.00276		-0.00003		-0.08875	
(after Labor Day)										
h7	0.00170		-0.00014		0.00126		-0.00005		0.02096	
(after National Day)										
h8	-0.00289		-0.00050		-0.00336		-0.00008		0.06673	
(after New Year's Day)										
h9	0.00010		0.00000		0.00014		0.00000		-0.00014	
(regular working day)										
_cons	0.00026		0.00020	**	0.00017		0.00019	***	2.57084	***
trend									0.00028	***
tr2									0.00000	***

Table 1.18 First period regression results for Shenzhen 'B'

Regression Results for Shenzhen 'B' Market Dec 20th 1995- Jan 20th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.13046	***	0.18132		0.48911	***	0.29247	***	0.79907	***
d_1	0.00854	*	-0.00411	**	0.01239	**	-0.00043	**	-0.16417	
d_2	-0.00169	*	0.00081	**	-0.00245	**	0.00009	**	0.03244	
d_3	0.00055		-0.00042	*	-0.00108		0.00001		-0.02168	
d_4	0.00013		-0.00026		0.00153		-0.00004		0.01272	
d_5	0.00143	*	-0.00003		0.00157		0.00002		0.04268	*
m_1	-0.01855		-0.00130		-0.01896		0.00098	**	0.94517	
m_2	0.00147		0.00010		0.00150		-0.00008	**	-0.07498	
m_3	0.00380		0.00129		0.00355		0.00001		0.03984	
m_4	0.00014		-0.00010		0.00038		-0.00006	**	0.08077	**
m_5	0.00353		0.00009		0.00405	*	0.00002		0.05347	
m_6	0.00074		0.00140		0.00017		0.00019	*	0.06517	
m_7	-0.00307	*	-0.00014		-0.00356	*	0.00004		0.04369	
m_8	-0.00181		-0.00030		-0.00200		0.00004		0.02853	
m_9	-0.00150		-0.00061	*	-0.00107		-0.00007	**	-0.07636	***
m_{10}	-0.00263	*	0.00026		-0.00345	**	-0.00005	*	-0.04386	
m_{11}	0.00109		-0.00003		0.00154		-0.00002		-0.06710	
m_{12}	-0.00114		-0.00101	*	-0.00080		-0.00003		-0.03017	
h1	0.07057		0.03685		0.02268		-0.00211		3.39990	
(before Spring Festival)										
h2	-0.00123		-0.00064		-0.00040		0.00004		-0.05931	
(before Labor Day)										
h3	0.00423		0.00018		0.00407		-0.00003		-0.03650	
(before National Day)										
h4	0.00289		0.00068		0.00531	*	-0.00008		-0.03454	
(before New Year's Day)										
h5	-0.00369		-0.00042		-0.00422		0.00015		-0.03188	
(after Spring Festival)										
h6	-0.00720	*	0.00063		-0.00852	**	-0.00008	*	-0.04077	
(after Labor Day)										
h7	0.00042		-0.00015		0.00042		0.00001		0.08527	
(after National Day)										
h8	-0.00229		0.00021		-0.00293		-0.00002		0.00052	
(after New Year's Day)										
h9	0.00002		-0.00001		-0.00003		0.00000		0.00018	
(regular working day)										
_cons	0.00055		0.00065	***	0.00024		0.00020	***	3.09202	***
trend									0.00025	**
tr2									0.00000	***

1.5.3.2 Second period Jan 23rd 1995 – April 8th 2006

In Table 1.19 and Table 1.20, both ‘A’ markets have positive April effects in returns and volume. Another similarity is the weekend effect in returns. A negative Tuesday effect is prominent in returns in both ‘A’ markets. There are also differences: In the Shanghai ‘A’ market, the regular working day has significantly lower close-close and open-close returns. In the Shenzhen ‘A’ market, prominent Spring Festival and Labor Day effects exist, and the Labor Day effect is more significant.

In Table 1.21 and Table 1.22, the patterns in the ‘B’ markets are even more different than the first period from Dec 20th 1995 to Jan 20th 2006. The Shanghai ‘B’ market has a weekend effect in returns and volatility, whereas there is no daily seasonality in the Shenzhen ‘B’ market. A negative Tuesday effect exists only in returns in the Shanghai ‘B’ market. The Shanghai ‘B’ market has a positive April effect in returns and volume while the Shenzhen ‘B’ market has a negative August effect in returns. The Shanghai ‘B’ market has a New Year’s effect in returns and volatility while the Shenzhen ‘B’ market has a National Day effect in returns. The 1st lag is significant for all time-series in Shanghai ‘B’ market and for volatility and volume only in Shenzhen ‘B’ market.

Table 1.19 Second period regression results for Shanghai 'A'

Regression Results for Shanghai 'A' Market Jan 23rd 2006- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	-0.00874		0.01411		0.38560	***	0.26664	***	0.88819	***
d_1	0.01011	**	0.00181		0.00945	*	-0.00015	**	-0.03788	
d_2	-0.00200	**	-0.00036		-0.00187	*	0.00003	**	0.00748	
d_3	0.00106		-0.00009		-0.00023		0.00001		0.00289	
d_4	-0.00156	*	0.00003		-0.00018		0.00002		0.00850	
d_5	0.00065		-0.00023		-0.00077		-0.00002		-0.03350	***
m_1	-0.01446		-0.00936		-0.00810		-0.00029		-0.31578	*
m_2	0.00115		0.00074		0.00064		0.00002		0.02505	*
m_3	-0.00048		0.00011		-0.00038		0.00000		0.00227	
m_4	0.00310	**	0.00154	*	0.00293	*	0.00001		0.04093	***
m_5	-0.00105		-0.00168	**	-0.00035		0.00002		-0.00644	
m_6	-0.00199		-0.00104	*	-0.00200		0.00003		-0.01641	
m_7	0.00198		0.00053		0.00243		-0.00003		-0.00287	
m_8	-0.00181		-0.00059		-0.00198		-0.00001		-0.02166	*
m_9	-0.00065		0.00077		-0.00102		-0.00002		-0.01819	
m_{10}	0.00004		0.00001		0.00031		-0.00002		-0.01118	
m_{11}	-0.00047		-0.00055		-0.00050		0.00001		-0.00125	
m_{12}	0.00166		0.00019		0.00178		-0.00003		-0.00375	
h1	0.18023		0.11492		0.20151		0.00244		3.07578	***
(before Spring Festival)										
h2	-0.00314		-0.00200		-0.00352		-0.00004		-0.05365	***
(before Labor Day)										
h3	0.00453		0.00118		0.00424		0.00002		-0.00023	
(before National Day)										
h4	0.00487		0.00109		0.00604		0.00001		0.01039	
(before New Year's Day)										
h5	-0.00106		-0.00071		-0.00230		-0.00007	*	0.01141	
(after Spring Festival)										
h6	0.00525		0.00181		0.00518		0.00000		0.05752	***
(after Labor Day)										
h7	0.00181		0.00057		0.00082		0.00009		0.02688	
(after National Day)										
h8	0.00225		0.00132	*	0.00109		-0.00002		0.01863	
(after New Year's Day)										
h9	-0.00040	**	-0.00008		-0.00038	*	0.00000		0.00028	
(regular working day)										
_cons	0.00034		-0.00084	***	0.00095	*	0.00015	***	1.32737	
trend									0.00048	***
tr2									0.00000	***

Table 1.20 Second period regression results for Shenzhen 'A'

Regression Results for Shenzhen 'A' Market Jan 23rd 2006- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.06372	***	0.02479		0.43491	***	0.25135	***	0.90581	***
d_1	0.00953	**	0.00207		0.00767		-0.00016	*	-0.08623	**
d_2	-0.00188	**	-0.00041		-0.00152		0.00003	*	0.01704	**
d_3	0.00156		-0.00018		0.00034		0.00002		0.00074	
d_4	-0.00203	**	0.00023		-0.00036		0.00000		0.00917	
d_5	0.00040		-0.00031		-0.00180		0.00000		-0.03537	***
m_1	-0.03142		-0.01179	*	-0.02282		-0.00053		-0.26009	
m_2	0.00249		0.00093	*	0.00181		0.00004		0.02063	
m_3	-0.00055		0.00009		-0.00040		0.00000		-0.00290	
m_4	0.00295	*	0.00154	*	0.00299		0.00003		0.04022	***
m_5	-0.00065		-0.00160	*	-0.00003		0.00005		-0.00243	
m_6	-0.00258		-0.00114		-0.00285		0.00004		-0.01150	
m_7	0.00191		0.00025		0.00270		-0.00003		0.00241	
m_8	-0.00183		-0.00093		-0.00185		-0.00001		-0.01314	
m_9	-0.00093		0.00071		-0.00145		-0.00002		-0.01884	
m_{10}	-0.00086		0.00011		-0.00087		-0.00005		-0.01144	
m_{11}	-0.00022		-0.00010		-0.00038		-0.00001		-0.00404	
m_{12}	0.00146		0.00031		0.00144		-0.00003		-0.00581	
h1	0.37069	*	0.16884	**	0.48160	*	0.00244		3.63574	***
(before Spring Festival)										
h2	-0.00647	*	-0.00295	**	-0.00840	*	-0.00004		-0.06342	***
(before Labor Day)										
h3	0.00135		0.00047		0.00124		0.00003		-0.01501	
(before National Day)										
h4	0.00009		0.00067		0.00026		-0.00002		-0.00929	
(before New Year's Day)										
h5	0.00133		-0.00023		0.00044		-0.00010	*	0.02686	
(after Spring Festival)										
h6	0.00586	*	0.00184		0.00675	**	-0.00001		0.04813	**
(after Labor Day)										
h7	-0.00046		0.00025		-0.00130		0.00008		0.02325	
(after National Day)										
h8	0.00233		0.00128	*	0.00111		-0.00007	*	0.02481	
(after New Year's Day)										
h9	-0.00020		-0.00005		-0.00017		0.00001	*	0.00096	
(regular working day)										
_cons	0.00059		-0.00103	***	0.00131	**	0.00017	***	1.37158	***
trend									0.00026	***
tr2									0.00000	***

Table 1.21 Second period regression results for Shanghai 'B'

Regression Results for Shanghai 'B' Market Jan 23rd 2006- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	0.08186	**	0.07245	**	0.41922	***	0.32955	***	0.85833	***
d_1	0.01151	**	0.00082		0.01458	**	-0.00031	**	-0.04947	
d_2	-0.00227	**	-0.00016		-0.00288	**	0.00006	**	0.00978	
d_3	0.00146		-0.00029		0.00004		0.00001		-0.00907	
d_4	-0.00123		0.00048		0.00077		-0.00002		-0.00853	
d_5	0.00133		-0.00062	*	-0.00053		-0.00002		-0.00673	
m_1	-0.02977		-0.00593		-0.03523		-0.00005		-0.56964	*
m_2	0.00236		0.00047		0.00280		0.00000		0.04519	*
m_3	-0.00056		-0.00049		-0.00008		-0.00003		-0.01581	
m_4	0.00243	*	0.00172	*	0.00211		-0.00004		0.04320	**
m_5	-0.00197		-0.00171		-0.00172		0.00018		0.00779	
m_6	-0.00247		-0.00087		-0.00290		0.00006		-0.02030	
m_7	0.00201		0.00019		0.00262		-0.00005	*	-0.00980	
m_8	-0.00295		-0.00078		-0.00313		-0.00001		-0.03052	
m_9	-0.00027		0.00073		-0.00079		-0.00003		-0.01171	
m_{10}	-0.00086		0.00031		-0.00091		-0.00004		-0.03752	*
m_{11}	0.00130		0.00042		0.00100		0.00000		0.02777	
m_{12}	0.00097		0.00032		0.00111		-0.00006	*	-0.02674	
h1	0.26699		0.12290		0.38422		-0.00783		-1.01132	
(before Spring Festival)										
h2	-0.00466		-0.00214		-0.00670		0.00014		0.01764	
(before Labor Day)										
h3	0.00410		0.00123		0.00427		0.00008		-0.00841	
(before National Day)										
h4	0.00166		0.00038		0.00167		-0.00006	**	-0.01054	
(before New Year's Day)										
h5	-0.00422		-0.00051		-0.00804		-0.00003		-0.02536	
(after Spring Festival)										
h6	0.00849		0.00394		0.00936		0.00004		0.05636	
(after Labor Day)										
h7	-0.00283		-0.00093		-0.00466		0.00015	*	0.07084	
(after National Day)										
h8	0.00331		0.00174	**	0.00276		-0.00017	*	0.04535	
(after New Year's Day)										
h9	-0.00023		-0.00010		-0.00010		0.00000		-0.00110	
(regular working day)										
_cons	0.00059		-0.00067	***	0.00115	*	0.00018	***	2.09780	***
trend									0.00022	
tr2									0.00000	

Table 1.22 Second period regression results for Shenzhen 'B'

Regression Results for Shenzhen 'B' Market Jan 23rd 2006- April 8th 2013										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
1st lag	-0.02155		-0.03499		0.10369		0.28901	***	0.85297	***
d_1	0.00661		-0.00551		-0.00010		-0.00001		-0.06904	
d_2	-0.00131		0.00109		0.00002		0.00000		0.01364	
d_3	0.00193		0.00082		-0.00042		0.00001		-0.02535	*
d_4	-0.00018		0.00100		0.00100		0.00002		-0.00094	
d_5	0.00173		0.00045		0.00039		-0.00002		-0.00768	
m_1	-0.12518		-0.09860		-0.12919		-0.00004		-0.20400	
m_2	0.00993		0.00782		0.01025		0.00000		0.01618	
m_3	0.00025		-0.00033		0.00087		-0.00001		-0.01192	
m_4	0.00201		0.00201	*	0.00214		-0.00003		0.05468	***
m_5	-0.00159		-0.00121		-0.00200		0.00010		-0.00324	
m_6	-0.00082		-0.00006		-0.00158		0.00001		-0.02873	
m_7	0.00122		0.00025		0.00203		-0.00004	*	-0.01416	
m_8	-0.00271	*	-0.00060		-0.00420	*	-0.00001		-0.03678	
m_9	-0.00238		0.00029		-0.00458		-0.00001		-0.00839	
m_{10}	0.00052		-0.00009		0.00095		-0.00003		0.01907	
m_{11}	0.00057		0.00005		0.00059		0.00001		0.01891	
m_{12}	0.00203		0.00029		0.00343		-0.00002		-0.02272	
h1	0.10605		0.10709		0.36388		-0.00008		2.05480	
(before Spring Festival)										
h2	-0.00185		-0.00187		-0.00635		0.00000		-0.03584	
(before Labor Day)										
h3	0.00671	**	0.00094		0.00873	**	0.00004		-0.01215	
(before National Day)										
h4	0.00381		0.00152		0.00363		-0.00004		-0.03883	
(before New Year's Day)										
h5	-0.00942		-0.00636		-0.01184	*	-0.00003		0.01490	
(after Spring Festival)										
h6	0.00912		0.00568		0.01289		0.00002		0.06080	
(after Labor Day)										
h7	-0.00161		-0.00005		-0.00009		0.00007		-0.01455	
(after National Day)										
h8	0.01172		0.00907		0.01275		-0.00011	*	0.04396	
(after New Year's Day)										
h9	0.00083		0.00109		0.00063		0.00000		0.00099	
(regular working day)										
_cons	-0.00050		-0.00238	*	0.00119		0.00013	***	2.22638	***
trend									0.00021	
tr2									0.00000	

1.5.4 Summary

After adding the 1st lag, the seasonality patterns changed. As to the full sample analysis, similar seasonality patterns exist in the Shanghai ‘A’ and Shenzhen ‘A’ markets. The Shanghai ‘B’ market and Shenzhen ‘B’ market have different seasonality patterns except for a strong weekend effect. As to the first timeframe from Dec 20th 1995 to Jan 20th 2006, similar seasonality patterns also exist in the ‘A’ markets while different seasonality patterns exist in the ‘B’ markets. For the second time period from January 23rd 2004 to Apr 8th 2013, ‘A’ markets still share similar seasonality patterns while ‘B’ markets display the most different seasonality patterns.

From the results of full sample analysis and two sub-periods analysis, more similar seasonality patterns exist in the ‘A’ markets than in ‘B’ markets. This also confirms the fact that the Shenzhen ‘A’ and Shanghai ‘A’ markets are highly correlated in the three returns, volatility, and trading volume in Table 1.4.

In general, a strong and significant weekend effect, a significant April effect, and a Tuesday effect exist in all four markets. The Tuesday effect is consistently negative in returns and positive in volatility in all four markets. This confirms the negative correlation between returns and volatility in Table 1.3. The April effect is positive for returns and volume. A Spring Festival effect is not a common phenomenon; only a very weak effect exists in the full sample Shanghai ‘A’ market and second sub-period Shenzhen ‘A’ market. No Spring Festival effect has been identified in ‘B’ markets. This is different from previous findings.

In general, negative January and positive February effects exist in returns in the ‘B’ markets. This is consistent with the negative returns in January in the U.S. market. This is reasonable since ‘B’ markets are considered foreign markets. In the same way, the nonexistence of a Spring

Festival effect in ‘B’ markets is also reasonable. However, there are no such effects in ‘A’ markets. Monthly seasonality is more prominent in ‘B’ markets than in ‘A’ markets.

1.6 Conclusion

This chapter finds evidence of weekend effect, April effect, and Tuesday effect in the Chinese Stock Market. Returns are generally higher in April and lower on Tuesday. Consistent seasonality patterns have been identified in returns, volatility, and volume, which indicate a distinct seasonal pattern in the investors’ behavior. Only a minimal and inconsistent Spring Festival effect exists in a full sample Shanghai ‘A’ market and second sub-period in Shenzhen ‘A’ market. Only minimal and inconsistent Labor Day and National effects exist in ‘B’ markets. None of the other holiday effects exists in the Chinese Stock Market, which contradicts previous findings. Monthly seasonality is more prominent in ‘B’ markets than in ‘A’ markets whereas Cao, Harris and Wang (2007) did not find any.

The purpose of this chapter is to better understand and grasp the Chinese Stock Market’s stock returns, price volatility, and liquidity. Different returns measurements give investors broader perspectives. Trading Volume is included for the investors to see the liquidity. Liquidity of equity investments provides investors an ideal investment channel, which makes studying liquidity important. Different investors can take different expected return and risk according to their own preferences for risk, return, and flexibility to the portfolios.

Chapter 2

Common Risk Factors in the Returns on Stocks of CSI300 Index in China

2.1 Introduction and Motivation

Introduction of Chinese Stock Market

The data set includes 300 component stocks in the CSI300 for two stock exchanges: Shanghai and Shenzhen from January 2006 to December 2011. The data set includes monthly size value, monthly PB ratio, and monthly return for 300 component stocks. All the data is from the Wind Financial Terminal provided by Shanghai Wind Information Co., Ltd. The CSI300 Index is very representative and indicative of the entire market in China. Based on the under-development of China's bond market and dearth of data, I do not include bond market in my analysis.

Since there is no longer a bond market, one big question arises: How do I determine the risk-free rate? While Fama-French (1993) used one month of Treasury bill rate as risk-free rate, what should be used here as a substitute? In previous similar studies in China, different scholars chose different measures for risk-free rate. Taking into account that in 2006-2007 China was a bull market, I use the arithmetic average of the three-month time deposit rate as the risk-free rate. This is also arbitrary choice. The data of risk-free rate is also from Wind Financial Terminal.

2.2 Model

The independent variables in the time-series regressions include the monthly excess returns on a market portfolio of stocks and mimic portfolios for size and book-to-market equity. The dependent variables are monthly excess returns on nine portfolios based on size and book-to-market equity. Dependent variables are portfolios returns. Independent variables are market factor, size factor, and book-to-market equity factor. Since I only have 300 total stocks in my analysis, I formed nine portfolios compared to 25 as in Fama and French (1993).

2.3 The Independent Returns

From previous literature, size and book-to-market equity are believed to proxy for risk factors in returns. In Fama and French (1992b), size and book-to-market equity are linked to economic fundamentals. It's very common that high book-to-market equity (low stock price relative to book value) firms tend to have low earnings on assets while low book-to-market equity (high stock price relative to book value) firms earn high profits all the time. Size plays an important role in profitability. For firms that have the same book-to-market equity, small firms tend to have higher earnings than big ones.

Fama and French (1992b) constructed six portfolios formed on size and book-to-market equity. Here, I use the same methodology to form portfolios meant to proxy for risk factors in returns related to size and book-to-market equity. Every year in June, all NYSE stocks on CRSP are ranked by size (price multiplied by shares). Fama and French (1993) used the median NYSE size to sort all stocks into two groups. One of the reasons provided by Fama and French for sorting in June each year is that all NYSE stocks on CRSP are ranked by size. However, there is no such ranking in Wind Financial Terminal. The Chinese public companies' fiscal calendar is from January to December, same as the calendar year. The deadline of disclosing the annual report is April 30th. As such, I also sort stocks at the beginning of June into small and big (S and B) using the median size of all 300 stocks at the end of May each year. I exclude the firms with missing data due to suspension or other reasons. Sorting stocks into two size groups follows the procedures of Fama and French (1993).

I also sort 300 stocks into three book-to-market equity groups according to the breakpoints for the bottom 30% (Low), middle 40% (Medium), and top 30% (High). I exclude the negative BE firms in calculating breakpoints for book-to-market equity groups and forming the six portfolios, which is the same as Fama and French (1993). Based on evidence in Fama and French (1992a) that book-to-market equity has stronger explanatory power than size, I sort firms into three book-to-market equity groups and two size groups. However, there are alternatives I did not follow.

I construct six portfolios (S/L, S/M, S/H, B/L, B/M, B/H) from the overlap of two size and three book-to-market equity groups; the members in these six portfolios are updated once a year at the beginning of June. For instance, the S/L portfolio includes the stocks both in the small size group and low book-to-market equity group, and the B/H portfolio includes the stocks both in the big size group and high book-to-market equity group. Monthly value-weighted returns on the six portfolios are calculated from June to next May, and the portfolios are reconstructed at the beginning of June each year. I use value-weighted returns here in the fashion of Fama and French (1993). Fama and French (1993) claimed that using a value-weighted component (the six portfolios formed on size and book-to-market equity) in SMB and HML is in the spirit of minimizing variance and corresponds to realistic investment opportunities. Here, I followed the rigid process of Fama and French (1993).

One Fama-French benchmark factor portfolio SMB (small minus big), which mimics the risk factor in returns linked to size, is the difference between the simple average of the returns on the three small size portfolios (S/L, S/M, S/H) and the simple average of the returns on the three big size portfolios (B/L, B/M, B/H). This procedure rules out the book-to-market equity effect.

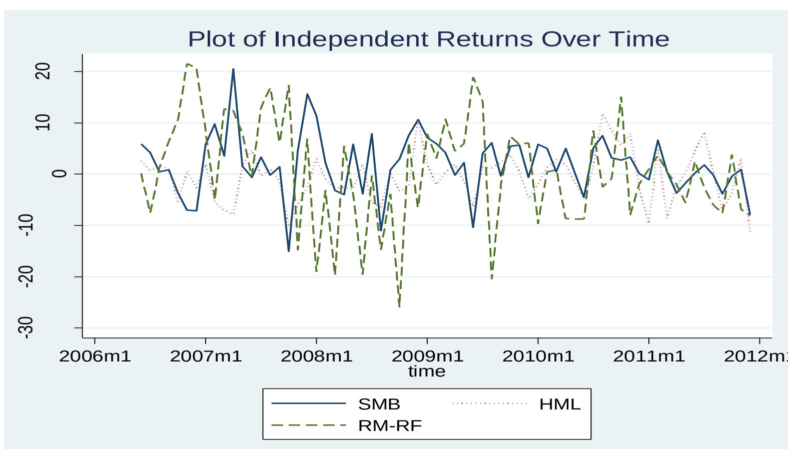
$$SMB = \frac{1}{3}\left[S/L + S/M + S/H\right] - \frac{1}{3}\left[B/L + B/M + B/H\right]$$

Another Fama-French benchmark factor portfolio HML (high minus low), which mimics the risk factor in returns linked to book-to-market equity, is the difference between the simple average of the returns on the two high book-to-market equity portfolios (B/H, S/H) and the simple average of the returns on the two low book-to-market equity portfolios (B/L, S/L). Thus, the factor HML only contains information related to book-to-market equity.

$$HML = \frac{1}{2}\left[S/H + B/H\right] - \frac{1}{2}\left[S/L + B/L\right]$$

The last independent variable is the factor related to the market, which is the excess return RM-RF. RM is the return on the value-weighted portfolio of the stocks in the six portfolios, plus the negative-BE stocks excluded from the portfolios. RF is the arithmetic average of a three-month time deposit rate since no bond market exists in this chapter.

Figure 2.1 Time Series Plot of Independent Returns



2.4 The Dependent Returns

Excess returns on nine portfolios, which are formed on size and book-to-market equity, are dependent variables in the time-series regressions. In Fama and French (1993), they formed 25 portfolios. While Fama and French (1993) had over 2000 stocks in their analysis, I only have 300 stocks. Therefore, nine portfolios are suitable here. The nine portfolios are formed in the same way as the six portfolios. I use the end of May size data to split 300 stocks into three size groups in the beginning of June based on the breakpoints of the bottom 33% (Low), middle 34% (Medium), and top 33% (Big): small, medium and big (S, M and B), excluding firms with incomplete data due to suspension or other reasons. For book-to-market equity, I split them into three groups: low, medium, high (L, M and H) based on the breakpoints of the bottom 33% (Low), middle 34% (Medium), and top 33% (High). This is in following with Fama-French (1993) by dividing the size and book-to-market equity groups equally. The nine portfolios are constructed by the intersection of the size and book-to-market equity groups. Both monthly value-weighted and equal-weighted returns are calculated from June to next May in this chapter. The nine portfolios are also updated once a year, at the beginning of June. Fama-French (1993) only use value-weighted excess return as dependent variables. In this chapter, both monthly value-weighted excess return and equal-weighted excess return from January 2006 to December 2011 are dependent variables in the time-series regressions.

From Table 2.1, the medium book-to-market equity portfolios have the largest number of stocks on average. S/M has 39.2 while M/M has 36.2. The small and big book-to-market equity portfolios contain almost the same number of stocks on average. This is very different from Fama-French (1993) in that the small size portfolios contain the largest number of stocks and big size portfolios contain the smallest number of stocks. In this chapter, the big size portfolios make up the largest fraction of market value while the small size portfolios make up the smallest fraction of market value. When holding book-to-market equity as a constant, the average of annual percent of market value in portfolio increases as size increases.

Table 2.1 Descriptive Results of 9 Portfolios

Descriptive statistics for 9 stock portfolios2006-2011,6 years[a]							
Size	Book-to-market equity (BE/ME)						
	Low	Medium	High		Low	Medium	High
	Average of annual percent of market value in portfolio				Average of annual numbers of firms in portfolio		
Small	1.367%	2.383%	1.556%		21.7	39.2	24.5
Medium	3.921%	4.784%	3.150%		28.8	36.2	23.2
Big	12.773%	28.264%	41.802%		26.8	28.2	29.8

[a] The descriptive statistics are calculated when the portfolios are formed in June of each year, 2006-2011, and are then averaged across six years.

Table 2.2 Summary Statistics

Summary statistics for the monthly independent and dependent returns in the regressions : June 2006 to December 2011, 67 observations.[a]											
					Autocorr.for lag				Correlations		
Name	Mean	Std.	t(mn)		1	2	12				
RM	1.3463	1.2595	1.07		-0.0067	0.2360	-0.2182				
									RM-RF	SMB	HML
RM-RF	0.5780	1.2692	0.46		0.0013	0.2419	-0.2220		1.0000		
SMB	1.8618	0.7155	2.6000		0.0934	-0.1716	0.1907		-0.0824	1.0000	
HML	-0.5640	0.5877	-0.9600		0.2858	-0.1902	0.1207		-0.0599	0.3177	1.0000
Dependent variables: Excess returns on 9 stock portfolios formed on ME and BE/ME (value weighted)											
Book-to-market equity(BE/ME)											
Size		Low	Medium	High		Low	Medium	High			
		Means				Standard deviations					
Small		3.5314	2.2627	3.7554		1.5123	1.4575	1.7232			
Medium		1.5778	1.6521	1.8763		1.4627	1.5672	1.4766			
Big		0.5072	0.6777	1.2158		1.3930	1.4552	1.3703			
		t-statistics for the means									
Small		2.34	1.55	2.18							
Medium		1.08	1.05	1.27							
Big		0.36	0.47	0.89							
Dependent variables: Excess returns on 9 stock portfolios formed on ME and BE/ME (equal weighted)											
Book-to-market equity(BE/ME)											
Size		Low	Medium	High		Low	Medium	High			
		Means				Standard deviations					
Small		3.9629	2.6855	4.4440		1.4747	1.4564	1.7422			
Medium		1.6179	1.7663	1.9566		1.4663	1.5681	1.4709			
Big		0.7549	1.1297	1.2518		1.3521	1.5179	1.4398			
		t-statistics for the means									
Small		2.69	1.84	2.55							
Medium		1.10	1.13	1.33							
Big		0.56	0.74	0.87							

[a] RM is the return on the value-weighted portfolio of the stocks in the six portfolios, plus the negative-BE stocks excluded from the portfolios. RF is the arithmetic average of a three-month time deposit rate, observed at the beginning of each month. The means are reflected as percentages.

Figure 2.2 Time Series Plot of Dependent Returns

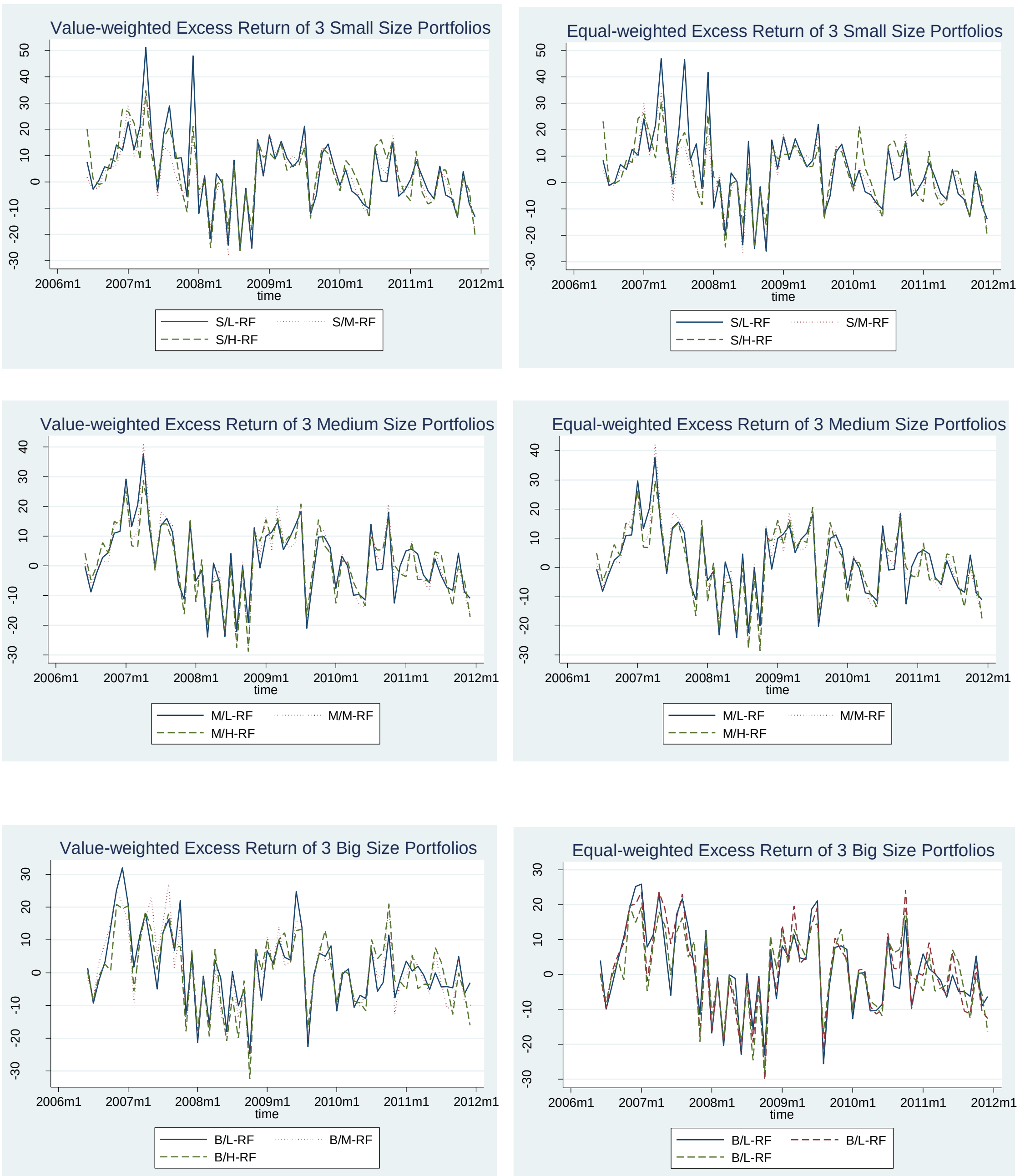


Table 2.2 summarizes the dependent and independent variables in the time-series regressions. The average excess returns on the portfolios give some perspective on the range of the risk factors. The nine portfolios formed on size and book-to-market equity have a wide range of average returns, from 0.5072% to 3.7554% for value-weighted returns and from 0.7549% to

4.4440% for equal-weighted returns. These summary results confirm the negative relation between size and returns. For every value-weighted and equal weighted book-to-market equity group, the portfolio returns tend to decrease with size. The differences between the average returns for the value-weighted big and small-size portfolios range from 1.5805% to 3.0242% per month; the equal-weighted big- and small-size portfolios range from 1.5557% to 3.2079% per month. Such differences are much bigger than 0.19% to 0.62% in Fama-French (1993). However, the relation between book-to-market and return is not that consistent. For value-weighted and equal weighted small-size groups, the returns decrease from low to medium book-to-market equity, then increase from medium to high book-to-market equity. For medium-size and big-size groups, the returns increase from low to high book-to-market equity. This contradicts the findings in Fama-French (1993) where book-to-market equity effect is stronger and more consistent than other effects.

The average risk premiums for the common factors in returns are the average values of the independent returns. The average value of RM-RF (the average premium per unit of market β) is 0.58% per month. This is very large for the investment perspective (about 5% per year). The average SMB return (the average premium for the size-related factor in returns) is 1.86% per month (t=2.60), which is much higher than 0.27% (t=1.73) in Fama-French (1993). The book-to-market factor HML has an average premium of -0.56% (t= -0.96), which also indicates a weak book-to-market equity effect.

2.5 Results

Table 2.3 and Table 2.4 show the regression results containing three factors: RM-RF, SMB, and HML. Although RM-RF already captures some time-series variations in stock returns, adding SMB and HML into the time-series regression captures even more variations. Adjusted R^2

increased dramatically compared to adjusted R^2 in regressions on RM-RF. All 18 adjusted R^2s (including value-weighted and equal weighted) are over 0.8565. This indicates that the modified Fama-French three factor model is relatively suitable for CSI300 component stocks in Chinese Stock Market.

Table 2.3 Regression of Value-weighted Portfolios on 3 factors

Regressions of value-weighted excess stock returns (in percent) on the excess stock-market return(RM-RF) and the mimicking returns for the size(SMB) and book-to-market equity(HML) factors: June 2006 to December 2011, 67 observations								
$R(t)-RF(t)=a+b[RM(t)-RF(t)]+sSMB(t)+hHML(t)+e(t)$								
Dependent variables: Excess returns on 9 stock portfolios formed on size and book-market equity								
Book-to-market equity(BE/ME)								
Size		Low	Medium	High		Low	Medium	High
			b				t(b)	
Small		0.9218	0.9494	1.1235		17.05	24.22	24.02
Medium		1.0147	1.0619	0.9987		27.04	23.73	21.10
Big		1.0387	1.0995	1.0235		30.40	26.75	31.68
			s				t(s)	
Small		1.1278	1.1555	1.3994		11.17	15.78	16.02
Medium		0.8058	1.0722	1.0080		11.50	12.83	11.40
Big		0.1988	-0.0472	-0.0875		3.12	-0.62	-1.45
			h				t(h)	
Small		0.3704	-0.0084	-0.4886		3.02	-0.09	-4.60
Medium		0.4572	0.0902	-0.3406		5.37	0.89	-3.17
Big		0.5865	0.1880	-0.3071		7.56	2.02	-4.19
			Adjusted R^2				s(e)	
Small		0.8652	0.9237	0.9223		4.55	3.30	3.93
Medium		0.9306	0.9140	0.8916		3.15	3.76	3.98
Big		0.9365	0.9159	0.9414		2.87	3.46	2.72

The slopes of SMB in Table 2.3 and Table 2.4 are positive except for two big size value-weighted portfolios. The slopes on SMB exceed 1.1 for portfolios in the small size groups, and they drop to -0.0875 in value-weighted returns and around 0.4 in equal-weighted returns for the big size groups. The standard deviation of SMB is 0.7155% per month from Table 2.2, which is much lower than 2.89% in Fama-French (1933).

The slopes of HML range from about -0.4886 for the high book-to-market equity group to value around 0.4 for the low book-to-market equity group. Thus, HML tends to increase the volatility in the high book-to-market equity group, and the slopes of high book-to-market equity groups are all negative.

Table 2.4 Regression of Equal-weighted Portfolios on 3 factors

Regressions of equal-weighted excess stock returns (in percent) on the excess stock-market return(RM-RF) and the mimicking returns for the size(SMB) and book-to-market equity(HML) factors: June 2006 to December 2011, 67 observations

$$R(t)-RF(t)=a+b[RM(t)-RF(t)]+sSMB(t)+hHML(t)+e(t)$$

Dependent variables: Excess returns on 9 stock portfolios formed on size and book-market equity

		Book-to-market equity(BE/ME)						
Size		Low	Medium	High		Low	Medium	High
			b				t(b)	
Small		0.8741	0.9538	1.1357		16.07	24.89	19.30
Medium		1.0103	1.0624	0.9898		27.32	24.22	21.17
Big		0.9994	1.1401	1.0649		32.76	26.87	24.04
			s				t(s)	
Small		1.1167	1.1483	1.3073		10.99	16.05	11.90
Medium		0.8280	1.0827	1.0283		11.99	13.22	11.78
Big		0.3572	0.3626	0.4304		6.27	4.58	5.20
			h				t(h)	
Small		0.4210	-0.0149	-0.4100		3.41	-0.17	-3.07
Medium		0.4798	0.0853	-0.3390		5.72	0.86	-3.19
Big		0.5649	0.2686	-0.2848		8.16	2.79	-2.83
			Adjusted R^2				s(e)	
Small		0.8565	0.9270	0.8797		4.57	3.22	4.95
Medium		0.9329	0.9175	0.8935		3.11	3.69	3.93
Big		0.9463	0.9176	0.9001		2.56	3.57	3.72

Size effect is stronger than book-to-market equity effect, which is different from Fama-French's conclusion that book-to-market equity effect is much stronger. The modified three factor model is suitable for those 300 stocks. The reasons behind this are that the CSI300 index has a very high selection standard and those stocks are also well regulated. The results of this chapter prove that the CSI300 Index is a reliable index for the Chinese Stock Market, and the creation of the CSI300 is a good sign for the Chinese Stock Market. Its creation indicates the Chinese Stock Market is trying to grow into a more mature market. In summary, the stocks in the CSI300 Index can be considered as investments.

Table 2.5 Adjusted R^2 in Different Models for Value-weighted Portfolios

Adjusted R^2 in Different Models for Value-weighted Returns						
Book-to-market equity						
Size	CAPM			3 Factor		
Small	0.5125	0.6027	0.6177	0.8652	0.9237	0.9223
Medium	0.6959	0.6634	0.6778	0.9306	0.9140	0.8916
Big	0.8500	0.9132	0.9197	0.9365	0.9159	0.9414
Size	SMB, RF-RM			HML, RF-RM		
Small	0.8481	0.9249	0.8978	0.6045	0.6279	0.6119
Medium	0.9004	0.9143	0.8763	0.7883	0.6942	0.6731
Big	0.8808	0.9118	0.9262	0.9279	0.9167	0.9404
Size	SMB			HML		
Small	0.2545	0.2365	0.1993	0.0571	0.0011	-0.0144
Medium	0.1312	0.1718	0.1271	0.0513	0.0039	-0.0144
Big	-0.0047	-0.0092	0.0125	0.0352	-0.0153	0.0265

Table 2.6 Adjusted R^2 in Different Models for Equal-weighted Portfolios

Adjusted R^2 in Different Models for Equal-weighted Returns						
Book-to-market equity						
Size	CAPM			3 Factor		
Small	0.4787	0.6104	0.6205	0.8565	0.9270	0.8797
Medium	0.6836	0.6628	0.6689	0.9329	0.9175	0.8935
Big	0.8215	0.8684	0.8592	0.9463	0.9176	0.9001
Size	SMB, RF-RM			HML, RF-RM		
Small	0.8327	0.9281	0.8638	0.5879	0.6344	0.6155
Medium	0.8997	0.9178	0.8782	0.7833	0.6935	0.6642
Big	0.8913	0.9089	0.8892	0.9142	0.8919	0.8595
Size	SMB			HML		
Small	0.2731	0.2321	0.1678	0.0729	0.0001	-0.0151
Medium	0.1415	0.1752	0.1365	0.0577	0.0038	-0.0146
Big	0.0212	0.0006	-0.0053	0.0478	-0.0050	-0.0043

In the time-series regressions, the slopes and adjusted R^2 values are direct evidence of whether those risk factors capture common variation in stock returns. In Table 2.5 and Table 2.6, I compare different regression models. The regression equations are in the following:

$$R(t)-RF(t)=a+b[RM(t)-RF(t)]+e(t)$$

$$R(t)-RF(t)=a+b[RM(t)-RF(t)]+sSMB(t)+hHML(t)+e(t)$$

$$R(t)-RF(t)=a+sSMB(t)+b[RM(t)-RF(t)]+e(t)$$

$$R(t)-RF(t)=a+hHML(t)+b[RM(t)-RF(t)]+e(t)$$

$$R(t)-RF(t)=a+sSMB(t)+e(t)$$

$$R(t)-RF(t)=a+hHML(t)+e(t)$$

The 3-factor model fits better than CAPM in the Chinese Stock Market; all adjusted R^2s are higher than those of CAPM, especially for small and medium size groups. When regressed alone, neither SMB nor HML capture the variation in the stock returns. All adjusted R^2s are extremely low, and some of them are even negative. Between the single factor model of SMB and HML, the SMB model outperforms HML. However, when combined with RM-RF, both the SMB and HML explain the variation very well. All adjusted R^2s increase dramatically. Therefore, the SMB and HML are factors in determining returns. The 2-factor model including RM-RF and SMB outperforms the 2-factor model that includes RM-RF and HML. This also confirms that the size effect in the Chinese Stock Market is stronger than the book-to-market equity effect. Among the six models, the 3-factor model has the highest R^2s.

2.6 Conclusion

This chapter studies the common risk factors in the returns on stocks in the CSI300 Index in the Shanghai Stock Exchange and Shenzhen Stock Exchange. There are at least three common factors in returns. Among these three risk factors, the RM-RF captures the most time-series variations in stock returns. By adding the SMB and HML into the time-series regressions, additional variation has been captured. There is a strong size effect in the stock returns. Small-size portfolios tend to have higher return than big-size stocks. The book-to-market equity has relatively weak power in explaining returns compared to size, which is different from Fama-French (1993)'s findings. However, there is still some book-to-market equity effect.

My results can be used for investors in selecting portfolios, evaluating portfolio performance, measuring abnormal returns and etc. in those 300 component stocks. The application is based on the fact that the three risk factors explain the stock returns variation very well. As to the portfolio selection, the exposures of a candidate portfolio to the three risk factors can be estimated with a regression of the portfolio's past excess returns on the three risk factors. Then the regression slopes and the historical average premium returns on the portfolio can be used to estimate the expected return of the portfolio. As to portfolio performance evaluation, the intercept in the time-series regression of the managed portfolio's excess return on three risk factors is the standard to judge whether a manager can beat the market.

In summary, the results here suggest that the modified three factors explained the variation in returns of those 300 component stocks very well. However, this chapter leaves many open questions. First, why is the three factors model derived from the mature market relatively suitable in the Chinese Stock Market? In future analysis, to examine the different assumptions between China and the U.S. stock markets is very important. Second, based on the results that size has a stronger effect than book-to-market equity, three size groups and two book-to-market equity groups should be used in constructing six portfolios to calculate the mimicking risk factors for further analysis in the Chinese Stock Market. Third, 300 component stocks in the CSI300 is just a small part of the Chinese Stock Market. The framework of this chapter can be extended to other Shanghai Exchange and Shenzhen Exchange indexes which include more stocks such as the SSE Composite Index and the Shenzhen Composite Index. Lastly, more risk factors can be added such as momentum factor, bond related factor, and etc. for further analysis.

Appendix

Regression Results for Shanghai 'A' Market Dec 20th 1995- April 8th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		v_t	
d_1	0.00664	**	0.00144		0.00631	*	-0.00010	**	0.06755	
d_2	-0.00131	**	-0.00028		-0.00125	*	0.00002	**	-0.01335	
d_3	0.00135	***	0.00011		0.00039		0.00000		-0.00661	
d_4	-0.00158	**	-0.00011		-0.00046		0.00001		0.01390	
d_5	0.00078		-0.00041	*	-0.00075		0.00000		0.00640	
m_1	-0.01072		-0.00218		-0.01524		-0.00020		-0.88336	
m_2	0.00085		0.00017		0.00121		0.00002		0.07008	
m_3	0.00053		0.00021		0.00100		-0.00003		0.06199	
m_4	0.00220	**	0.00099	**	0.00338	**	-0.00002		0.29695	***
m_5	-0.00047		-0.00093		-0.00011		0.00004		0.14804	**
m_6	0.00026		0.00034		0.00065		0.00004		0.10132	*
m_7	-0.00001		0.00033		-0.00050		-0.00001		-0.00712	
m_8	-0.00130		-0.00049	*	-0.00244	*	-0.00001		-0.15123	***
m_9	-0.00093		0.00026		-0.00204		-0.00003	*	-0.17425	***
m_{10}	-0.00017		0.00062		-0.00078		0.00000		-0.07793	
m_{11}	-0.00009		-0.00029		-0.00006		-0.00001		-0.11240	**
m_{12}	-0.00010		-0.00059		0.00040		-0.00002		-0.15699	***
h1	0.14536		0.07044		0.24033		-0.00115		4.88876	
(before Spring Festival)										
h2	-0.00254		-0.00123		-0.00419		0.00002		-0.08528	
(before Labor Day)										
h3	0.00255		0.00109		0.00269		0.00000		-0.15200	
(before National Day)										
h4	0.00041		0.00073		0.00015		-0.00003		-0.12524	
(before New Year's Day)										
h5	0.00114		0.00074		0.00186		0.00006		0.04100	
(after Spring Festival)										
h6	0.00063		0.00200	*	-0.00073		-0.00003		0.10118	
(after Labor Day)										
h7	-0.00013		-0.00007		-0.00017		0.00003		-0.21250	*
(after National Day)										
h8	0.00200		0.00030		0.00401		-0.00005		-0.15579	
(after New Year's Day)										
h9	-0.00018		-0.00009		-0.00022		0.00000		0.01376	**
(regular working day)										
_cons	0.00032		-0.00011		0.00074	*	0.00016	***	19.41671	***
trend									0.00061	***
tr2									0.00000	

Regression Results for Shenzhen 'A' Market Dec 20th 1995- April 8th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
d_1	0.00497	*	0.00097		0.00339		-0.00010	**	0.05218	
d_2	-0.00098	*	-0.00019		-0.00067		0.00002	**	-0.01031	
d_3	0.00148	***	0.00001		0.00077		0.00001		-0.00510	
d_4	-0.00186	***	0.00001		-0.00050		0.00000		0.01296	
d_5	0.00035		-0.00053	**	-0.00160	**	0.00001		0.00845	
m_1	-0.02291		-0.00592		-0.03709		-0.00009		-0.27146	
m_2	0.00182		0.00047		0.00294		0.00001		0.02154	
m_3	0.00050		0.00024		0.00079		-0.00003		0.02163	
m_4	0.00205	*	0.00090	**	0.00295	*	-0.00002		0.25846	***
m_5	-0.00023		-0.00100		0.00041		0.00008	**	0.17102	**
m_6	-0.00036		0.00033		-0.00046		0.00005	*	0.14258	**
m_7	0.00043		0.00019		0.00048		0.00000		0.03408	
m_8	-0.00146		-0.00057	**	-0.00290	*	-0.00001		-0.09108	
m_9	-0.00116		0.00024		-0.00217		-0.00003		-0.11542	*
m_{10}	0.00041		0.00063		0.00003		0.00000		-0.03240	
m_{11}	-0.00006		0.00010		-0.00024		-0.00002		-0.09156	
m_{12}	-0.00104		-0.00097		-0.00114		-0.00004		-0.22622	***
h1	0.19044		0.06779	*	0.28781		-0.00505		1.88653	
(before Spring Festival)										
h2	-0.00332		-0.00118	*	-0.00502		0.00009		-0.03291	
(before Labor Day)										
h3	0.00060		0.00057		-0.00232		0.00000		-0.15298	
(before National Day)										
h4	-0.00009		0.00140	*	-0.00071		-0.00004		-0.13608	
(before New Year's Day)										
h5	0.00120		0.00044		0.00237		0.00003		-0.00647	
(after Spring Festival)										
h6	0.00147		0.00206	*	0.00085		-0.00004		0.06557	
(after Labor Day)										
h7	-0.00107		0.00004		-0.00104		-0.00002		-0.26312	**
(after National Day)										
h8	0.00223		0.00048		0.00288		-0.00008	***	-0.14108	
(after New Year's Day)										
h9	-0.00011		-0.00009	*	-0.00005		0.00000		0.01495	**
(regular working day)										
_cons	0.00049	*	-0.00044	***	0.00141	**	0.00019	***	19.89815	***
trend									0.00012	**
tr2									0.00000	***

Regression Results for Shanghai 'B' Market Dec 20th 1995- April 8th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
d_1	0.00635	*	-0.00019		0.00966	*	-0.00028	***	-0.06871	
d_2	-0.00125	*	0.00004		-0.00191	*	0.00005	***	0.01358	
d_3	0.00145	**	-0.00026		0.00019		0.00001		-0.00995	
d_4	-0.00047		0.00013		0.00120		0.00001		0.01360	
d_5	0.00064		-0.00021		-0.00008		-0.00001		0.02265	*
m_1	-0.03780	**	-0.00441		-0.06262	**	0.00061	*	-1.51973	
m_2	0.00300	**	0.00035		0.00497	**	-0.00005	*	0.12056	
m_3	0.00131		0.00040		0.00241		-0.00004		0.08363	
m_4	0.00115		0.00065	*	0.00177		-0.00009	***	0.15381	
m_5	0.00087		-0.00068		0.00171		0.00008		0.12788	
m_6	-0.00129		-0.00031		-0.00148		0.00010	**	0.07687	
m_7	-0.00167		-0.00007		-0.00335		-0.00001		-0.04580	
m_8	-0.00153		-0.00055	**	-0.00240		0.00008	**	0.05017	
m_9	-0.00077		-0.00002		-0.00171		-0.00005	*	-0.21345	**
m_{10}	-0.00204		0.00036		-0.00392	*	-0.00004		-0.20993	**
m_{11}	0.00004		0.00018		-0.00052		-0.00005	**	-0.15300	*
m_{12}	0.00086		0.00002		0.00174		-0.00001		-0.13802	
h1	0.04608		0.05535	*	0.25248		-0.00725		0.28122	
(before Spring Festival)										
h2	-0.00080		-0.00097	*	-0.00440		0.00013		-0.00491	
(before Labor Day)										
h3	0.00332		0.00120		0.00417		0.00002		-0.09300	
(before National Day)										
h4	0.00040		-0.00001		0.00156		-0.00014	***	-0.25370	
(before New Year's Day)										
h5	-0.00488		-0.00001		-0.00772		0.00006		0.10598	
(after Spring Festival)										
h6	0.00202		0.00188		0.00539		-0.00001		0.08978	
(after Labor Day)										
h7	-0.00025		-0.00061		-0.00067		0.00003		0.04816	
(after National Day)										
h8	-0.00075		0.00039		-0.00259		-0.00017	**	-0.19779	
(after New Year's Day)										
h9	-0.00004		-0.00005		-0.00001		0.00000		0.00743	
(regular working day)										
_cons	0.00040		-0.00015		0.00095		0.00025	***	16.04390	***
trend									0.00072	***
tr2									0.00000	***

Regression Results for Shenzhen 'B' Market Dec 20th 1995- April 8th 2006										
Variable	$r_t^{c/c}$		$r_t^{c/o}$		$r_t^{o/c}$		σ_t		ν_t	
d_1	0.00793	*	-0.00467	*	0.00550		-0.00019	*	-0.05657	
d_2	-0.00157	*	0.00092	*	-0.00109		0.00004	*	0.01118	
d_3	0.00106		0.00019		-0.00126		0.00002		-0.01680	
d_4	0.00004		0.00028		0.00076		-0.00001		-0.00719	
d_5	0.00158	**	0.00013		0.00123		0.00000		0.01950	
m_1	-0.05989		-0.03486		-0.07876		0.00088	***	0.37402	
m_2	0.00475		0.00277		0.00625		-0.00007	***	-0.02967	
m_3	0.00258	**	0.00072		0.00466	**	-0.00001		-0.00305	
m_4	0.00090		0.00072	**	0.00147		-0.00006	***	0.32623	***
m_5	0.00148		-0.00049		0.00230		0.00007		0.13161	
m_6	0.00032		0.00102	*	0.00040		0.00017	***	0.17783	**
m_7	-0.00161		0.00000		-0.00322		0.00001		0.08277	
m_8	-0.00231	**	-0.00046		-0.00408	**	0.00002		-0.00411	
m_9	-0.00192		-0.00029		-0.00341	*	-0.00007	***	-0.23898	***
m_{10}	-0.00158		0.00021		-0.00331		-0.00006	***	-0.11218	
m_{11}	0.00093		-0.00002		0.00149		-0.00001		-0.16438	**
m_{12}	0.00003		-0.00063		0.00085		-0.00003		-0.14508	*
h1	0.09745		0.07432		0.34298		-0.00043		8.70773	
(before Spring Festival)										
h2	-0.00170		-0.00130		-0.00598		0.00001		-0.15189	
(before Labor Day)										
h3	0.00510	**	0.00040		0.00546		0.00001		-0.10042	
(before National Day)										
h4	0.00375		0.00117		0.00706	*	-0.00011	***	-0.15428	
(before New Year's Day)										
h5	-0.00533		-0.00225		-0.00654		0.00011		0.02759	
(after Spring Festival)										
h6	-0.00072		0.00273	**	-0.00020		-0.00005		0.14523	
(after Labor Day)										
h7	-0.00038		-0.00040		0.00187		0.00002		-0.03255	
(after National Day)										
h8	0.00239		0.00327		0.00174		-0.00008		-0.19205	
(after New Year's Day)										
h9	0.00030		0.00039		0.00024		0.00000		0.00912	
(regular working day)										
_cons	0.00032		-0.00011		0.00074		0.00016	***	15.44781	***
trend									0.00105	***
tr2									0.00000	***

Bibliography

Agrawal, A., & Tandon, K. (1998). Anomalies or illusions? Evidence from stock markets in eighteen countries. *Journal of International Money and Finance*, *13*, 83-106.

Ariel, R.A. (1987). A monthly effect in stock returns. *Journal of Financial Economics*, *18*, 161-174.

Ariel, R.A. (1990). High stock returns before holidays: existence and evidence on possible causes. *Journal of Finance, 45*, 1611-1626.

Balaban, E. (1995). Day of the week effects: new evidence from an emerging stock market. *Applied Economics Letters, 5*, 139-143.

Balaban, E., Bayar, A., & Kan, Ö. (2001). Stock returns, seasonality and asymmetric conditional volatility in world equity markets. *Applied Economics Letters, 8*, 263-268.

Cadsby, C.B., & Ratner, M. (1992). Turn-of-month and pre-holiday effects on stock returns: some international evidence. *Journal of Banking and Finance, 16*, 497-509.

Deng, Changrong, & Ma, Yongkai. (2005). Empirical Study of Three-factor Model in China's Stock Market. *Journal of Management*, *5*, 591-596.

Chinese Stock Markets. *Finance Letters, 2007*, 5 (6), 1-11

Fama, Eugene F., &French, Kenneth R. (1992a). The cross-section of expected stock returns. *Journal of Finance, 47*, 427-465.

Fama, Eugene F. (1996). Multifactor portfolio efficiency and multifactor asset pricing. *Journal of Financial and Quantitative Analysis*, *31*, 441-465.

Fama, Eugene F., & French, Kenneth R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*, 3-56.

Fama, Eugene F., & French, Kenneth R. (1995). Size and book-to-market factors in earnings and returns. *Journal of Finance, 50*, 131-155.

Fama, Eugene F. (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance, 25*, 383.

French, K. (1980). Stock returns and the weekend effect. *Journal of Financial Economics, 8*, 579-596.

Gao, L., & Kling, G. (2005). Calendar effects in Chinese stock market. *Annals of Economics and Finance, 6*, 75-88.

Gibbons, M.R., & Hess, P.J. (1981). Day of the week effects and asset returns. *Journal of Business, 54*, 579-596.

Hong, H., & Yu, J. (2006). Gone Fishin': Seasonality in trading activity and asset prices, mimeo. Princeton University.

Jaffe, J., & Westerfield, R. (1985). The weekend effect in common stock returns: the international evidence. *Journal of Finance, 40*, 433-454.

Xu, Jin, & Zhang, Shaojun. (2014). The Fama-French Three Factors in Chinese Stock Market. *China Accounting and Finance Review, Volume 16, Issue 2*, 210-227.

Keim, D.B., & Stambaugh, R.F. (1984). A further investigation of the weekend effect in Stock returns. *Journal of Finance, 39,* 819-835.

Lakonishok, J., & Levi, M. (1982). Weekend effects in stock returns: a note. *Journal of Finance, 37,* 883-889.

Merton, Robert C. (1973). An Intertemporal Capital Asset Pricing Model. *Econometrica, 41*, 867-887.

Mookerjee, R., & Yu, Q. (1999a). Seasonality in returns on the Chinese stock market: the case of Shanghai and Shenzhen. *Global Finance Journal, 10*, 93-105.

Mookerjee, R., & Yu, Q. (1999b). An empirical analysis of the equity markets in China. *Review of Financial Economics, 8*, 41-60.

Rogalski, R.J., & Tinic, S. (1986). The January size effect: anomaly or risk mismeasurement? *Financial Analyst Journal*, 63-70.

Rozev, M., & Kinney, S. (1976). Capital market seasonality: the case of stock returns. *Journal of Financial Economics, 3,* 379-402.

Sharpe, William F. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk. *Journal of Finance, 19*, 425-442.

Solnik, B., & Bousquet, L. (1990). Day of the week effect on the Paris Bourse. *Journal of Banking and Finance, 14*, 461- 468.

Suits, D. (1984). Dummy variables: mechanics v. interpretation. *The Review of Economics and Statistics, 66*, 177-180.

Tinic, S., & West, R. (1984). Risk and return: January versus the rest of the year. *Journal of Financial Economics, 13*, 561-74.

Fan, Zhenlong, & Yu, Shidian. (2002). Three-factor Model in China's Stock Market. *Journal of System Engineering, 6,* 537-546.

Cao, Zhiguang, Harris, Richard D. F., & Wang, Anxing. (2007). *Seasonality in the Returns, Volatility and Turnover of the Chinese Stock Market.*