Designation and Detection of the Best Capital Buffer of Nonlife Insurance Countercyclical Regulation in China

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Abstract

Countercyclical regulation was an important research field in insurance in these years. The insurance regulation department of most countries all took researches about the countercyclical regulation constantly. In this article, the appropriate monitor control index of nonlife insurance countercyclical regulation was got by panel data model on the foundation of history data of nonlife insurance in China. Using Markov regime switching model, the detailed regulation system of nonlife insurance countercyclical regulation was designed in detail and the best capital buffer was got. The results showed that premium increasing rate was the best monitor control index of nonlife insurance countercyclical regulation, as it kept a deep relationship with solvency margin. The smooth possibility in Markov regime switching model could show correctly the regime of different time. If the regulation department required appropriate positive or negative capital buffer according with the smooth possibility, the premium increasing could be turned over quickly. Then, the fluctuation of insurance market would be smoother and smoother. Except that, the nonlife insurance countercyclical regulation was most effectively if we took the capital buffer ratio c as 2.5%. Those research results were useful for the “Solvency II” designation in China.

Key Words: Nonlife Insurance; Countercyclical Regulation; Capital Buffers; Markov Regime Switching Model

Introduction

After the financial crisis of 2008, the financial regulation department realized the problem of financial regulation system at that time. Most of those countries began to develop macro-prudential regulation. Basel III was published in G20 conference in 2010 soon, which suggested developing Countercyclical Regulation in the finance industry. So, this became to be the revolution direction of financial regulation in the world. In the insurance regulation, International Association of Insurance Supervisors (IAIS) also suggested that insurance regulation department should put macro-prudential regulation into effect, develop and enhance Countercyclical Regulation importantly. IAIS were keeping research of the uniform regulation framework of the world. In China, China Insurance Regulatory Commission (CIRC) almost kept the same speed with IAIS. They have finished *Regulation Framework of Solvency II in China*, and confirmed that Countercyclical Regulation would be implemented in the future, which would require insurance companies draw capital buffers of Countercyclical Regulation according with the macro-prudential regulation.

In fact, there were so many articles in China which tested the cycle of nonlife insurance in China (Sun Qixiang, 2011). Countercyclical Regulation based on the cycle of insurance market, which took some adverse measure with the market cycle. For example, when the market was very low, the regulation would be a little looser so that the market would recover soon. While when the market was very hot, the regulation would be very stricter to make the speed slower and avoid bubble. So that, the system risk of market would be counteract because of Countercyclical Regulation, and the stability of market would be better than before. Capital buffer was the core of Countercyclical Regulation System, which was some extra capital requirement according with the cycle of insurance market. In detailed, when the insurance market was very low, there should be a negative capital buffer. So, the capital requirement would be decreased a little. The operation expense and capital expense would be decreased, the developing speed of insurance company would increase and all market could recover soon. While when the insurance market was very hot, there should be a positive capital buffer. So, the capital requirement would be increased a little, which increased the operation expense and capital expense, insurance company must decrease the developing speed as they didn't have enough extra capital. So that, the developing speed of premium would decrease and the market could go back to rational market soon. In China, CIRC has published the *Exposure Draft of Solvency II* on April 2014. They said the requirement of countercyclical regulation capital buffer would be published separately. But until now, the detailed countercyclical regulation and capital buffer haven't come on yet. So, how to design the countercyclical regulation and capital buffer in China? What's the best index to be monitored? How much rate was suitable? There were so many detailed questions to be answered before designing the countercyclical regulation system. Basel Commission made the ratio of credit outstanding with GDP as the monitor control index of cycle in the

countercyclical regulation of bank, then, what should be the monitor control index in insurance? Which one is better for premium, net income or combined ratio? When was the best time to draw capital buffer? How many capital buffers should be drawn in order to realize the effect of the countercyclical regulation?

The framework of countercyclical regulation system would be clearer if we can answer those questions above. In this article, we tried to answer those questions by using panel data model and Markov regime switching model. The monitor control index of countercyclical regulation for nonlife insurance was got with panel data. Then, the detailed countercyclical regulation method was designed by using Markov regime switching model. The best rate of capital buffer was got at last after comparing the regulation effect of different capital buffer. This article tried best to make some innovation below: (1) Getting the suitable monitor control index of nonlife insurance countercyclical regulation in China according with the pro-cyclicality of solvency margin. (2) Designing the detailed countercyclical regulation schedule. (3) Comparing the regulation effect of different capital buffer and deciding the best capital buffer. The results of this article could provide some suggestion to the insurance regulation department in China. The contents of this article included below. The second part was literature review. The third part was theory and model. The fourth part was demonstration. The fifth part was testing and final part was results and suggestions.

Literature Review

In these years, the financial regulation department of many countries took more and more attentions on macro-prudential regulation and reinforced countercyclical regulation. Those scholars also took more and more researches about countercyclical regulation. But most of them concentrated themselves on the countercyclical regulation of bank. The detailed countercyclical regulation system of bank was almost clear and would be born soon. But in insurance, more researches still focused on the test of premium cycle or claim cycle, and calculate the length of cycle. Only little articles took research about the detailed methods and schedule of countercyclical regulation in insurance. So, we could do some deep research in insurance and take the research results of countercyclical regulation in bank as a reference.

Basel Commission published *Guiding Principle of Countercyclical Capital Regulation for Bank* in 2010. They took the monitor control index of countercyclical regulation of bank as the deviation of General Credit/GDP with its secular trend. The regulation department would decide the capital buffer with the secular trend of the deviation in General Credit/GDP. They took the capital buffer as 2.5%. This decision based on the research of Bank for International Settlements (Drehmann et al. 2010). They analyzed the data from 30 countries in 40 years. They found General Credit/GDP could reveal the accumulation of system risk in bank. So, they suggested making it as the monitor control index of countercyclical regulation in bank. But some other academics analyzed the same data of different countries and got different results. Repullo & Saurina (2011) thought GDP increasing rate wasn’t positive correlated with

the secular trend of deviation in General Credit/GDP. It's useless to stop the fast credit increasing rate if the countercyclical regulation based on General Credit/GDP. Li Wenhong & Luo Meng (2011), Gao Guohua (2013) also thought General Credit/GDP can't monitor the accumulation of system risk in China.

Some articles also made researches about the drawing of countercyclical regulation. Edge & Meisenzahl (2011) thought the countercyclical regulation method of Basel Commission would change bigly with the different sample, different calculation of secular trend and different parameter. These would affect the effectiveness of regulation. Peng Jiangang et al. (2010) agreed with that the countercyclical regulation of Basel Commission was insufficiently a little.

The detailed countercyclical regulation of insurance hasn't been decided, neither in the framework of international insurance regulation from International Association of Insurance Supervisors (IAIS, 2006), nor in the solvency II of European. Academics all were making some exploration in the insurance countercyclical regulation and taking that of bank as references. Cerchiara & Lamantia (2009) designed the countercyclical regulation model of simple insurance company on the foundation of claim cycle of insurance, which was from the point of internal model of Solvency II in European. They chose solvency margin and premium change as the monitor control index. But the defect of the model was very obvious as it just can be used to simple insurance company which took internal model, it can't be popularized to all insurance industry. Boyle & Kim (2012) designed a theory model to measure the system risk with the CoCTE model, and designed the capital buffer model with Markov regimes switching model. But they just provided a possible idea for the countercyclical regulation, instead of designing a really operable model. They even didn't test whether the model could realize the regulation object really.

In China, most academics were still focused on the verification of insurance cycle in the nonlife insurance market, the procyclical effect with macroeconomics, and some theory suggestions for the countercyclical regulation. Wang Bo & Shi Anna (2006) found that the cycle of main insurance products were 6 years, but the cycle of nonlife insurance industry wasn't very obvious on the foundation the claims ratio for 22 years. Zhang Lin & Zhu Yuanli (2007) also got the similar results. Ji Yuna & Zhen Haitao (2009) found there were some cycles of all insurance products, which were same with Li Xinyu & Li Jie (2010) and Zhang Lin & Tang Linjuan (2012). Gen Yunjie (2011) thought there were some pro-cyclical effects between premium and GDP. She analyzed the cycle reason from accounting system and solvency regulation system. Huang Xi & Zhou Hui (2012) found insurance industry was pro-cyclical with economics. Most of them tested the operation cycle of nonlife insurance. They didn't take deep account with the object, method and index of countercyclical regulation. Some provided little suggestions about that. Liu Chao & Liu Zhiwei (2010) and Zhao Guangyi & Wang Rui (2010) suggested that countercyclical regulation could be realized from underwriting regulation, reserves rules, fair value and solvency regulation at the same time. But actually, if the regulation department would intervene the operation of insurance companies by reserve drawing and fair value calculation,

it's a good chance for insurance company to manipulate the profit. Wu Jie & Su Fang (2014) distinguished the concept of premium cycle and claim cycle. They thought those two cycles both existed and they related with each other. Every nonlife insurance products had their own premium cycle and claim cycle. Different factors affected those two different cycles. The countercyclical regulation should focus on the claim cycle which showed the real change of system risk in market. But it's a little difficult to catch the claim cycle correctly. We could decide the best chance of countercyclical regulation though observing the premium cycle as the significant relationship between premium cycle and claim cycle. In the *Exposure Draft of Solvency II* in China CIRC, countercyclical regulation was focused on solvency margin.

On the foundation of above researches, the countercyclical of nonlife insurance in China was designed taking that of bank into reference. As the detailed schedules were all designed, this article was a good suggestion to Solvency II of insurance regulation.

Theory and Model

There were two important points in the countercyclical regulation system. First, what is the monitor control index to judge the cycle? That was to say, when should we require the capital buffer of countercyclical regulation? How to judge the right time? Second, how much capital buffer should take? Should it be positive or negative? The difficulty of countercyclical regulation was solved if we found the answers for those two questions. So that, the logic of this article was as below: First, the monitor control index should be found. We can judge whether to take capital buffer according with the change of monitor control index. Second, the rate of capital buffer should be defined. We should take different rate of capital buffer according with the different developing of insurance company. Third, the effect of capital buffer for countercyclical regulation should be tested. We could know whether the system we designed realize the object of countercyclical regulation.

Monitor Control Index

There were some articles about the monitor control index of countercyclical regulation in nonlife insurance. But they had different suggestions about that. Cerchiara & Lamantia（2009）calculated the premium cycle of insurance company by premium income. They also thought premium income should be the monitor control index of countercyclical regulation. Boyle & Kim（2012）made the monitor control index as the difference between debt and asset in the balance sheet (which was the opposite number of net asset). Sun Qixiang (2011) and Wu Hong (2011) thought the insurance market in China should be different with other countries as it's a developing country. We should distinguish the difference between insurance quality cycle and insurance quantity cycle. Premium income should be taken as the monitor control index for insurance quantity cycle, while retained profit (or loss ratio) should be taken

as the monitor index for insurance quality cycle. But they didn't decide which cycle should be regulated by countercyclical regulation, insurance quality cycle or insurance quantity cycle. According with the *Regulation Framework of Solvency II in China*, the countercyclical regulation was aim at keeping away the excess or insufficient of solvency and keeping the stability of solvency.

But the solvency margin was a little hysteretic with the development of insurance market[1]. There wasn't any dynamic solvency regulation in real-time in China. It wasn't feasibility to make the solvency margin as the monitor control index of countercyclical regulation of nonlife insurance. We'd better think from the original intention of countercyclical regulation. Those indexes should be the best monitor control index which has an apparent relationship with solvency margin, measureable and easy to be got. Otherwise, if the monitor control index wasn't correlated with solvency margin, the regulation can't changeover the development of insurance market and the solvency margin though capital buffer was required according with the change of monitor control index. On the other hand, it would take a long time to calculate and statistic the monitor control index if it was too complex. The delaying of index would affect the quality of regulation and make the regulation decision incorrect. In this article, panel data model was used first in order to find a measureable index correlated with solvency margin.

1. Dependent variable

Minimum Capital was the basis of countercyclical regulation in the *Framework of Solvency II in China*. The solvency margin would be changed because of the changing of Minimum Capital. So, solvency Margin could be chosen as the independent variable (*Solvency*).

2. Independent variable

Possible Monitor Control Index: According with the regulation system in China, Solvency Margin equals to Minimum Capital divided by Real Capital. Minimum Capital is related with premium income or claims amount. Real Capital equals to the difference between admitted assets and admitted liability. As a result, those indexes which correlated with admitted asset, admitted liability, premium income and claims amount should related with solvency margin (Boyle & Kim, 2012; Sun Qixiang et al., 2011; Wu Hong, 2011; Wu Jie & Su Fang, 2014). The possible monitor control indexes would be premium[2] (*premium*) or increasing rate of premium, retained profit (*NetP*), equity (*NetA*), combined ratio (*CostR*) and investment (*investment*). Premium affected Minimum Capital. Solvency margin would decrease if the premium increased. While, retained profit, equity, combined ratio and investment affected Real Capital by affecting to the admitted capital and admitted liability. Solvency Margin would increase if retained profit, equity and investment increased and combined ratio

[1] Solvency Margin is a data at some times in the Regulation system of China. There isn't dynamic solvency regulation until now. CIRC will show the solvency margin of all insurance companies at each April, so the solvency margin is a little hysteretic.

[2] It's gross premium income in this article.

decreased. All of those possible indexes would be taken as depended variable in order to find the best one. But there were multicollinearity among retained profit, equity, combined ratio and investment. Three different models were designed to avoid multicollinearity in order to find the different affects to solvency margin from retained profit, equity, combined ratio and investment. The index which had the most sensitively correlated with solvency margin could be chosen as the monitor control index after comparing the results of those three models.

Control Variables: The control variables were decided from other related research articles. (1) Capital rate (*CapitalR*). Shim (2010) thought that higher capital rate, higher the solvency margin is. Wang Lizhen et al. (2012), Zhao Guiqin and Wu Hong (2013) also tested the relations between capital rate and solvency margin in China nonlife insurance market and got the same results. (2) Size (*Size*). Size was defined as the logarithm of asset. Cummins & Sommer (1996) thought big insurance company was stronger to disperse risk. It would make the solvency margin of big insurance company lower. But they were more capable to invest and get money so that they would have higher operation control capability than that of small insurance companies. It would make the solvency margin higher. So, the relationship between size and solvency margin can't be confirmed. (3) Reinsurance Rate (*Rein*). Reinsurance was a popular method to distribute risk of nonlife insurance companies. Minimum Capital was lower if the reinsurance rate was higher and the net premium was lower. Yuan Cheng and Yang Bo (2014) confirmed that reinsurance rate was positive correlated with solvency margin in China nonlife insurance market. (4) Ownership (*D*). According with the corporate governance, the relationships among solvency margin and premium, retained profits were different in the different ownership companies (Zhao Guiqin & Wu Hong, 2013). Dummy variable was designed to show the ownership of companies. 1 was for Chinese insurance companies and 0 for foreign insurance companies[1]. Three panel data models were below[2]:

$$\Delta Solvency_{it} = \alpha_0 + \alpha_1 \Delta \mathrm{Pr}emium_{it} + \alpha_2 \Delta NetP_{it} + \alpha_3 \Delta CaptialR_{it} + \alpha_4 \Delta Size_{it} + \alpha_5 \Delta \mathrm{Re}in_{it} + \alpha_6 D_i + \varepsilon_{it} \quad (1)$$

$$\Delta Solvency_{it} = \alpha_0 + \alpha_1 \Delta \mathrm{Pr}emium_{it} + \alpha_2 \Delta NetA_{it} + \alpha_3 \Delta Size_{it} + \alpha_4 \Delta \mathrm{Re}in_{it} + \alpha_6 D_i + \varepsilon_{it} \quad (2)$$

$$\Delta Solvency_{it} = \alpha_0 + \alpha_1 \Delta \mathrm{Pr}emium_{it} + \alpha_2 \Delta CostR_{it} + \alpha_3 \Delta Investment_{it} + \alpha_4 \Delta CaptialR_{it} + \alpha_5 \Delta Size_{it} + \alpha_6 \Delta \mathrm{Re}in_{it} + \alpha_7 D_i + \varepsilon_{it} \quad (3)$$

The differences for all data were calculated before regulation as no all data were stable, which can also avoid of spurious regression. All variable were in Table 1.

Table 1 Variables Definition and Calculation

[1] We divided all companies into Chinese company and Foreign company according with the standard of CIRC.
[2] There wasn't CapitalR in the Model (2) because of the multicollinearity of NetA and CapitalR.

	Name	Definition	Relationship
Dependent Variable	Δ*Solvency*	First differences of solvency margin	
Independent Variables	Δ*Premium*	First differences of the logarithmic for gross premium	-
	Δ*NetP*	First differences of retained profit	+
	Δ*NetA*	First differences of logarithmic for equity	+
	Δ*CostR*	First differences of combined ratio	-
	Δ*Investment*	First differences of logarithmic for investment	+
	Δ*CaptialR*	First differences of asset rate	+
	Δ*Size*	First differences of logarithmic for asset	+/-
	Δ*Rein*	First differences of reinsurance rate	-
	D	1 for Chinese companies, 0 for foreign companies	+/-

Designation of Countercyclical Regulation

The monitor control index should be the most sensitive variable to solvency margin, after the analyzing of panel data model. The regulation decision could be made according with the periodical change of the monitor control index. Usually, the periodical change of variable could be matched by AR(p) model (autoregression model of *p* orders). But AR(p) model couldn't identify the structural jumping in the different period. It just can describe the linear relationship between variables. For example, the increasing speed of premium may change to intermediate increasing from low increasing suddenly. AR(p) model couldn't identify such phenomenon. Hamilton (1989) raised Markov Regime Switching Model to identify such jumping phenomenon and judge the regime of different period, which satisfied the requirement of capital buffer in the countercyclical regulation.

1. Identification of cycle by Markov Regime Switching Model

The monitor control index was unstable maybe. The secular trend should be removed before matching to cycle in order to show the cyclical fluctuation better. The cyclical fluctuation was kept at last. According with Hamilton (1989), HP smoothing was chosen to remove the secular trend and keep seasonal medium-high frequency fluctuations and random noise fluctuations. The model was:

$$Y_t = \alpha^{S_t} + \sum_{i=1}^{p} \beta_i^{S_t} Y_{t-i} + \sigma^{S_t} \varepsilon_t , \qquad (4)$$

$$\alpha^{S_t} = \alpha_1 S_{1t} + \alpha_2 S_{2t} + \alpha_3 S_{3t} , \quad \beta_i^{S_t} = \beta_{i1} S_{1t} + \beta_{i2} S_{2t} + \beta_{i3} S_{3t} , \quad \sigma^{S_t} = \sigma_1 S_{1t} + \sigma_2 S_{2t} + \sigma_3 S_{3t}$$

Y_t was the monitor control index of countercyclical regulation. S_t $(t = 1,2,3)$ was the different regime in the fluctuation. In this article, three regimes model were taken, which were low regime, mediate regime and high regime. High regime showed the hot and hard insurance market. Mediate regime showed the normal insurance market and low regime was the soft and cold insurance market. For example, if the monitor

control index Y_t was something like premium which showed the increasing speed, three regimes were low speed increasing regime, mediate speed increasing regime and high speed increasing regime. If the monitor control index Y_t was something like combine ratio which showed the operation level of insurance market, three regimes were low cost regime, mediate cost regime and high cost regime.

If $S_i = i$, S_{it}=1 and S_{jt}=0, $j \neq i$. α^{S_t} was a constant in the condition of S_t ($t = 1,2,3$). $\beta_i^{S_t}$ was the regulation coefficient of lagged variable in the condition of S_t, σ^{S_t} was the standard deviation in the condition of S_t, $\varepsilon_t \sim N(0,1)$. The transition possibility among regimes of first order Markov as below:

$$P = \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix} \qquad (5)$$

$P[S_t = j \mid S_{t-1} = i] = p_{ij}$, $i, j = 1,2,3$ and $\sum_{j=1}^{3} p_{ij} = 1$. The duration of each regime could be got according with the transition possibility and the duration of one cycle would be got. The formula was $D = 1/(1 - p_{ii})$, $i = 1,2,3$. (6)

In addition to this, the smooth possibility of all sample periods would be got according with the parameter estimation of model and information updating of Markov. The smooth possibility showed the possibility in the situation of which two regimes continuously were both low, or mediate or high regime. Suppose $\hat{\xi}_{t|t} = [P(S_t = 0 \mid I_t), P(S_t = 1 \mid I_t), P(S_t = 2 \mid I_t)]'$ showed the smooth possibility of time t, it could be got by the method in Kim (1994).

2. Designation of Capital Buffer

Smooth possibility described the possibility of different regimes in different time reasonably. We can judge the regime by the biggest smooth possibility of that period. The insurance company must withdraw different capital buffer when they were in different regim. Of course, it would be better if the capital buffer were different as the different smooth possibility though they were in the same regime. The suggestions for capital buffer were below:

(1) Low Regime：Low regime showed the soft and cold insurance market. The requirement of capital should be decreased. When the smooth possibility of low regime was in $[a,b]$, the capital buffer for countercyclical regulation should be $-c$; When the smooth possibility of low regime was more than *b*, the capital buffer should be $-2c$; while when the smooth possibility of low regime was below *a* , no any capital

buffer was required.

(2) High Regime：High regime showed the hard and hot insurance market. The requirement of capital should be increased. When the smooth possibility of high regime was in $[a,b]$, the capital buffer for countercyclical regulation should be c; When the smooth possibility of high regime was more than *b*, the capital buffer should be $2c$; while when the smooth possibility of high regime was below a, no any capital buffer was required.

(3) Mediate Regime: Mediate Regime was a normal regime. No any capital buffer was required.

Demonstration

Monitor Control Index

1. Data sources and descriptions

In China, Solvency Margin was announced from 2009. This article can only use the data from 2009 to 2013 to analysis the monitor control index. On the other side, the analysis should consider the normal situation of the insurance industry. Only those companies for more than 10 years could be considered. Those mature companies have passed the turbulent period of the setting up and operated stable very well. At last, we collected 33 insurance companies from 2009 to 2013. Some singular points were deleted, 163 samples were got finally. And 130 difference data were got after differential treatment. All data were got from the website of the Association of Insurance Industry in China. The descriptions of all variable were shown in Table 2.

Table 2 Descriptions of All Variables

Variables	Observation	Mean	Standard Variation	Min	Max
Δ*Solvency*	130	0.2021	7.4130	-16.62	74.53
Δ*Premium*	130	0.1795	0.3056	-1.4630	1.7050
Δ*NetP*	130	115.7148	667.361	-1497.75	3428.26
Δ*NetA*	130	0.1907	0.4859	-1.1507	2.5052
Δ*CostR*	130	-0.0108	0.1865	-0.9475	0.9637
Δ*Investment*	130	0.1683	0.7335	-3.2883	2.3342
Δ*CaptialR*	130	0.0087	0.1673	-0.8671	0.7794
Δ*Size*	130	0.0687	0.1575	-0.6940	1.2374
Δ*Rein*	130	-0.0059	0.1519	-0.8585	0.9192
D	130	0.6933	0.4626	0	1

2. Analysis Results

Which model should we take according with those short samples, fixed effect model or random effect model? We tested and chose models by Hausman test (Table

3). P value of Hausman in those three regression models all were above 0.05. We can't reject the null hypothesis. So, random effect model should be taken in this article. Table 3 also showed the regression results of random effect model.

Table 3 Regression with Random Effects Model

Independent Variables	Dependent Variables（Δ*Solvency*）		
	Model 1	**Model 2**	**Model 3**
Δ*Premium*	-4.3605** （-2.10）	-5.6035*** （-2.68）	-3.3350*** （-3.60）
Δ*NetP*	-0.0002 （-0.23）		
Δ*NetA*		7.3236 （1.43）	
Δ*CostR*			5.0345 （1.30）
Δ*Investment*			-1.4908** （-2.04）
Δ*CaptialR*	25.8501*** （6.07）		27.2350*** （6.48）
Δ*Size*	28.8778*** （4.79）	20.0784*** （2.90）	29.0480*** （4.74）
Δ*Rein*	-4.5285 （-1.16）	-4.9114 （-1.23）	-3.1351 （-0.79）
D	1.0116 （0.86）	1.2245 （1.03）	0.8264 （0.72）
Constant	-1.9029* （-1.73）	-2.4095** （-2.18）	-1.6898 （-1.57）
Samples	130	130	130
R^2	0.4614	0.4231	0.4882
P value of Hausman	0.1318	0.3106	0.1739

Note: Data in the bracket are Z values. ***、** and * showed the significance level of 1%, 5% and 10% respectively. All were same in this article.

In table 3, Δ*Solvency* was negative correlated with Δ*Premium* in Model 1. The significance level was 5%. But the correlation between Δ*Solvency* and Δ*NetP* wasn't significant. In Model 2, Δ*Solvency* was negative correlated with Δ*Premium* at 1% significance level, but wasn't correlated with Δ*NetA*. In Model 3, Δ*Solvency* was also negative correlated with Δ*Premium* at 1% significance level, and negative correlated with Δ*Investment* at 5% significance level. But Δ*Solvency* wasn't correlated with Δ*CostR*. In all three models, Δ*Solvency* was all negative correlated with Δ*Premium* significantly. They were all same with our expectation. But, Δ*Solvency* almost wasn't correlated with Δ*NetP*，Δ*NetA* and Δ*CostR* significantly. Though Δ*Solvency* was significant correlated with Δ*Investment* negatively, but the significance was lower than that with Δ*Premium*. So, solvency margin was more sensitively with the change of premium, but wasn't sensitively with Retained Profit, Equity and Combined Rate. That was also to say, solvency margin was sensitively with the Minimum Capital which was denominator, but not sensitively with Real Capital which was numerator. This also showed that the solvency margin requirement was a little stricter in China. At other side, it's true that the relationship between Δ*Solvency* and Δ*Premium* was negative. When the premium of insurance companies was increasing rapidly, solvency margin would decrease because of the explosion of operation scale.

We suggested to take premium increasing as the monitor control index of countercyclical regulation in China just below. First, the correlation between solvency margin and premium increasing was the highest one. Second, it's very easy to get

gross premium, and the data was very timeless. Third, it's better to take a simple index as the monitor control index. The index of premium increasing was satisfied with all requirements above. So, we should take Premium Increasing as the monitor control index of countercyclical regulation. When premium was increasing very rapidly, insurance companies should withdraw extra capital buffer according with the requirement of countercyclical regulation. So, the increasing speed of premium should be lower and lower as they didn't have enough capital to support the requirement of solvency margin. The object of countercyclical came true. On the contrary, when the premium was very low, the requirement of Minimum Capital would decrease. So, insurance company had extra capital to develop business. Premium would turn to increase soon. In the bank, Basel Commission suggested to make the monitor control index as the ratio of credit outstanding with GDP. This index also showed the scale of business in bank, neither the quantity of business. Similarly, we suggested to make the monitor control index as the increasing of premium. It also showed the scale of business in insurance, neither the quantity of business. What we suggested for insurance kept the same logic and means with that of bank.

Designation of Countercyclical Regulation

1. Data Resource

The results would be more correct if we had more data to analyze the cycle. The insurance companies in China began to develop from 1980, which was a little late than that of other countries. So, there were so less year data of premium. There were only 33 years from 1980 to 2013. In this article, season data was taken in order to get more samples. We got 63 data from the first season of 1999 to the third season of 2014. All data came from the website of CIRC.

2. Designation of Countercyclical Regulation

Now, we decided the monitor control index as premium increasing. The secular trend was removed by HP smoothing and only kept seasonal medium-high frequency fluctuations and random noise fluctuations.

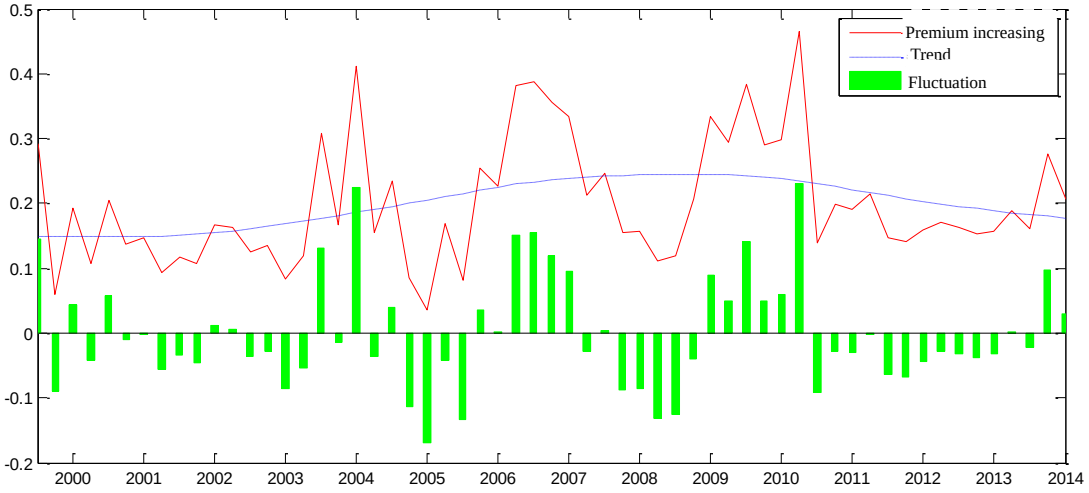

Figure 1　Premium Increasing after HP Smoothing

In Figure 1, histogram showed the fluctuation of cycle. There were obviously cycles in the fluctuation of Δ*Premium*. In 2005 and 2008, the premium kept lower increasing really. And it kept high increasing in 2004, 2007 and 2010. But, we can't decide whether there were some structure changes in the fluctuation of premium increasing.

According with Markov regime switching model, the three regimes based on premium increasing. They were low speed increasing regime (Regime 1), mediate speed increasing regime (Regime 2) and high speed increasing regime (Regime 3). Using Matlab to design the model, we designated that the lag order was 2 in the autoregression model according with AIC and SIC of different lag order models. In order to compare with the results of Markov and choose the best model, the parameter of AR(2) also got though it can't show the designability jumping. All results were in Table 4.

Table 4　Parameter Estimation of AR（2）and Markov Regime Switching Model

Parameter	AR（2）	Markov Regime Switching Model		
		Regime 1	Regime 2	Regime 3
α^{S_t}	0.0004	-0.1188***	-0.0266***	0.0912***
$\beta_1^{S_t}$	0.2103*	-0.1105	0.0879*	-0.2185
$\beta_2^{S_t}$	0.3242**	-0.1544**	0.0720**	0.467**
σ^{S_t}	0.0849***	0.0390***	0.0295***	0.0632***

In table 4, the parameter of mean value α^{S_t} wasn't significant in AR（2）, but it was significant at 1% level in the three regimes of Markov model. It showed that the mean value α^{S_t} of three regimes were different outstanding. There were some designability jumping in Δ*Premium* . Markov model could match the changing of premium increasing better. The switching possibilities were shown in table 5.

Table 5 Possibility of Regime Switching

Switching Possibility p	Regime 1	Regime 2	Regime 3
Regime 1	0.72	0.09	0
Regime 2	0	0.86	0.20
Regime 3	0.28	0.05	0.80
Log-likelihood Function Value	79.7565		

Smooth possibilities were got according with the definition before. Figure 2 showed the smooth possibility in different regimes, which showed the regimes of different time.

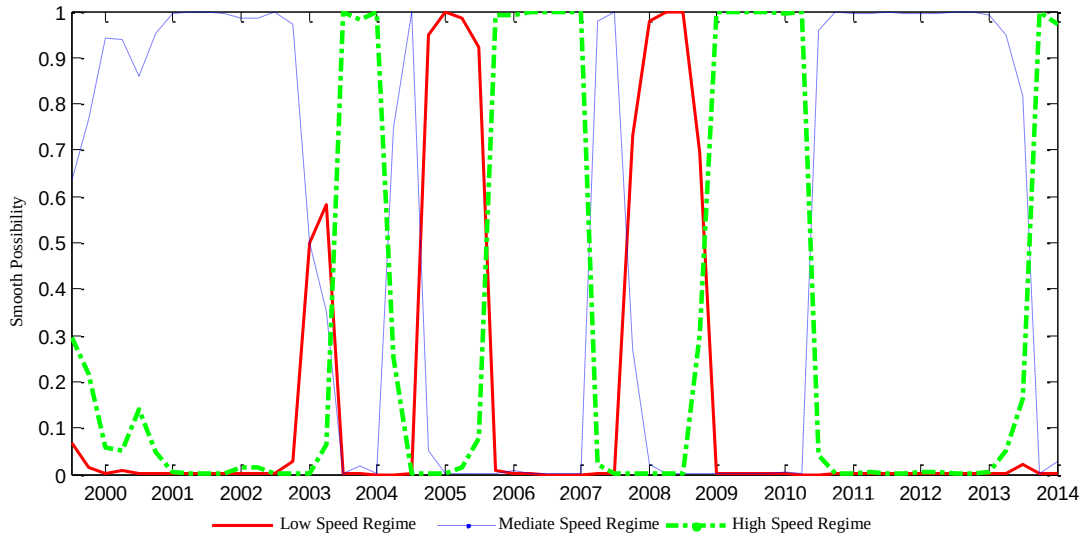

Figure 2 Smooth Possibility of Regime Each Season

Figure 2 was almost the same with Table1. Overall, the premium of China nonlife insurance kept mediate and high speed increasing in last 15 years. There were 3 high speed regimes in 2004, 2007 and 2010 obviously. But the low speed regimes were very short relatively, which were in 2005 and 2008. In Figure 2 of the financial crisis in 2008, the premium of China nonlife insurance just had a very short low speed regime. Then, it turned to high speed increasing regime quickly after the Chinese government invested four trillion to promote economics in 2008. From 2011, the premium increasing changed to mediate speed increasing regime mainly from high speed regime. All these change were correlated with the economy policy. Figure 2 almost showed the real market in nonlife insurance market of China.

The length of period could be got after we got the length of different regimes by formula (6). The length of low speed increasing regime was 3.52 months, while that for mediate regime was 7.13 months and was 5.06 for high speed increasing regime. It also showed that it was high speed increasing regime mainly. Of course, one cycle includes two mediate speed increasing regime, one high speed increasing regime and one low speed increasing regime. The length of one cycle of nonlife insurance market of China should be 5.5 years (22 seasons). This result was almost the same with Li Xinyu & Li Jie (2010) and Sun Qixiang (2011).

When should the insurance company withdraw capital buffer? How much they

should withdraw? We should answer such two questions to finish the designation of countercyclical regulation. The detailed capital buffer wasn't decided In the *Regulation Framework of Solvency II in China*. It just said that would be decided later. Gao Guohua (2013) suggested that the bank should withdraw capital buffer for 5% in the bank. Basel Commission stipulated the capital buffer as 2.5% in the *Guiding Principle of Countercyclical Capital Regulation for Bank* of 2010. Taking the regulation of bank for reference, we supposed a=0.5, b=0.9 and c=2.5%. So that, different capital buffers were required according with different smooth possibility and different regimes. No capital buffer should be withdrawn in the mediate speed increasing regime. It's -2.5% or -5% to be withdrawn in the low speed increasing regime. And it's 2.5% or 5% to be withdrawn in the high speed increasing regime. The capital buffers were shown in Figure 3 according with the fluctuation of nonlife insurance market.

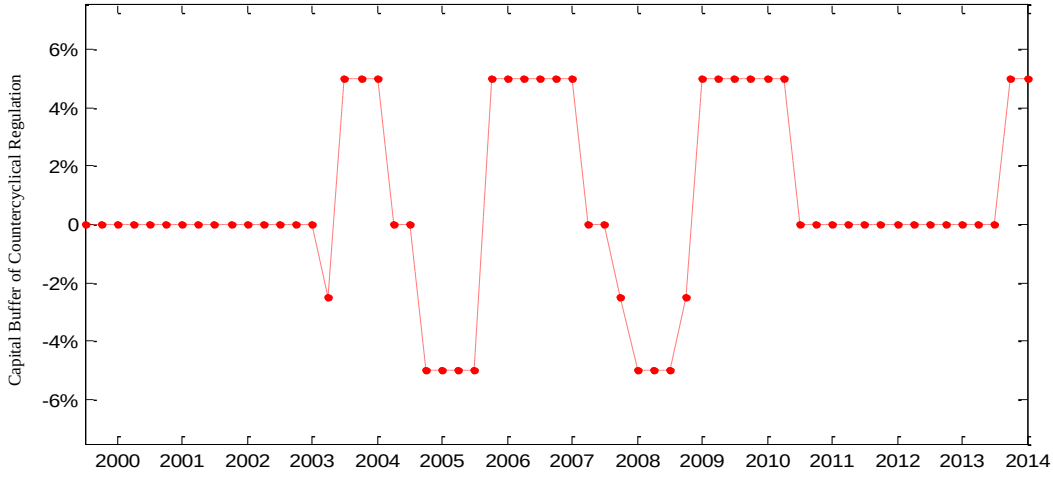

Figure3 Capital Buffer of Countercyclical Regulation

According with the Countercyclical Regulation we designed in this article, there were 17 sample periods in which we need increase capital buffer, while there were only 10 sample periods in which we need decrease capital buffer and 32 sample periods in which no capital buffer was needed[1]. That showed that no capital buffers were needed in most periods. We only need increase or decrease capital buffer occasionally. The results coincided with the object of countercyclical regulation, which showed that don't intervene the market excessively and continually. Except that, the number of periods in which we need to increase capital buffer (17 periods) were a little more than the number of periods (10periods) in which we need to decrease capital buffer. This also agreed with the overheating premium increasing in the sample years. Before the financial crisis of 2008, the insurance market was a little too hot and it need increase capital buffer. As the inflection of financial crisis, the insurance market was caught in fatigued and weak market quickly. We need decrease capital buffer from the second season of 2008. After 2011, the increasing rate of premium was very smooth, so that no any capital buffer was needed. The results of capital

[1]Note: Premium increasing was the monitor control index, which was a differential data. So, the data of 1999 was a base, which was disappear after we got the differential data. The samples reduced 4 data at all. The first data began form the first season of 2000.

buffer withdrawing were almost the same with the real insurance market.

Testing

How about the effect of capital buffer in the countercyclical regulation? Was the change of premium smoother? Was the solvency margin more stable? Has the object of countercyclical regulation been realized? Was the monitor control index of 2.5% suggested before the best? We need to test the results to know whether it's useful to keep countercyclical regulation.

Designation of Test Model

Let analyze the logic of this article first. The premium increasing was chosen to be the monitor control index as it correlated with solvency margin closely. If premium increasing was smoother, it tested the effect of countercyclical regulation. The method to test was as below. First, the change of solvency margin was got after increasing or decreasing the capital buffer. Second, the change of premium income was got according with the relationship between premium and solvency margin. Finally, we compared the real premium change with that after capital buffer. It meant the countercyclical regulation was useful if the premium income became smoother. So, we should calculate the elastic coefficient between solvency margin and premium increasing. Double logarithmic model was taken as below.

$$\ln Solvency_{it} = \gamma_0 + \gamma_1 \ln \Pr e\_ratio_{it} + \varepsilon_{it} \qquad (7)$$

$\ln Solvency_{it}$ was the logarithm of solvency margin for insurance company i in t year. $\ln \Pr e\_ratio_{it}$ was the logarithm of premium increasing for insurance company i in t year. γ_1 was the elastic coefficient between solvency margin and premium increasing. And $\gamma_1 = (dSolvency / Solvency)/(d \Pr e\_ratio / \Pr e\_ratio)$.

When the increasing of nonlife insurance was very fast, insurance companies should increase minimum capital by withdraw capital buffer. Suppose the real capital kept same as before, so the solvency margin would decrease. Insurance companies would try their best to keep the solvency margin in order to satisfy the requirement of regulation department. There were two ways to be chosen. First, they could keep solvency margin by decreasing premium and decreasing minimum capital. Second, they could keep solvency margin by getting more capital and increasing real capital. But there were so many difficulties to get more money from capital market. It would take a long time to apply and operate. Regulation department may not agree with their financial plan. So, it's easy and effective to decrease premium income. And it's in the insurance company's control. On the other hand, minimum capital would decrease if

the capital buffer was negative. Solvency margin would increase. There were extra capitals to develop new business and new market for those insurance companies. Premium income would be increased very soon.

Suppose the capital buffer was c (c was positive) required by regulator, solvency margin would decrease $c/(1+c)$. The elastic parameter was $|\gamma_1|$ between solvency margin and premium increasing. Premium increasing should be decreased for $c/|\gamma_1|(1+c)$ if the insurance company must keep the solvency margin[1]. It would be the same on the contrary. For example, if γ_1=-0.1, regulators would require more 2.5% capital buffer if the premium increasing was in high increasing speed regime. The solvency margin would decrease 2.439%, and premium increasing would decrease 24.39%. So, according with the elastic relationship between solvency margin and premium increasing, the premium increasing would be got after we know the change of solvency margin came from capital buffer. We would know the difference of premium increasing before and after capital buffer.

Test and Choose Best Ratio

The data for double logarithmic was also from 2009 to 2013 as the solvency margin were public from 2009. Also, we should decide the best model, random effect model or fixed effect model (leave out the detailed calculation). The P value for Hausman was 0.1344, which was more than 0.05. The null hypothesis couldn't be rejected. So, random effect model was better. The results of double logarithmic were showed in Table 6.

Table 6 Elastic Analysis Regression Results

Independent Variable	Regression Parameter	Standard Error	Z Value	P Value
$\ln Pre\_ratio$	-0.1062**	0.0537	-1.98	0.048
Constant	1.3240***	0.1421	9.32	0.000

The elastic parameter γ_1 between solvency margin and premium increasing was -0.1062 from Table 6. It was outstanding at 5% level. γ_1 was negative, which meant that the relationship between solvency margin and premium increasing was negative. When the capital was kept no change, premium increasing was higher, solvency margin was lower. So, when the solvency margin decreased 1% according with the requirement of regulator, the premium increasing would decrease 9.42% at

[1] γ_1 was positive or negative. It was showed by "increasing" or "decreasing" in the article. So, it just show the change using absolute value.

most in theory[1].

What was the best rate of capital buffer? The different solvency margins were got when capital buffer c were 1.25%, 2.5%, 5% and 10%. The premium increasing were also got according with the elastic analysis. We compared the cyclical fluctuation of different premium increasing after HP smoothing with the real premium increasing[2]（Figure 4）.

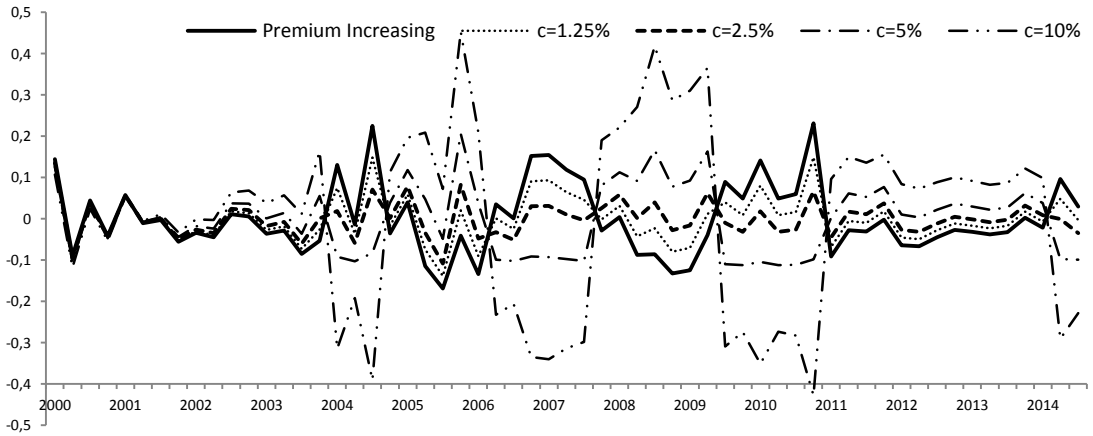

Figure 4 Premium Increasing for Different Capital Buffer

There were five curves in Figure 4, which shown the fluctuation of original premium increasing, capital buffer to be 1.25%, 2.5%, 5% and 10% respectively. When the capital buffer *c* was 1.25%, the fluctuation of premium increasing was a little stable than that of original. But the regulation effect was very limit. The premium increasing waved still obviously. When the capital buffer *c* was 2.5%, the regulation effect was the best. The fluctuation of premium increasing was very stable than whatever. But with the increasing of capital buffer *c*, the premium increasing turned over to decreasing quickly when *c* was equal to 5% or 10%. In such situation, countercyclical regulation intervened the market excessively. The standard value and range of the fluctuation in the premium increasing also told the same story (Table 7).

Table 7 Standard Value and Range of Premium Increasing

	Raw Premium Increasing	***c* =1.25%**	***c* =2.5%**	***c* =5%**	***c* =10%**
Std. Value	0.0864	0.0583	0.0440	0.0828	0.2192
Range	0.3998	0.2874	0.2436	0.3182	0.8803

From Table 7, the standard value and range of the fluctuation for raw premium increasing was a little big. But they all decreased when the capital buffer of c =1.25% was withdrawn. It kept decreasing continually when the capital buffer of c =2.5%,

[1] When the solvency margin decreased for 1%, the premium increasing wouldn't decrease 9.42% really in order to keep the solvency margin no change, as there were so other factors and restrict. For example, insurance company could get more money from financial market and improve solvency margin. They needn't to decrease the premium increasing rate. But it should be 9.42% in theory at most. Especially when the insurance market developed very fast, capital wasn't enough and regulation was very strict. The withdrawing of Capital buffer could decrease the increasing of premium very soon.

[2] The value of *a* and *b* shown the bound of smooth possibility. But it's very limit to affect the effect of capital buffer. In Figure 2, the smooth possibilities of all regimes were between 0.5 and 0.9 rarely. It's useless to change the value *a* and *b*. the core in this article was the monitor control index. The value of *a* and *b* weren't discussed in this article.

and was the least one at all, which shown the premium increasing was very stable at that time. But the standard value and range of fluctuation for premium increasing became larger and larger when the capital buffer of c=5% and 10%, which shown the premium increasing became more fluctuate. All this shown that the countercyclical regulation effect was best when the capital buffer was c=2.5%.

In conclusion, the capital buffer c shouldn't be very low, neither very high. The regulation effect wouldn't be very obviously when the capital buffer was very low. The premium increasing fluctuated still very big. But the regulator intervened the market excessively if the capital buffer was too big. The premium would develop to the adverse direction. Relatively, it's the best one when capital buffer c equaled to 2.5%. When the market was in low or mediate increasing speed regime, the capital buffer should be 2.5% if the smooth possibility was in $[a,b]$. The capital buffer should be 5% if the smooth possibility was more than b.

Results and Suggestions

In this article, the monitor control index of countercyclical regulation was got as the sensitive index with solvency margin using panel data model. The system of capital buffer in the countercyclical regulation was designed basing on Markov Regime switching model. The best monitor control index was found and the effect of countercyclical regulation was tested. Those results below were got. (1) The change of solvency margin was very sensitive with the premium increasing, but wasn't correlated with the change of retained profit, net asset and combined ratio. The monitor control index of countercyclical regulation in insurance should be premium increasing, which were the similar with that in bank. (2) The smooth possibility of different regime would be got by Markov regimes switching model. Different capital buffer should be withdrawn according with different regimes. This system could decrease the fluctuation of premium increasing really and made the development of insurance market more stable. (3) The value of capital buffer would affect the regulation effect, which should be 2.5% best. Beyond is as wrong as falling short.

We can describe the capital buffer of countercyclical regulation clearly below. First, the monitor control index should be premium increasing; Second, the smooth possibility would be got by Markov regime switching model and the regime of the different period was got. The capital buffer should be positive if it's in high speed increasing regime, and it's negative in the low speed increasing regime. Third, different capital buffer was required according with the smooth possibility of different regimes. It's 0 when smooth possibility was less than 0.5. It's +2.5% or -2.5% when the smooth possibility was between 0.5 and 0.9. It's +5% or -5% when the smooth possibility was more than 0.9. Except the designation of detailed regulation system, regulator should think about those questions below.

(1) There was cycle fluctuation in the nonlife insurance market of China. Countercyclical regulation could turn over the developing of insurance

market. Insurance regulation changed from imposing uniformity in all cases to adopting different arrangement according with the operation cycle. It's a right way really. We should work hard on this way. Though the relatively research was about the discussion about the idea of countercyclical regulation, the results in this article shown the strong effect of countercyclical regulation. It's possibly to make the regulation into reality. So, insurance regulator should take countercyclical regulation as the important method in the future.

(2) The monitor control index of countercyclical regulation should be simple and statistical. Premium increasing was the best index for these characters. It's correlated with solvency margin very obviously. So, premium increasing should be the best and only index for countercyclical regulation. On the other hand, premium increasing only shown the developing cycle of insurance, it didn't show the quality cycle. But the quality cycle (Claim cycle) was a lag of the developing cycle of insurance (Premium cycle). The countercyclical regulation basing on premium cycle affected claim cycle really.

(3) Regulators could monitor the change of smooth possibility in different regime by Markov Model and decided whether to withdraw capital buffer. The change of smooth possibility in different regime could show the change of premium increasing well and shown the real situation of insurance market. Regulator could judge the insurance market was hot or cold and took different capital buffer according with the requirement of countercyclical regulation.

(4) It's very important to design the suitable capital buffer for regulators. The effect of countercyclical regulation could be realized when the capital buffer were appropriate. The regulation was useless if the capital buffer was very small, while it bended over backwards if the capital buffer was very big. Relatively, the capital buffer should be 2.5% best.

Of course, all results of this article based on the sample, which limited our research. When CIRC was going to design the "*Solvency II*" in the future, they should collect more data, and get more accurate results by big data. They also should design a standard schedule to simplify the complex model. The capital buffer should adapt with the development of insurance market. Regulator should adjust it now and then.

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