

# Rational Speculative Bubbles in Chinese Stock Market

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**Abstract** Chinese Stock market performed well in recent years after a long bear market, raising the question of whether equity prices in China reflect their fundamental values. The study employs duration dependence test using the Log Logistic and Weibull's hazard model for the detection of rational speculative bubbles. The presence of unit root, leptokurtic distribution of weekly real returns and duration dependence tests support the existence of bubbles in China equity prices. The results of the study are a harbinger and call for serious policy implication to avoid the detrimental effects of bubble burst, not to iterate another episode of the Asian crisis.

*Keywords:* Fundamental value, rational bubbles, China stock market

*JEL Classification:* G14, G15

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## 1. Introduction

The well functioning and growing stock market is a foreteller of economic boom. It encourages capital accumulation and allocation to its best possible use, paving the path for long-term investment and thus spurring the economic growth. Investors are benefited by capital gains as well as with due dividends. In efficient stock markets, prices of stock provide an accurate signal for optimal resource allocation. Factors like a healthy economy, growing profit margins, a growing consumer base, etc., lead to better fundamentals and a higher stock price. Contrary to it situation gets worsen and certain worries are mounted if it is surrounded by speculators. Successful investors start probing and speculate the up coming events for another triumph. Traders buy and sell shares based on speculative motives rather than investment value and market presents no more than a casino. Without speculative "noise" trading, very little trading occurs in individual assets (Black, 1986). A certain level of speculative trading is required to keep the market moving provided it is supported by fundamentals which actually is not. According to Tobin, share prices are mostly not "fundamental-valuation efficient" because they are largely determined by "speculations on the speculations of other speculators" (Tobin, 1984). A continuous sharp rise in the price of an asset is also an indication of a bubble (Kindelberger, 1978). Speculators create faddism, inflating price bubbles unless they burst and causing asset prices to fall. An asset price movement, unexplained by the fundamentals is called a price bubble (Garber, 1990). Rational speculative bubbles might be an effort to recognize the activities investors who behave irrationally, especially when herding arises (Cuthbertson, 1996). "Men, it has been well said, think in herds; it will be seen that they go mad in herds, while they only recover their senses slowly, and one by one."

The irrational attitude of investors can be characterized as personal contentment (Statman, 1998). Rational speculative bubbles have a unique feature that frenzy investors despite of knowing the fact that stock prices surpass their fundamental values yet think that it is very likely that the bubble may keep on growing and yield a high return. Eventually the loss caused by the bubble crash might be compensated by the high return obtained, a valid excuse of rational investors to play inspite overvaluation (Chan et al., 1998). Investment choices are mostly misguided during the bubble build up phase. Stock market bubbles finance unstable business and encourage overinvestment in popular sectors. Myopic investors perceiving that the share market will continue to rise in the long term. However the bubble must burst and share prices will not recover in the aftermath of bubble burst. Ultimately its splashes have long lasting and detrimental effect on real economy.

Chinese stock market has made tremendous progress just in a short period of time, since its establishment in 1990. China has become as the second largest equity market in Asia as for as total market capitalization is concerned, Japan being the first (The Economist, February 6, 2003). Though China has been achieving a rapid economic growth for last many years but its stock market development trends have over taken its overall economic performance (Laurenceson, 2002). Its significant growth has made it an investment paradise for both domestic and international investors. But there are some threats associated with this young prodigy. It is evident from the 26 highest rates of daily return ranging from 8.08% to 28.86% and 25 lowest rates of daily return ranging from -17.91% to -7.41% of the Shanghai Stock Exchange index from 1991 to 2002 (Wang, Shi, and Fan, 2006). The Shanghai Stock Exchange Comp index dropped from 2202 on June, 2001 to 1514 on October, 2001. The market has been in a state of low trading activity since then and went to a bear market for a long time, about five years. After dropping to 1,000 in Aug 2005,<sup>1</sup> even in March 2006 the composite index was still hovering around 1,300 but by the end of 2006 it reached up to 2675. The 8.8% drop in the Shanghai stock market on February 2007<sup>2</sup> that sparked a sell-off in markets around the world is still fresh in memory, and there is no guarantee that such an event will not happen again.<sup>3</sup> Recently the benchmark Shanghai composite index hits a new high and crossed the barrier of 5500.<sup>4</sup> Market data confirms a seven times increase in the overall value of Chinese shares during last two years, surpassing the 21 trillion Yuan (2.77 trillion U.S. dollars) of GDP last year, in comparison to 3 trillion Yuan two years ago. Indeed, as symbolized by a sharp rise in the number of stock trading accounts, now in excess of 100 million, the Chinese stock market has fallen into a state of “euphoria,” as termed by Galbraith (1994).

Given the above stated facts, the main purpose of the study is to analyze whether this hike in Chinese stock market is supported by fundamentals or a precursor of speculative bubble. Why has the stock market recovered so quickly? Was there some positive news that caused millions of investors to put on green eyeshades, fire up their spreadsheets, and conclude that the real value of stocks exceeded current market prices?

## **2. Literature Review**

Based on standard financial asset pricing theory, the fundamental value of a security can be defined as the present value of all the future cash flows associated with that security. Persistent

divergence of actual stock prices from their fundamental values can be explained by the presence of rational expectations bubbles in stock prices. A special characteristic of rational expectations bubble is that the positive abnormal returns are persistent and increasing due to the pre-occupation beliefs of market participants, causing stock prices to deviate from their fundamental values.

There is a plethora of research related to possible causes and detection of the presence of rational speculative bubbles. Empirical evidences in this area relate to the developed countries, with hard econometric evidence lacking for developing and emerging market economies.<sup>5</sup> Every technique has its own importance and validity according to the suitability of the situation. A widely used method to test rational speculative bubbles involves the non-stationarity and cointegration test between prices and fundamental variables which determine security prices. A Cointegration relation implies that stock prices converge to fundamental values to satisfy the long-run equilibrium condition. Conversely, the lack of Cointegration relationship between prices and fundamental values is an indicative of a rational bubble. However the studies looking for cointegration relation provide some mix results and face criticism. Campbell and Shiller (1987) show no evidence of cointegration between annual stock prices and dividends for the S&P 500 index from 1871 to 1986. However, Horvath and Watson (1995) find evidence of a cointegrated relationship using quarterly data from 1947 to 1994. Koustas and Serletis (2005) show that the S&P 500 log dividend yield is mean reverting, rejecting the presence of rational bubbles in stock prices. Brooks and Katsaris (2003) show evidence of divergence from fundamental values in the U.K. stock market during the late 1990s by examining the cointegration. Capelle-Blancard and Raymond (2004) demonstrate no cointegration between prices and dividends in the French, German, Japanese, U.K. and U.S. stock markets during 1973–2002. Anderson et al. (2003) include expected inflation in the cointegration vector and find support for cointegration among prices, dividends, excess return and expected inflation. However, they conclude that U.S. stock prices deviate from fundamental values due to the significance of non-fundamental components.

The contradictory views about the cointegration technique can perhaps be explained by different ways. The cointegration test depends mainly on the correct identification of controversial fundamental variables. Therefore, the lack of cointegration could be interpreted as an evidence of a bubble or the result of missing fundamental factors (Brooks and Katsaris, 2003; Anderson et al., 2003). Studies by Lim (2005) and Jiang and Lee (2005) show that accounting data such as earnings provide useful information about stock price movements rather than dividends alone. Recently Jirarasakuldech, et al (2007) report a lack of cointegration relationship among prices, dividend and earning indicating the presence of bubbles in Thai equity market pre-Asian financial crisis in 1997. However prices appear to be in line with fundamentals in the more recent post-1997 period. Conventional cointegration tests have low power when limited data span are used, and furthermore the cointegration results are sensitive to data that are subject to regime shifts or structural changes (Shiller and Perron, 1985; Brooks and Katsaris, 2003). A few, but large highly persistent shocks in the systems or a change in the economic regime will bias the cointegration test in favor of no cointegration relationship (Chow, 1998). The above concerns with the cointegration methodology call to question the definitiveness of the conclusions in the previously mentioned studies.

Some studies involve tests for bubble premium, as an indication of bubble presence. The investors demand for excess return above the fundamentals indicates speculative bubbles and is termed as bubble premium. This return incorporates the actual excess return of the stock over the risk free rate which has a volatile character and rises exponentially. Hardouvelis (1988), DeLong et al. (1990), Rappoport and White (1993) and Liu et al., (1995) studied the bubble premium (excess return) for the detection of rational speculative bubbles. Due to its inability to adequately detect or disapprove the existence of rational speculative bubbles it faces some criticism and unpopularity.

Another different technique is to examine the stock market's variance and the application of tests for excess volatility. Theoretically, a higher variance of stock price than that of fundamental price is linked with the presence of speculative bubbles. Among the researchers who used this technique are Friedman (1953), Kohn (1978), Flood and Garber (1980), Leroy and Porter (1981), Shiller (1981), Hart and Kreps (1986), Marsh and Merton (1986), Dezhbakhsh and Demirguc-Kunt (1990).

In this study, we employ a technique that is more elegant and different from other methods because it is more flexible and does not require the identification of fundamental factors, namely, the duration dependence test. The duration dependence technique examines security returns for the presence of negative duration dependence (or decreasing hazard rate) in positive return runs, a unique characteristic of rational expectations bubbles (McQueen and Thorley, 1994). This approach relies on the argument that if security prices experience episodes of rational bubbles, stock returns will exhibit negative duration dependence where the probability of obtaining a negative abnormal return in the current period is a declining function of the established length of positive abnormal returns. The additional benefit of the duration dependence test is that it does not require the time series behavior under investigation to be normally distributed.

Several empirical studies have employed duration dependence test for the detection of speculative bubbles including Chan et al. (1998), Lavin and Zorn (2001). Chan et al. (1998) detected rational speculative bubbles in Asian (Hong Kong, Japan, Korea, Malaysia, Thailand and Taiwan) and the U.S stock markets. Watanapalachaikul and Sardar (2003) and Jirasakuldech, Emekter, and Rao (2008) used duration dependence model for the detection of speculative bubbles in Thai stock market, they supported the presence of bubbles before Asian Financial crisis. Harman and Zuehlke (2001) also used duration dependence test but using Weibull's hazard model to detect rational speculative bubbles in the New York Stock Exchange. Mokhtar, Nassir and Hassan (2006) conducted a study for detection of rational speculative bubbles in the Malaysian stock market. They also employed duration dependence test but using two hazard models: (1) Log-Logistic hazard model and (2) Weibull's hazard model. Their study provided an evidence of rational speculative bubbles in Malaysian equity prices, especially before and after the Asian Financial Crisis in 1997.

Our findings show strong evidence of departures from fundamental values in the Chinese stock market over the sample period. The non-stationarity test signifies the presence of a unit root in equity prices over the sample period. Significant, skewness and Jarque-Bera statistic specify the returns distribution to be non normal. The results are confirmed by the duration dependence test,

which shows evidence of negative duration dependence (decreasing hazard rate) in runs of positive returns, consistent with the characteristic of a rational expectations bubble.

### 3. Methodology

#### 3.1 Duration Dependence Test

The duration dependence technique introduced by McQueen and Thorley (1994) is employed for the detection of rational speculative bubbles in the Chinese stock market. Rational expectations bubbles get rooted when the investors despite the fact that equity prices are valued no more desired to liquidate their holdings, anticipating that the ultimate high return will reimburse for the likelihood of a crash. As the bubble expands, its innovation is positive and small compared to an infrequent large negative innovation when the bubble bursts. Thus in case, the stock prices plagued with rational speculative bubbles, the price fluctuations may reveal a decreasing hazard rate. For positive runs, the probability a run will end and its length are negatively correlated.

The duration dependence tests are conducted by analyzing the hazard rate ( $h_i$ ) for positive and negative runs. The hazard rate is the probability of obtaining a negative return ( $\varepsilon_t < 0$ ) given a sequence of  $i$  prior positive returns ( $\varepsilon_{t-1} < 0$ ). In the presence of a rational speculative bubble,  $h_i = \text{Pr ob}(\varepsilon_t < 0 / \varepsilon_{t-1} > 0, \varepsilon_{t-2} > 0, \dots, \varepsilon_{t-i} > 0, \varepsilon_{t-i-1} < 0)$ , the hazard rate decreases with  $i$  or  $h_{i+1} < h_i$  for all  $i$ .

In order to apply the duration dependence test, first of all the real returns are converted into run lengths of positive and negative returns. The returns are separated in to two groups by following the same way as adopted by Blanchard and Watson (1982), Evans (1986), and McQueen and Thorley (1994). The numbers of positive or negative runs of particular length  $i$  are then counted.

The sample hazard rate for each length  $i$  is computed as  $\hat{h}_i = N_i / (M_i + N_i)$ , which is derived from maximizing the log likelihood function of the hazard function,

$$L(\theta / S_T) = \sum_{i=1}^{\alpha} N_i \text{Ln} h_i + M_i \text{Ln}(1 - h_i) + Q_i \text{Ln}(1 - h_i) \quad (1)$$

with respect to  $h_i$ , where  $N_i$  the number of completed runs of length  $i$  in the sample,  $M_i$  and  $Q_i$  are the numbers of completed and partial runs with length greater than  $i$ , respectively. To test the null hypothesis of no rational expectations bubble, a functional form of the hazard function is to be specified, McQueen and Thorley (1994) specify the logistic form hazard function.

$$h_i = \frac{1}{1 + e^{-(\alpha + \beta \text{Ln} i)}} \quad (2)$$

The duration dependence test for logistic hazard function is performed by substituting Eq. (2) into (1) and maximizing the log likelihood function with respect to  $\alpha$  and  $\beta$ .

Harman and Zuehlke (2001) defined the Weibull hazard model

$$S(t) = \exp(-\alpha t^{\beta+1}) \quad (3)$$

where  $S(t)$  is the probability of survival in a state to at least time (t), the corresponding hazard function is:

$$h(t) = \alpha (\beta + 1) t^\beta \quad (4)$$

where  $\alpha$  is the shape parameter of the Weibull distribution, and  $\beta$  is the duration elasticity of the hazard function. The fundamental assumption of the Weibull Hazard model is a linear relationship between the log of the hazard function and the log of duration, where:

$$\ln[h(t)] = \ln[\alpha(\beta + 1)] + \beta \ln(t) \quad (5)$$

The duration dependence test for Weibull hazard function is performed by substituting Eq. (5) into (1) and maximizing the log likelihood function with respect to  $\alpha$  and  $\beta$ . The null hypothesis of no rational expectations bubble implies that the probability of a positive run ending is unrelated to prior runs; in other words the hazard rate should be constant ( $H_0 : \beta = 0$ ). The alternative bubble hypothesis suggests that the probability of a positive run ending should decrease with the length of the run, i.e., decreasing hazard rate. Under the null hypothesis of no bubble, the likelihood ratio test (LRT) is asymptotically distributed  $\chi^2$  with one degree of freedom.

$$LRT = 2[\text{Log unrestricted} - \text{Log restricted}] \square \chi_1^2$$

This study documents the results of duration dependence test by using both, Log Logistic and Weibull's hazard model. Employing both models ensure that the results are not sensitive to the underlying assumptions of a particular test and that they are not biased.

## 4. Data and Descriptive Statistics

### 4.1. Data

Tests are conducted using weekly data on the Shanghai and Shenzhen Comp index over the <sup>6</sup>sample period. The weekly closing prices  $P_t$ , are collected from CCER data base. The duration dependence test for rational speculative bubbles is conducted on the real returns. The weekly closing prices are transformed into continuously compounded weekly returns,  $R_t = 100 * (\ln P_t - \ln P_{t-1})$  where  $P_t$  is the index closing price for *week<sub>t</sub>*, and  $P_{t-1}$  is the closing price for the week proceeding. The weekly returns are then converted to real returns by subtracting the continuously compounded inflation<sup>7</sup> rate for China as reflected in the Consumer Price Index (CPI) data.

## 4.2 Descriptive Statistics

A time series plot of the Shanghai Comp index is shown in Fig 1.<sup>8</sup> The graph reveals several episodes of price swings also including a sheer hike acknowledging the present market boom in Chinese stock market since late 2006. The Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root (non-stationarity) tests are applied to the time series of the log of real stock prices and the results are reported in table 1. The tests are performed on the model with and without a trend. The number of lagged differences in the ADF regressions to eliminate the autocorrelation is chosen by the Akaike Information Criterion (AIC). The results based on the sample, as shown in <sup>9</sup>Panel A and B of table 1; do not reject the null hypothesis of a unit root or non-stationarity for the variables at conventional levels of significance. When the unit root test is performed on the first <sup>10</sup>difference of the variables, the null hypothesis of a unit root is rejected at the 1% significance level for all variables, suggesting that stock prices are realizations of a I (1) process. To have a better understanding, panel A in table 2 contains information on the mean, standard deviation, minimum, maximum, skewness and kurtosis for variables used in study. The Jarque-Bera (1980) test statistic for departure from normality is also presented. The results are reported for both Shanghai and Shenzhen stock exchanges.

The existence of bubbles in Chinese stock market can be inferred from the strong evidence of skewness, excess kurtosis and non-normality of returns. The returns distribution of both stock markets is skewed and leptokurtotic, having “fat tails” compared to a normal distribution, as indicated by the significant kurtosis coefficients. Fat tails imply that price changes occasionally deviate by large amounts, an indication of the possible existence of bubbles and stock price departures from fundamental values. High kurtosis coefficients also cast a doubt on returns distribution to be normal. The Jarque–Bera test statistics shown in table 2 rejects the null hypothesis of normality at the 1% significance level.

Tests for serial dependence in the price and return series are also reported in panel B of table 2. These statistics are informative to the extent that departures from fundamental value are found to be more likely when price changes follow the same direction. The price index show positive autocorrelations up to lag 12 but the magnitude is declining. The slow decay of the sample autocorrelation function suggests high persistence in the series and the pattern is same in both markets. The Ljung–Box test statistics for 6 and 12 lags [(denoted by Q(6) and Q(12))] is significant and reject the null hypothesis of no temporal dependence in the series at conventional significance levels.

## 4.3 Duration Dependence Test

The duration dependence test results for two stock markets are reported in Tables 3. For Shanghai stock exchange, a total of 350 runs comprising of 175 runs of positive returns and 175 runs of negative returns. The longest positive return run lasts 30 weeks and only once. For Shenzhen stock exchange, we observe 180 runs of positive returns and 180 runs of negative returns for a total of 360 runs. The longest positive return run lasts 13 weeks and we find one.

We now discuss the results based on the log logistic and the Weibull hazard functions. The null hypothesis of no-bubble implies a constant hazard rate. The alternative bubble hypothesis

implies a negative sloping hazard function i.e. decreasing hazard rate or longer survival time for runs of positive returns. From Table 3 we note that the Shanghai comp index has a significant  $\beta$  coefficient for the sample period. The likelihood ratio test (LRT) of the null hypothesis of no duration dependence or constant hazard rate is rejected at the 1% significance level. Similar findings are reported when the duration dependence test is performed for the Shenzhen Stock Exchange—the null hypothesis of no duration dependence i.e.  $H_0: \beta = 0$  is rejected in favor of alternative of bubbles at the 1% significance level. The empirical findings suggest that securities prices in these markets experienced some episodes of rational expectations bubbles in the sample period and the results remain robust irrespective of hazard models. Since rational expectations bubbles cannot occur in runs of negative returns, we do not find evidence of rational speculative bubbles in the negative returns and the results are not reported.

## 5. Conclusion

This study examines whether the current boom and hike in the Chinese equity prices is characterized by the rational expectations bubbles. The study uses the weekly return index for Shanghai and Shenzhen exchanges over the period 1990w49 to 2007w33 and 1991w13 to 2007w33. The presence of unit root, excess kurtosis and leptokurtic distribution of return data indicates the existence of bubbles in Chinese stock markets. Further the significant duration dependence tests magnify the likely presence of rational speculative bubbles in the Chinese stock markets. The results provide the corroborating evidence on Chinese equity price's departure from fundamentals. We report that the that the return dynamics of the SHANG and SHENZ index depict a decreasing hazard rate in runs of positive returns, a unique feature of rational speculative bubbles.

The results of our investigation are harbinger of bubble burst. It recall for policy implication to CSRC as a safeguard before the bubble burst so that its detrimental effects can be avoided. Market's huge size and unprecedented growth have posed a real challenge to the quality of its performance and the effectiveness of rules and regulations. Normally the presence of a bubble goes unnoticed unless it bursts. History is a repeat of the presence of bubbles in many countries but people do not learn a lesson (East Asian Financial crises, particularly from other countries' histories). When the market is overheating the myopic investors enjoys and forgets future worries. Even if the formation a bubble is unavoidable there must be some precautionary measures to minimize post-bubble effects. The small investors who recently bought the over valued shares would be the worst sufferer of a sudden plunge in stock prices. This trend can precipitate into social instability, political turmoil, deteriorating public order and can culminate into a potential threat for the stability of government. In spite of the fact that this study is an attempt to show the clear picture of Chinese Stock market and it's anticipated role in future economic development of the country. But it should not lead a researcher to have a pessimistic view of its contribution towards long run economic development. These findings can rather be used in good spirit to constitute viable policies to avoid any financial crisis.

Given, the conclusive remarks are based on the rigorous investigation of latest available data; these results should not be confused with previous studies conducted in this field because they mostly relied on the data different from our time period.

### Endnotes:

\* Corresponding author [abdulhaqueali@hotmail.com](mailto:abdulhaqueali@hotmail.com). The authors are grateful to the editor and anonymous referees for their very helpful comments. Many thanks to Mr. Bing Zhang for his kind suggestions.

1. On 11 Aug, 2005 the Shanghai Comp index was 1011. [www.sse.com.cn](http://www.sse.com.cn)
2. On 27 Feb 2007 the Shanghai Comp index dropped to 2771 from a previous day high 3040.
3. On 28 Sept, 2007 the Shanghai Comp index was 5552.
4. [www.chinaview.cn](http://www.chinaview.cn), 2007-08-13.
5. A few studies related to the developed countries are conducted after East Asian financial crisis in 1997.
6. For Shanghai, 1990<sub>w49</sub> to 2007<sub>w33</sub>, and for Shenzhen, 1991<sub>w13</sub> to 2007<sub>w33</sub>.
7. Inflation data are collected from the National Bureau of Statistics of China (NBSC). [www.stats.gov.cn](http://www.stats.gov.cn)
8. The graph is for weekly return data of Shanghai Comp index. A similar graph is also obtained for Shenzhen Comp index, narrating the same episodes (but not reported).
9. Panel A is for Shanghai and Panel B is for Shenzhen.
10. The first difference is  $\Delta P_t = P_t - P_{t-1}$ .

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**Figure 1**



**Table 1. The ADF and PP Unit Root Test**

Variables	ADF		PP	
	No trend	Trend	No trend	Trend
Panel A: for Shanghai (1990w49-2007w33)				
$p_t$	-2.151	-2.856	-2.44	-3.062
$\Delta p_t$	-12.566	-	-26.586	-26.576
		12.566		
Panel B: for Shenzhen (1991w13-2007w33)				
$p_t$	-0.889	-1.782	-0.469	-1.382
$\Delta p_t$	-10.449	-	-25.280	-25.283
		10.457		

**Notes :** The lag length  $l=4$  in the ADF and PP regressions is the highest significant lag order from either the autocorrelation function or the partial autocorrelation function of the first differenced series.  $p_t$  and  $\Delta p_t$  denotes the log and first diff of log of Comp index adjusted for inflation. Corresponding critical values for model with no trend for the ADF and PP unit root tests are  $-3.45$ ,  $-2.86$  and  $-2.57$  for 1%, 5% and 10% significance level, respectively. Corresponding critical values for model with trend for the ADF and PP unit root tests are  $-3.98$ ,  $-3.42$  and  $-3.13$  for 1%, 5% and 10% significance levels, respectively. \*, \*\* and \*\*\* indicate significance at the 1%, 5% and 10% levels

**Table 2. Summary Statistics and Serial Correlation for Variables Used in Analysis**

Variable	N	Mean	Med	S.D	Min	Max	Skewness	Kurtosis	Jarque-Bera
Panel: A									
For Shanghai the period (1990w49-2007w33)									
$p_t$	846	6.959	7.117	0.686	4.648	8.536	-1.348	5.366	453.677*
$r_t$	845	0.455	0.233	6.385	-22.63	90.105	5.576	70.873	166472.5*
For Shenzhen the period (1991w13-2007w33)									
$p_t$	828	7.939	8.068	0.597	6.005	9.791	-0.535	3.971	72.016*
$r_t$	827	0.351	-0.156	5.431	-29.895	45.369	1.471	16.30	6389.75*
Auto correlations	$\rho_1$	$\rho_2$	$\rho_3$	$\rho_4$	$\rho_5$	$\rho_6$	$\rho_{12}$	$Q_{(6)}$	$Q_{(12)}$
Panel: B									
For Shanghai the period (1990w49-2007w33)									
$p_t$	0.986	0.972	0.959	0.946	0.932	0.920	0.840	4638.2*	8565.5*
$r_t$	0.084	-0.045	0.065	0.017	-0.015	0.036	-0.055	12.75**	18.019
For Shenzhen the period (1991w13-2007w33)									
$p_t$	0.988	0.976	0.963	0.949	0.935	0.921	0.834	4565.9*	8387.1*
$r_t$	0.130	0.062	0.073	0.063	0.088	0.016	0.032	31.411*	33.475*

**Notes :**  $p_t$  denotes the log of Comp index adjusted for inflation. Mean and standard deviation are expressed in percent. Min and Max refer to minimum and maximum value, respectively. Asymptotic standard error of coefficient skewness is  $(6/N)^{1/2}$ . Jarque–Bera test statistics test for the departure from normality  $\rho_t$  is the sample autocorrelation at lag t.  $Q_{(6)}$  and  $Q_{(12)}$  are the Ljung–Box (1978) portmanteau test statistics for 6 and 12 lags. The statistics are distributed as  $\chi^2$  with 6 and 12 degrees of freedom. \*, \*\* and \*\*\* indicate significance at the 1%, 5% and 10% levels, respectively.

**Table 3. Runs of Positive Abnormal Real Returns**

	Shanghai Stock Exchange		Shenzhen Stock Exchange	
	Log-Logistic	Weibull	Log-Logistic	Weibull
$\alpha$	0.414	0.892	0.390	0.767
$\beta^*$	0.478*	0.978*	0.444*	0.894
LRT of $H_0 : \beta = 0$	75.24*	185.38*	73.50*	215.26

**Notes:** The duration dependence test is performed on weekly real returns. Weekly real returns are nominal returns subtracted inflation rates. Weekly returns are transformed into series of run length. A run is a series of returns of the same sign. Actual run counts do not include the partial runs which may occur at the beginning or at the end of period investigated.

$\beta$  is the estimated coefficient of run length. The likelihood ratio test (LRT) of the null hypothesis of no duration dependence or constant hazard rate  $H_0 : \beta = 0$  is asymptotically distributed  $\chi^2$  with one degree of freedom. p-value is the marginal significance level—the probability of obtaining the calculated value of LRT or higher under the null hypothesis. \*, \*\* and \*\*\* indicate significance at the 1%, 5% and 10% levels, respectively. Rational speculative bubble is indicated when the  $\beta$  coefficient is positive. \*The  $\beta$  is estimated coefficient of length of run in accelerated failure-time(AFT), which implies that longer bubble period indicates longer bubble survival(decreasing hazard rate).