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Stock Price Volatility and Policy Bailout: Evidence from Growth Enterprise Market in China

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ABSTRACT

Growth enterprises in China have been increasing their paces to raise capital through Growth Enterprise Market (GEM) since October, 2009. Based on mass Monte Carlo simulation, this article utilizes multi break structural change method to examine the fluctuation characteristics of GEM stock index in China. This study indicates that time series of Chinese GEM stock index are not characterized by mean reversion. As a result, The rescue of the securities market in 2015 was invalid. The long-term growth of GEM stock indexes depend on investor mentality, the stock supply and so on. The results provide policies making guidance on GEM in China with empirical evidence.

Keywords: random walk, GEM, policy bailout
JEL Classification: C1; G1; G18

INTRODUCTION

The Growth Enterprise Market is a key part of China's securities market. It is important for investors to decide whether the stock price is subject to stochastic volatility. Besides, this is also very important for government in policy making. For a long time, scholars have studied whether the stock price obeys random walk. Suppose the stock prices in GEM are subject to random walks, then the prices in the future are unpredictable. Therefore, technical analysis will be useless. Analogously, it's impossible for government policies to change the way GEM indexes grow. But if GEM indexes are not stochastic, then government policies can influence the market effectively.

So far, no one has studied whether GEM price follows random walk. However, Many scholars find that the price of the stock market is random. Typical studies include: the stock prices of 22 OECD countries studied by Narayan and Smyth (2005); the Lisbon stock market examined by Borges (2011); Shen and Holmes (2014) researching in 12 Asia-Pacific countries; the real monthly U.S. stock returns from 1871 to 2003 invested by Clark and Coggin (2011); Indian stock market researched by Chattopadhyay (2016). Meanwhile, some studies show that stock price follows mean reversion process. There are many such studies including the following literature: Balsara et al (2007) studying China's B-shares prices from February, 1992 to June, 2005; Mishra et al (2015) studying Indian stock indexes.

Other studies have found that stock prices sometimes follows random walks and sometimes obey mean reversion. For example, Chang and Ting (2000) investigating Taiwan's stock price index, Hooi and Smyth (2007) studying stock prices in eight Asian countries, Lakshmi and Roy (2012) studying six Indian stock markets, Shirvani and Delcoure (2016) investigating stock prices of 18 OECD countries from 1985 to 2013.

The key purpose of this article is to investigate the volatility of GEM index based on breakpoints method. By using Monte Carlo simulation, we get the critical value of structural change test. The finding of this article provides policies making guidance on GEM in China with empirical evidence. This paper is written as follows. The second part describes the models and data processing. The third part presents the critical value of breakpoints test. The fourth part analysis the empirical results. The last part is the conclusion.

MODELS AND DATA PROCESSING

For investigating the volatility of GEM stock price, we set the null and alternative hypothesises of the time series at first.

The null hypothesis is as follows:

$$H_0 : \alpha = 0 \quad (1)$$

The alternative hypothesis is as follows:

$$H_1 : \alpha < 0 \quad (2)$$

Then, we set the linear model for testing breakpoints below.

$$\Delta sp_t = \alpha sp_{t-1} + \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \sum_{i=1}^{p} c_i \Delta sp_{t-i} + e_i \quad (3)$$

$DU1_t$ and $DU2_t$ above are mean abrupt changes, $DT1_t$ and $DT2_t$ are trend abrupt changes.

Therefore, according to the methods of Lumsdaine and Papell (1997), Wang et al (2009) and Chi and Wang (2013), we can obtain another 5 equations for searching breakpoints.

$$\Delta sp_t = \alpha sp_{t-1} + \mu + \beta t + \theta DU1_t + \gamma DT1_t + \psi DT2_t + \sum_{i=1}^{k} c_i \Delta sp_{t-i} + e_i \quad (4)$$

$$\Delta sp_t = \alpha sp_{t-1} + \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \sum_{i=1}^{k} c_i \Delta sp_{t-i} + e_i \quad (5)$$

$$\Delta sp_t = \alpha sp_{t-1} + \mu + \beta t + \gamma DT1_t + \psi DT2_t + \sum_{i=1}^{k} c_i \Delta sp_{t-i} + e_i \quad (6)$$

$$\Delta sp_t = \alpha sp_{t-1} + \mu + \beta t + \theta DU1_t + \psi DT2_t + \sum_{i=1}^{k} c_i \Delta sp_{t-i} + e_i \quad (7)$$

$$\Delta sp_t = \alpha sp_{t-1} + \mu + \beta t + \theta DU1_t + \omega DU2_t + \sum_{i=1}^{k} c_i \Delta sp_{t-i} + e_i \quad (8)$$

The value of α and $t_{\hat{\alpha}}$ can be gotten via OLS regression of model 3-8. Let's write t statistics of $\hat{\alpha}$ as $t_{\hat{\alpha}}$ and obtain the minimum value $t[\lambda_{inf}^{i}] = \inf_{\lambda \epsilon \Lambda} t_{\hat{\alpha}^2}(\lambda)$ from set of $t_{\hat{\alpha}}$. Compare $\inf_{\lambda \epsilon \Lambda} t_{\hat{\alpha}^2}(\lambda)$ with critical value getting from simulation and $\alpha = 0$.

We get GEM stock prices data from Wind database. The key indexes in GEM are ChiNext Price index (CNPI) starting from June 1st, 2010, ChiNext Composite Index (CNCI) starting from August 20th, 2010, ChiNext TRN Index (CNTI) starting from June 1st, 2010.

We utilize STL decomposition method to seasonally adjust CNPI, CNCI and CNTI series.

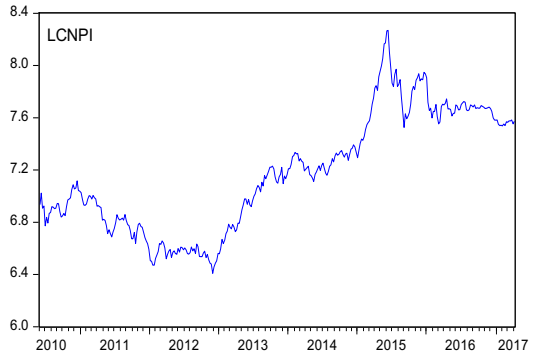

Fig. 1. The natural logarithm of CNPI

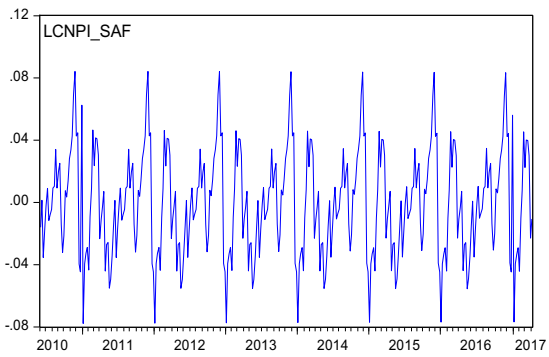

Fig. 2. Seasonal Factor of LCNPI

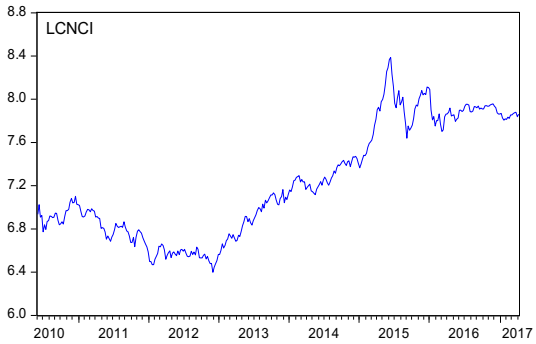

Fig. 3. The natural logarithm of CNCI

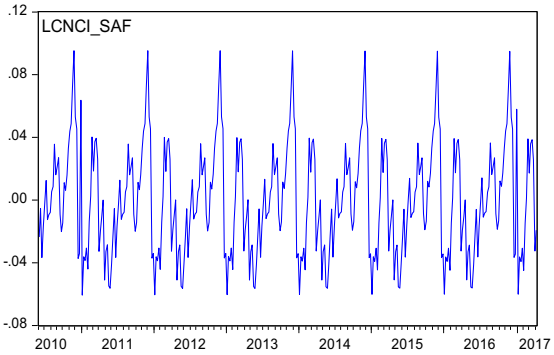

Fig. 4. Seasonal Factor of LCNCI

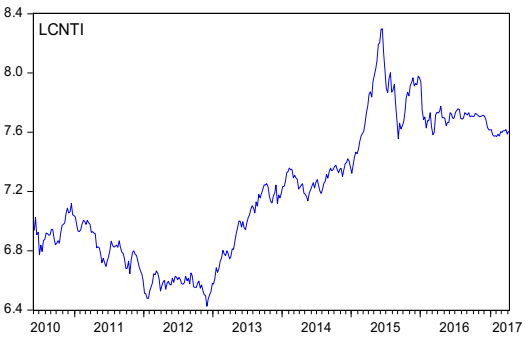

Fig. 5. The natural logarithm of CNTI

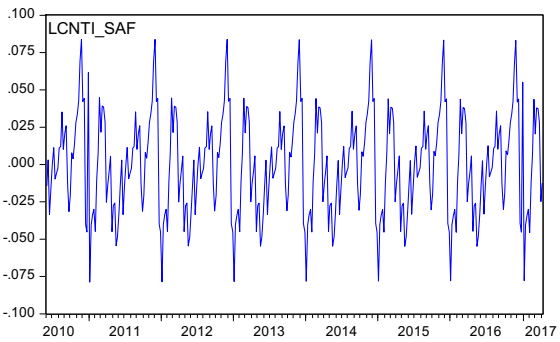

Fig. 6. Seasonal Factor of LCNTI

We believe the fluctuate of securities prices is influenced by inflation. CCPI (China Commodity Price Index) covers twenty-six commodities which has a close relationship with the GEM companies. We use CCPI to eliminate inflation factor in GEM prices and obtains real price logarithmic series LRCNPI, LRCNCI and LRCNTI. The period of the sample covers from June 4th, 2010 to April 7th, 2017.

THE CRITICAL VALUE OF BREAKPOINTS TEST

The software Eviews 10 is used to obtain the distribution of $\inf_{\lambda \epsilon \Lambda} t_{\hat{\alpha}^2}(\lambda)$. We deem $y_t=\varepsilon_t$ as data generation process (DGP) to get a random series including 385 samples.

According the method of simulation in Chi and Wang (2013), and let model CC and BB correspond to equations 3 and 4, we obtain the Kernel density of them as below.

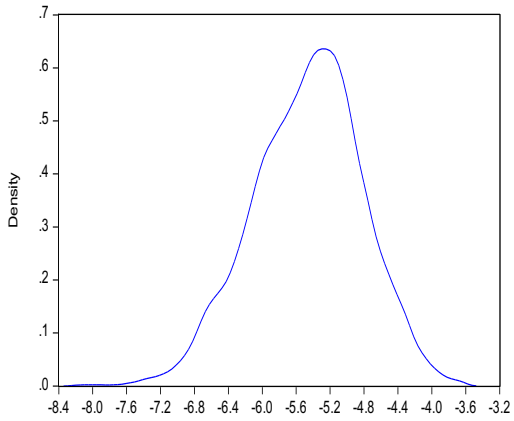

Fig. 7. Kernel density of model CC

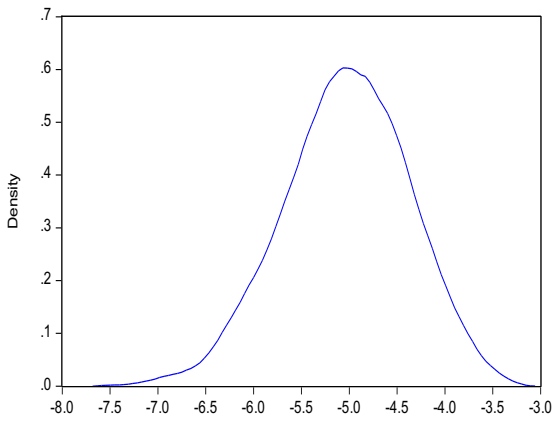

Fig. 8. Kernel density of model CB

Then, let CA, BB, AB and AA correspond to formulas 5 to 8, we can also get the figures of the Kernel density bellow.

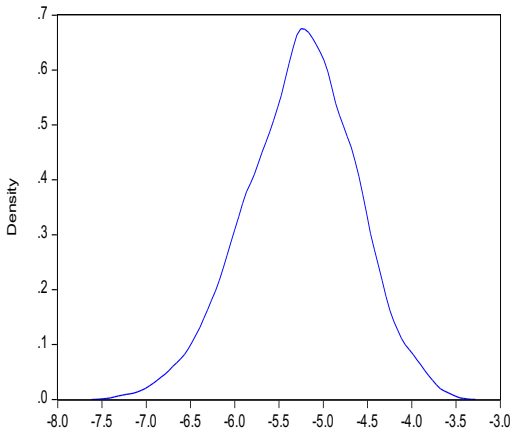

Fig. 9. Kernel density of model CA

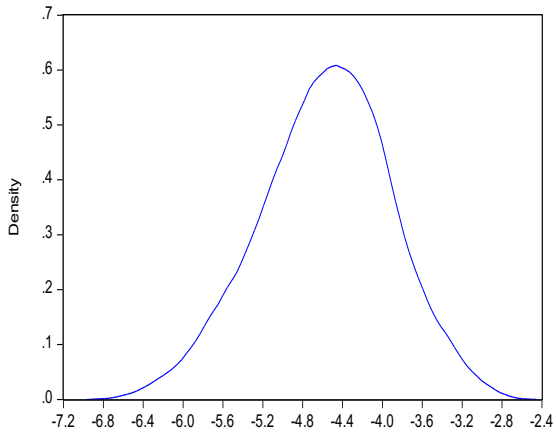

Fig. 10. Kernel density of model BB

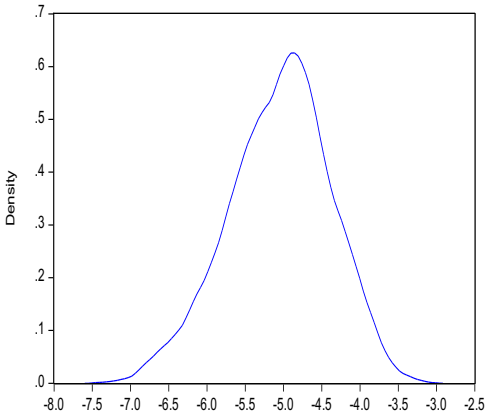

Fig. 11. Kernel density of model AB

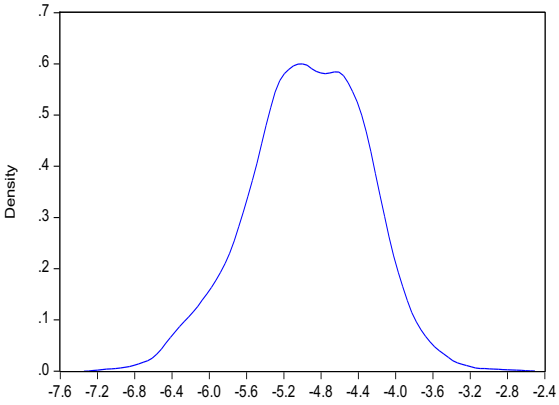

Fig. 12. Kernel density of model AA

Therefore, the critical values for testing break change are obtained.

Table 1. Critical Value

Model	CC	CB	CA	BB	AB	AA
Computation times	1,000	1,000	1,000	1,000	1,000	1,000
Sample size	358	358	358	358	358	358
1%	-7.012585	-6.699039	-6.776923	-6.156363	-6.672849	-6.477983
2.5%	-6.756680	-6.345585	-6.554663	-5.918221	-6.475058	-6.255102
5%	-6.566178	-6.155370	-6.306392	-5.706303	-6.208973	-6.058066
10%	-6.317349	-5.895820	-6.071776	-5.460814	-5.960187	-5.772871
15%	-6.121426	-5.702880	-5.896877	-5.268734	-5.740345	-5.579541
50%	-5.422432	-5.012013	-5.226086	-4.549462	-5.008840	-4.925621
85%	-4.830478	-4.358986	-4.612477	-3.908706	-4.363598	-4.306089
90%	-4.678602	-4.210989	-4.507325	-3.767342	-4.224888	-4.175881
95%	-4.469382	-3.989240	-4.298436	-3.512755	-4.010053	-4.002933
97.5%	-4.297633	-3.834984	-4.086204	-3.332543	-3.868515	-3.821451
99%	-4.131557	-3.639082	-3.957398	-3.143905	-3.725770	-3.627633

Note：DGP：$\Delta y_t=\varepsilon_t$

ADF UNIT ROOT TEST AND BREAKPOINTS TEST

ADF unit root test on GEM indexes

Unit root test for the GEM stock indexes necessary the breakpoint test because the breakpoint test is needless if time series is stationary. In other words, only unstable series need to be retested by the breakpoint test.

The result of ADF test on GEM indexes are shown as follows.

Table 2. Result of ADF test on GEM indexes

Series	Test form	t-Statistic	Test critical values		
			1% level	5% level	10% level
lrcnpi	(c, t, 0)	-2.028371	-3.984047	-3.422497	-3.134120
lrcnci	(c, t, 0)	-2.265831	-3.984047	-3.422497	-3.134120
lrcnti	(c, t, 0)	-2.023929	-4.030729	-3.445030	-3.147382
D(lrcnpi)	(c, 0, 1)	-17.41507	-3.448518	-2.869442	-2.571047
D(lrcnci)	(c, 0, 1)	-17.33712	-3.448518	-2.869442	-2.571047
D(lrcnti)	(c, 0, 1)	-17.41385	-3.448518	-2.869442	-2.571047

Table 2 shows all of real GEM stock indexes (LRSSPI, LRSSCI and LRSPMI) are I (1) processes at 1% significance level.

Breakpoints test

Let $k_{max} = 12$, we apply equations 3-5 and the method proposed by Lumsdaine and Papell (1997) to do GEM indexes breakpoint test. The result is shown in table 3.

For logic integrity, we also use the supplementary approach proposed Wang et al (2009) to do GEM indexes breakpoint test. The result is shown in table 4.

Table 3. GEM indexes breakpoint test equations 3-5

series	model	$\hat{\alpha}$	$t_{\hat{\alpha}}$	breakpoints	$\hat{\theta}$	$\hat{\omega}$	$t_{\hat{\theta}}$	$t_{\hat{\omega}}$	$\hat{\gamma}$	$\hat{\varphi}$	$t_{\hat{\gamma}}$	t_{φ}	k
lrcnpi	AA	-0.049247	-4.272523	11/21/2014	0.052455		-3.019474						9.00000
				4/05/2013		0.049554		3.865295					
	CC	-0.112587	-5.621671	12/02/2011	-0.034158		-2.472214		0.001803		4.373776		9.00000
				3/13/2015		0.077005		4.270137		-0.001753		-5.865322	
	CA	-0.055401	-4.519791	1/09/2015	0.054665		3.759273		-0.000883		-5.184951		5.00000
				3/25/2011		-0.045705		-3.409499					
lrcnci	AA	-0.044548	-3.951519	4/12/2013	0.041158		3.401408						9.000000
				11/21/2014		0.049708		3.169397					
	CC	-0.139008	-5.878894	7/13/2012	-0.001681		-0.145512		0.002303		5.376502		9.00000
				3/13/2015		0.092637		4.709523		-0.002015		-6.088815	
	CA	-0.055672	-4.261100	1/09/2015	0.052085		3.474527		-0.000772		-4.442141		9.000000
				9/02/2011		-0.043647		-3.126128					
lrcnti	AA	-0.049313	-4.270017	11/21/2014	0.052252		3.493734						9.00000
				11/21/2014		0.052252		3.493734					
	CC	-0.113225	-5.639437	12/02/2011	-0.034144		-2.472629		0.001810		4.386273		9.00000
				3/13/2015		0.077210		4.285133		-0.001768		-5.882997	
	CA	-0.055413	-4.515181	1/09/2015	0.054518		3.752918		-0.000886		-5.185475		5.000000
				3/25/2011	-	-0.045459		-3.390778					

Table 4. GEM indexes breakpoint test equations 6-8

series	model	$\hat{\alpha}$	$t_{\hat{\alpha}}$	breakpoints	$\hat{\theta}$	$\hat{\omega}$	$t_{\hat{\theta}}$	$t_{\hat{\omega}}$	$\hat{\gamma}$	$\hat{\varphi}$	$t_{\hat{\gamma}}$	$t_{\hat{\varphi}}$	k
lrcnpi	BB	-0.094117	-4.694313	7/20/2012	0.052455		3.501933		0.001636		4.045143		9.00000
				11/06/2015		0.049554		3.865295		-0.001903		-4.741039	
	CB	-0.121287	-5.623033	3/13/2015	0.080934		4.371461		-0.007407		-3.521763		9.00000
				4/06/2012		0.077005		4.270137		-0.001894		-5.885666	
	AB	-0.042316	-3.654622	9/02/2011	-0.038446		-2.649053		-0.000883		-3.573019		9.00000
				11/13/2015		-0.045705		-3.409499		-0.000894		5.065533	
lrcnci	BB	-0.100967	-4.793667	9/28/2012	0.041158		3.401408		0.001821		4.244656		9.00000
				11/13/2015		0.049708		3.169397		-0.001977		-4.833480	
	CB	-0.139012	-5.887916	3/13/2015	0.092509		4.745183		-0.002018		-6.168004		9.00000
				7/20/2012		0.092637		4.709523		0.002300		5.413734	
	AB	-0.048100	-3.651766	7/15/2016	-0.042737		-3.456382		-0.002283		-1.539364		9.000000
				1/13/2012		-0.043647		-3.126128		-0.000772		2.793410	
lrcnti	BB	-0.094379	-4.692299	7/20/2012	0.049734		3.870520		0.001633		4.038430		9.00000
				11/06/2015		0.052252		3.493734		-0.001913		-4.740504	
	CB	-0.121642	-5.629767	3/13/2015	0.080917		4.376550		-0.001905		-5.892361		9.00000
				4/06/2012		0.077210		4.285133		0.002080		5.064345	
	AB	-0.042662	-3.668815	9/02/2011	-0.038600		-2.658271		-0.000886		-5.185475		7.000000
				11/13/2015		-0.045459		-3.390778		-0.000903		-3.590739	

According to table 3 and 4, $t_{\hat{\alpha}}$ are smaller than the absolute critical value 10% (see table 1). Therefore, the null hypotheses can't be rejected at 90% confidence level. That is to say, the GEM indexes follow unit root process.

CONCLUSION

We use multiple break points test to study the fluctuation of GEM stock prices. Be based upon Monte Carlo Simulation for 1,000 times, we have finished the structural change tests on ChiNext Price index (CNPI), ChiNext Composite Index (CNCI) and ChiNext TRN Index (CNTI).

The inflation factor is eliminated by China Commodity Price Index (CCPI). The test result shows that CNPI, CNCI and CCTI are all unstable at or above 90% confidence level. There are more than 700 enterprises issue in GEM until 2017. The result that CNPI, CNCI and CCTI do not follow mean reversion process reveal any imposition of macroeconomic policies and change of equity market environment cannot change how stock prices grow in GEM. In other words, policy bailout in 2015 do not have structural change effect on CNPI, CNCI and CCTI. The rescue of the securities market in 2015 was invalid. The long-term growth of GEM stock indexes depend on investor mentality, the stock supply and so on. The results provide policies making guidance on GEM in China with empirical evidence. Consequently, the fluctuation of GEM prices may be different from other boards such as the Main Board in China. Therefore, it is necessary to conduct another investigation rather than apply the result of this research if we want to get the features of price fluctuation in this market.

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APPENDIX: THE RESULTS OF ANALOGUE SIMULATION