Life Insurance Contribution, Insurance Development and Economic Growth in China

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Abstract

Under L-type economy, remodelling the growth power in the medium and long term is essential. The insurance industry during the 13th Five-year Plan period has been given a heavy expectation on promoting economic quality and upgrading economic efficiency, so it will try to accelerate its innovation and development process which serves national needs, market demand and people's requirements. Referring to the previous researches of Solow and Zhang and measuring Capital Stock and Total Factor Productivity independently, the paper analyses the inherent correlation between insurance (including life insurance and non-life insurance) and economic growth, reveals the contribution law of the insurance development in economic growth in the short and long term from both economic scale and quality respectively. It also shows enlightenments on policy decision for insurance industry, thus helps economic stability under the downturn periods.

1. Introduction

'Opinions of the State Council on Accelerating the Development of Modern Insurance Service Industry' gives re-position of accelerated development of the insurance industry from national governance level. Under its guidance, China's insurance industry during the 13th Five-year Plan period aims to serve national needs, market demand and requirements of the people, to more practically play the role of social 'stabilizer' and economic 'booster'. Unlike the past 30 years, macroeconomic environment of the insurance industry is undergoing a major transformation - from high-speed growth to medium-high speed growth, and from 'troika'-driven economic growth to innovation-driven economic growth. However, no matter what type of growth it is, economic growth is the foundation, and cultivation of growth momentum is the key, thus insurance industry is placed with high expectations of promoting L-type economy and contributing to economic growth.

For the two indicators most commonly used to measure development level of the insurance industry, one is insurance depth, that is, proportion of premium income in GDP; the other is insurance density, that is, per capita premium. The two indicators reach to 4.16% and RMB 2258 per capita respectively. The reality of development of China's insurance industry reflected by these two indicators shows that:(1) proportion of the insurance industry in GDP gradually increases, showing M-type curve segment climbing;(2) insurance density significantly increases since 2005, generally demonstrating J-shape growth trend;(3) personal insurance with life insurance as the main body follows suit with the entire insurance industry, or life insurance is the key force promoting change in insurance industry trends.

However, the above indicators and illustrations are far from being able to explain the relationship between China's insurance industry and economic growth, nor can it provide a strong empirical support for accelerating development of the insurance industry. In this paper, based on the domestic and international research results, the insurance industry is divided into life insurance and

non-life insurance, and the two and economic growth are placed in the same research framework for research. The main contributions of this paper are as follows: (1) The economic growth model with life insurance and non-life insurance as new endogenous variable is constructed by Solow Growth Model with technological progress. (2) China's sub-quarter capital stock and total factor productivity between 1999 and 2015 is measured according to Zhang et al. (2003, 2004) research results, and measurement is carried out on this basis; (3) Contribution law of life insurance, non-life insurance and insurance in economic growth is distinguished from the two perspectives of economic growth scale and quality, and relevant policy recommendations are put forward to promote insurance development.

2. Literature review

There are three different conclusions about the relationship between insurance development and economic growth:(1) there is a 'demand follow-up relationship' between the two, that is, economic growth drives insurance demand (Blum et al.,2002);(2) there is 'supply guide relationship' between the two, that is, insurance promotes economic growth (Webb et al.,2002; Boon,2005; Han et al.,2010);(3) the two demonstrate 'two-way causal relationship', that is, economic growth promotes development of the insurance industry, and vice versa (Kugler et al., 2005). This paper combs the representative literature at home and abroad, and finds out that the research results cover the three research perspectives of industry nature, market subject and business category, and form two logical lines:(1) in the static aspect, modern service industry is essentially rooted in insurance industry, and its inherent link with economic growth naturally exists;(2) in the dynamic aspect, insurance company's operations and insurance business strengthen and deepen the above-mentioned internal relations.

A) Nature of the insurance and economic growth

Outreville (1990, 1996) successively used the property rights data of 55 developing countries and the life insurance data of 48 developing countries to reveal the natural close relationship between insurance industry and economic growth: elasticity of per capita insurance expenditure versus per capita GDP is greater than 1, per capita insurance demand is function of per capita GDP, financial development level and premium. Skipper (1997) argues that insurance contributes to economic growth in six areas: enhancing financial stability, facilitating business and trade, mobilizing domestic savings, effectively controlling risk, promoting effective allocation of capital and reducing losses. Not only that, insurance can invigorate market transactions and maintain financial stability through risk identification and risk transfer (Ward et al., 2000), and even replace and supplement government support programs (Skipper, 2001). To some extent, stimulus effect of the insurance on economic growth is an endogenous function (Regan et al., 2007), which promotes economic growth by means of risk transmission, asset allocation and influence in economic unit decision making (Das et al., 2003). For developing countries, the positive role of the insurance in infrastructure construction, foreign direct investment and job creation cannot be ignored (Rao et al., 2013).

More research is focused on the impact of the insurance on economic unit behaviour decisions. Insurance has reduced the risk of family purchases of cars or investment in real estate, thus stimulating consumption (Ward et al., 2000). If the rate design is attractive, insurance will effectively encourage families to convert savings into premium payments, not only driving competition between banks and insurance companies, but also stimulating consumer demand and market efficiency (Zou et al., 2006; Adams et al., 2009). For businesses, insurance encourages them to develop new technologies and test new products, encouraging investment, innovation and competition (Han et al., 2000). In terms of cultivation of entrepreneurial spirit, the role of the insurance is irreplaceable. As insurance creates a safer business environment, entrepreneurs will take more initiative to adopt innovative initiatives and develop high-return projects (CEA, 2006). In this way, insurance enters production area in the form of enterprise production and consumption, encouraging investment and guaranteeing production; on the other hand, it enters consumption area

in the form of family and government services consumption, improving consumption willingness and becoming a strong guarantee for economic development (Pu et al., 2012).

Many empirical analyses support the judgement about relationship between the two. Ćurak et al. (2009) adopted fixed effect panel model analysis for 10 EU countries. Chang et al. (2013) conducted a Granger causality test of 10 OECD countries, Hotta (2015) applied endogenous economic growth model analysis for 10 Asian countries, Olayungbo (2015) conducted a VECM analysis of South Africa, and the research results jointly show that insurance development has a positive and significant impact on economic growth of most countries. Zhou (2008) used endogenous economic growth model to confirm that role of development of the insurance industry is limited in promotion of economic growth from the national perspective, Wu et al. (2010) Cobb-Douglas production function measurement results found that insurance industry plays a more significant role in promoting economy in medium and poor economic areas. Hu et al. (2010) adopted simulation verification to prove the two-way causal relationship between the two in China; Shao (2015) used nonlinear dynamical system model to reveal the long-term equilibrium nonlinear relationship between the two.

B) Insurance companies and economic growth

The important carrier of development of the insurance industry is insurance companies. Insurance companies raise and allocate funds from decentralized economic units to create liquidity (Jappelli et al., 1994); achieving economies of scale and increasing the likelihood of long and high return investments (Devereux et al., 1994). To accurately assess the level of risk, insurance companies will actively collect large amounts of information from businesses and individuals (Antzoulatos et al., 2007), reducing information asymmetry in financial markets (Wood et al., 1990). Bo et al. (2012) found that improving market share of small and medium-sized insurance companies in the insurance market can effectively promote economic growth.

Since the 1990s, the role of the insurance companies as institutional investors has become increasingly prominent in international capital markets (IMF, 2002). For example, in 2009, US life insurance companies accounted for 6% and 10% of the equity and commercial mortgage markets respectively (Ernst et al., 2014), and the total global management asset of the insurance companies reached $ 24.1 trillion in 2012 and will exceed $ 35 trillion in 2020 (PwC, 2014). The identity of the insurance companies as institutional investors enjoys advantages different from other companies: it often participates in various company practices of improving governance structure (Catalan et al., 2000), actively integrates into various company processes of reducing management, operational and financial risk (Hoyt et al., 2000). The investment of the insurance companies has stimulated healthy competition among financial institutions, reduced transaction costs and improved contribution of the financial sector to economic growth (Bosworth et al., 2004), and life insurance companies contribute to capital optimization through investment in special reserve fund (Millo et al., 2014). To achieve Pareto's optimal asset allocation under the second-generation regulatory regime, insurance companies need to reduce their allocation costs through contract signing or institutional arrangements (Filipovic et al., 2014).

C) Insurance business and economic growth

Webb et al. (2005), using 16-year time series data of 55 countries, calculated that higher level of banking and higher life insurance depth means higher economic growth rate. A study conducted by Arena (2008) with 56 countries as sample shows that life insurance is a positive incentive for economic growth in high-income countries, but not in developing countries. Haiss et al. (2008) pointed out that only life insurance in "mature economies" can play a stimulating role in economic growth. Studies in recent years break the above judgments: for example, empirical analysis of 93 countries by Nguyen et al. (2010) found that a country's rule of law and property rights protection are important force to promote development of the insurance, including life insurance, which has not much relationship with national development degree; another example is that Han et al. (2010) used

77 countries' panel data to conclude that role of life insurance in developing countries is far higher than that in developed countries. Lee et al. (2013) selected 41 countries' data and found that every increase of1 unit of premium in life insurance can bring 0.06 units of GDP growth from the long term. Since 1990, life insurance premiums have doubled in 10 transition countries in the EU, ensuring that businesses and families can engage in riskier investment, and contributing to long-term economic growth (Feyen et al., 2011). In India, life insurance has a significant positive effect on economic growth both in long and short terms (Verma et al., 2013), and Malaysia is no exception (Wong et al., 2013).

Domestic research focuses on property and endowment insurances. Pang's (2009) modified Solow model, Cao (2015) VAR model analysis results show that property insurance has a long positive effect on China's economic growth. Liao (2015) found that introduction of property loss insurance will reverse the long-term economic output reduction, but cannot make long-term economic growth restore risk-free situation. Wang (2012) pointed out that it's conducive to economic growth if endowment insurance system is converted to mixed model of individual and pooling accounts. Li et al. (2014) introduced annuity insurance into household expenditure decision model, demonstrating the direct effect of annuity on savings and capital and its indirect effect on economic growth. Gao et al. (2015) pointed out that increasing allocation of state-owned capital income to endowment insurance can improve personal welfare, increase investment in children's education, and thus promote economic growth.

From the above literature, we find that: different from long and rich studies on relationship between financial industry and economic growth, docking analysis of the insurance industry separated from financial industry and economic growth lasts only two or three decades, and developing countries have an even later start. Seen from the domestic research results, we not only lack consistent analysis framework, but also lack variable selection considering insurance business category, and moreover, lack economic growth model building with technological progress. And most of the research used public data, had to use other variables to replace the initial variables, for instance, replacing capital stock with fixed assets investment, replacing technological progress variables with education population and age limit, thus affecting the measurement results. In this paper, referring to the previous research results, we will first measure sub-quarter capital stock and total factor productivity in China, and then carry out some useful attempts and explorations into empirical analysis of the insurance industry and economic growth from the two dimensions of scale and quality.

3. Theoretical model and empirical analysis

Based on the economic growth model of Solow (1956), this paper represents capital with capital stock, represents labour with employed population, represents technological progress with total factor productivity, represents opening to the outside world with total import-export volume, and takes insurance industry development as new endogenous variable. It selects GDP to measure the scale of economic growth, life insurance premium income to measure life insurance industry scale, non-life premium income to measure scale of the insurance industry except life insurance. The model is constructed as follows:

$$GDP_t = f(K_{t-1}, L_{t-1}, TFP_{t-1}, EM_{t-1}, NLI_{t-1}, LI_{t-1}, T, e_t) \quad (1)$$

Wherein, GDP: Economic growth (100 million yuan); K: Capital stock (100 million yuan); L: Total population of employment (million); TFP: Total factor productivity; EM: Total import-export volume (100 million yuan); NLI: Non-life premium income (100 million yuan); LI: Life insurance premium income (100 million yuan); T: Time Trend; e_t: Error term

A). Data description

The model data is derived from previous China Statistical Yearbook, previous China Insurance Yearbook, CSMAR Database and Wind Database. The sample range is quarterly data from 1999 to 2015, and Eviews is used for analysis. At present, there is no domestic official public data on capital stock K and total factor productivity TFP. In view of significant and far-reaching impact of the research by Zhang, et al. (2003, 2004), this paper follows their measurement methods.

According to research results of Zhang (2003), capital stock is calculated as follows:

$$K_t = K_{t-1} + I_t/P_t \qquad (2)$$

Wherein, K_t is the capital stock of t-the year, I_t is the fixed capital investment of t-the year which is indicated by production accumulation, P_t is the fixed asset investment price index of t-the year which is replaced by Shanghai fixed asset investment price index. The capital stock with year 1952 as the base is 80 billion yuan. In the paper, the calculated capital stock data from 1999 to 2015 in China is shown in Figure 1.

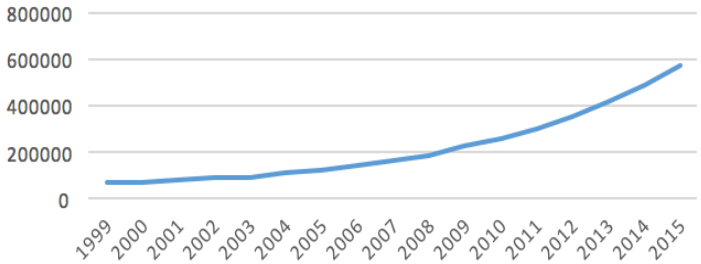

Figure 1: Sequence diagram of capital stock in China from 1999 to 2015

Total Factor Productivity (TFP), as an indicator of quality of a country's economic development, is often used by domestic and foreign academic circles to analyse potential of economic growth (Li & Zeng, 2009). According to research results of Zhang et al. (2003, 2004), total factor productivity is defined as:

$$TFP_t = \frac{Y_t}{K^{\alpha_K} L^{\alpha_L}} \qquad (3)$$

In this paper, through regression of the data from 1952 to 2015, it is obtained that $\alpha_K = 0.606$, $\alpha_L = 0.394$.

B) **Stationarity test**

Before co-integration test of variables, stationarity test must be carried out, to ensure that the variables are of the same order integration. In this paper, ADF unit root test and PP test are adopted, and the test results are obtained by table look-up and statistical threshold, and judged according to the size of p value. When p value is less than the significance level, it is considered that the original hypothesis can be rejected, that is, the sequence is stable sequence. To obtain the relationship between variable growth rates and avoid multiple collinearity problems, the horizontal variable in this model uses post logarithmic data. Specific test results are shown in Table 1.

It can be seen from Table 1 that, p value of PP test of horizontal value series of life insurance after taking the logarithm at 1% significance level is 0.2590> 0.01, that is, PP test accepts the original hypothesis; p value of the ADF test is 0.2146> 0.01, which cannot accept the original hypothesis. In the stationarity test of the first order differential sequence of each variable, the first order differential sequence of GDP and K after taking the logarithm are not stationary at the significance level of 5%.

At the 5% and 1% significance levels, the second order differential sequences of the variables are stationary. Thus, at the 5% and 1% significance levels, the sequences are all the same order integration and can be cointegrated. In the Table 1, GI is the national premium income, the data is the sum of life insurance and non-life insurance premium income.

Variable	Level value		First order difference		Second order difference	
	ADF	PP	ADF	PP	ADF	PP
ln(GDP)	-1.024486 (0.7394)	-0.711536 (0.8363)	-2.490173 (0.1227)	-25.35818 (0.0001) ***	-4.312491 (0.0011) ***	-89.98375 (0.0001) ***
ln(K)	0.448339 (0.9834)	8.392808 (1.0000)	-1.846932 (0.3547)	-1.486985 (0.5340)	-4.603753 (0.0023) ***	-15.45153 (0.0000)
ln(L)	-2.389175 (0.3816)	-2.515451 (0.3200)	-7.488214 (0.0000) ***	-24.68686 (0.0001) ***	-6.912555 (0.0000) ***	-112.2299 (0.0001) ***
ln(EM)	-2.091680 (0.2487)	-2.442728 (0.1342)	-3.434829 (0.0555) *	-3.077428 (0.0332) **	-8.237103 (0.0000) ***	-8.239636 (0.0000) ***
ln(LI)	-2.768550 (0.2146)	-2.065651 (0.2590)	-2.746148 (0.0722) *	-23.49971 (0.0001) ***	-4.409810 (0.0045) ***	-54.16381 (0.0001) ***
ln(NLI)	-0.114728 (0.9429)	-0.857827 (0.7956)	-10.76956 (0.0000) ***	-23.97156 (0.0001) ***	-4.043704 (0.0025) ***	-39.33272 (0.0001) ***

Note: *** indicates 1% significance level; ** indicates 5% significance level; * indicates 10% significance level

Table 1: Results of stationarity test

C) Co-integration test

In multivariate co-integration analysis, the common method is Johansen co-integration analysis. Compared with another common EG co-integration test, the advantage is that it can test all the co-integration relationship and the test function is more stable, so this paper selected Johansen co-integration analysis. According to the requirements of this method, number of vector co-integration relations can be tested by both Trace statistics and Maximal Eigenvalue statistics. Table 2 shows the test results of the two methods.

Hypothesized No. of CE(s)	Eigenvalue	Trace statistics			Max-Eigenvalue statistics		
		Trace	5% threshold	P value	Max-Eigenvalue	5% threshold	P value
None*	0.723198	214.5256	111.7805	0.0000	83.48937	42.77219	0.0000
Up to one*	0.490061	131.0363	83.93712	0.0000	43.77517	36.63019	0.0062
Up to two*	0.451076	87.26110	60.06141	0.0001	38.98667	30.43961	0.0034
Up to three*	0.313885	48.27443	40.17493	0.0063	24.48611	24.15921	0.0452
Up to four	0.206363	23.78832	24.27596	0.0575	15.02339	17.79730	0.1246

Table 2: Johansen co-integration test results

In the two test results, the first column corresponds to the number of co-integration relations under the original hypothesis, and the second column corresponds to estimated value of eigenvalue of the test matrix from large to small, the third column is test statistics of the two statistics under the corresponding hypothesis, the fourth column corresponds to the threshold at the 5% significance level, and the fifth column is p value under the corresponding hypothesis.

Johansen co-integration test begins from the original hypothesis that there is no co-integration relation, until the original hypothesis cannot be rejected. As can be known from the test results, the p values of the fifth row in Table 2 are 0.0063 and 0.0452 at 5% significance level, both less than 5%, while p value of the sixth row is 0.1027, greater than 5%, indicating that the test rejects the original hypothesis that there are up to three co-integration relations, and cannot reject the original hypothesis that there are up to four co-integration relations, so it is deemed that there are four co-

integration relations. This shows that there is a long-term stable relationship among economic growth and life insurance, non-life insurance.

With $\ln GDP$ as explained variable, $\ln K$、$\ln L$、TFP、$\ln EM$、$\ln LI$、$\ln NLI$ as explanatory variable, co-integration (long-term) equation of the seven variables is estimated as:

$$ecm_{t-1} = \ln GDP_{t-1} - 0.267 \ln K_{t-1} - 10.327 \ln L_{t-1} - 0.612 TFP_{t-1} - 0.175 \ln EM_{t-1} + 0.240 \ln LI_{t-1} - 0.151 \ln NLI_{t-1} + 109.720$$

(-3.55266) *** (-2.48734) ** (-1.80044) * (-1.21436) (4.25101) *** (-3.00026) ***

The fitting coefficient of the model is $R^2 = 0.68$, the adjusted one is $R^2 = 0.64$, the model is well fitted. Seen from the model obtained from the fitting, there is a long-term equilibrium relationship among life insurance, non-life insurance and economic growth at the 1% significance level.

Specifically, in view of GDP growth, life insurance has a significant negative impact on scale of economic growth, and non-life insurance has a significant positive effect on scale of economic growth. From the perspective of total factor productivity, life insurance has a significant positive long-term effect on quality of economic growth, and non-life insurance has a significant negative long-term effect on quality of economic growth. By comparing the coefficients, the promotion effect of life insurance on TFP is greater than the back action of non-life insurance when other conditions remain unchanged. Therefore, it is considered that insurance industry has a significant positive effect on quality of economic growth in the long run. In the long run, although life insurance plays a limited role in promoting scale of economic growth, it plays an active role in promoting quality of economic growth. Life insurance is closely related to each person's life and health, and to a certain extent, it reflects a key role in improving people's livelihood, quality of life, more conducive to healthy cycle of economic growth.

At the same time, there is long-term significant positive interaction between life insurance and non-life insurance. When other conditions remain unchanged, for every increase by one percentage point in non-life insurance, life insurance will rise 0.240 / 0.151 = 1.589 percentage points. The positive interacting relationship between life insurance and non-life insurance shows development of non-life insurance can better promote a substantial increase in life insurance, serving scale and quality of economic growth together.

4. Vector Error Correction Model (VECM) Estimation

To further describe the short-term fluctuation and long-term equilibrium relationship among life insurance, non-life insurance and economic growth, this paper constructs the VECM model. The estimation results are as follows:

$$\begin{bmatrix} \Delta \ln GDP_t \\ \Delta \ln K_t \\ \Delta \ln L_t \\ \Delta TFP_t \\ \Delta \ln EM_t \\ \Delta \ln LI_t \\ \Delta \ln NLI_t \end{bmatrix} = \begin{bmatrix} -0.191\ ** \\ 0.006\ ** \\ 0.005\ ** \\ -0.096\ * \\ 0.044\ * \\ 1.090\ *** \\ 0.447\ ** \end{bmatrix} + \begin{bmatrix} -2.523\ *** \\ 0.061\ *** \\ -0.002 \\ -1.014\ ** \\ 0.209 \\ 8.966\ *** \\ 3.798\ ** \end{bmatrix} ecm_{t-1}$$

$$+ \begin{bmatrix} 1.582\ *** & 5.694\ *** & 7.248\ * & -3.761\ *** & 0.196 & -0.191\ *** & -0.079\ ** \\ -0.043\ *** & 0.852\ *** & -0.164 & 0.087\ *** & 0.005 & 0.004\ *** & 0.001 \\ 0.039\ *** & -0.126\ ** & -0.455\ *** & -0.074\ *** & -0.003 & -0.003\ *** & 0.001 \\ 0.992\ *** & 2.381\ ** & 3.325 & -2.353\ *** & 0.152 & -0.097\ *** & -0.083 \\ -0.088 & -0.971\ * & -0.427 & 0.151 & 0.717\ *** & 0.012 & 0.006 \\ -7.251\ *** & -25.030\ *** & -8.025 & 12.108\ *** & -1.015 & -0.178 & -0.013 \\ -4.484\ *** & -7.844 & -10.692 & 6.706\ *** & -0.577 & 0.235\ ** & -0.263\ ** \end{bmatrix} * \begin{bmatrix} \Delta \ln GDP_{t-1} \\ \Delta \ln K_{t-1} \\ \Delta \ln L_{t-1} \\ \Delta TFP_{t-1} \\ \Delta \ln EM_{t-1} \\ \Delta \ln LI_{t-1} \\ \Delta \ln NLI_{t-1} \end{bmatrix}$$

From the regression results, the error correction coefficient of GDP is -2.523, and it is significant at 1% significance level. It indicates that in the long term, error correction term has a negative regulatory effect on GDP. When GDP deviates from the long-term equilibrium relationship, error correction mechanism will reverse it with intensity of 2.523 in the next phase, so that it does not deviate from the long-term equilibrium.

The error correction coefficient of TFP is -1.104, and it is significant at 1% significance level. It indicates that in the long term, error correction term has a negative regulatory effect on TFP. When TFP deviates from long-term equilibrium relationship, error correction mechanism will reverse it with intensity of 0.612 in the next phase, so that it does not deviate from the long-term equilibrium.

Similarly, the error correction coefficients of life and non-life insurance are 8.966 and 3.789, respectively, which are significant at significance levels of 1% and 5%, respectively. It indicates that error correction term has a positive regulatory effect on life insurance and non-life insurance in the short term. When the two deviates from the long-term equilibrium, error correction mechanism will reverse the two with intensity of 8.966 and 3.789 respectively in the next phase, so that the two do not deviate from the long-term equilibrium.

5. Vector autoregressive model (VAR) estimation

VAR model uses all current variables to return many lagged variables of all variables and examine the effect of several lagged variables on a variable.

Based on this, this paper analyses lag phase I and lag phase II of each variable, and constructs the VAR (2) model. The estimation results are as follows:

$$\begin{bmatrix} \ln GDP_{1,t} \\ \ln K_{2,t} \\ \ln L_{3,t} \\ TFP_{4,t} \\ \ln EM_{5,t} \\ \ln LI_{6,t} \\ \ln NLI_{7,t} \end{bmatrix} = \begin{bmatrix} 52.226 \\ -2.490 \\ 2.530 \\ 53.938 \\ -35.133 \\ -697.542 \\ -217.004 \end{bmatrix} + \begin{bmatrix} 0.350 & 12.299 & 1.381 & -0.689 & 0.307 & -0.092 & 0.020 \\ 0.001 & 1.561 & 0.064 & 0.025 & -0.002 & -0.003 & -0.002 \\ 0.041 & -0.168 & 0.404 & -0.079 & 0.003 & -0.002 & 0.001 \\ 0.262 & 4.349 & -1.176 & -0.457 & 0.133 & -0.031 & 0.026 \\ 0.149 & 3.148 & 1.444 & -0.097 & 1.704 & -0.001 & -0.009 \\ -0.397 & -10.611 & 36.946 & 3.392 & -1.551 & 0.025 & -0.147 \\ -1.265 & 21.057 & 8.124 & 3.046 & 0.323 & 0.026 & 0.062 \end{bmatrix} \begin{bmatrix} \ln GDP_{1,t-1} \\ \ln K_{2,t-1} \\ \ln L_{3,t-1} \\ TFP_{4,t-1} \\ \ln EM_{5,t-1} \\ \ln LI_{6,t-1} \\ \ln NLI_{7,t-1} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.756 & -11.677 & -5.800 & 2.032 & -0.061 & 0.126 & 0.173 \\ 0.003 & -0.562 & 0.162 & -0.004 & -0.003 & -0.002 & -0.004 \\ -0.027 & 0.162 & 0.360 & 0.055 & 0.001 & 0.002 & -0.003 \\ -0.182 & -4.464 & -3.767 & 0.693 & -0.019 & 0.056 & 0.097 \\ 0.033 & -3.259 & 1.794 & -0.104 & -0.852 & -0.009 & -0.004 \\ 1.406 & 9.514 & 27.383 & -0.273 & 0.146 & 0.227 & -0.174 \\ 1.283 & -20.090 & 11.358 & -1.152 & -0.977 & -0.003 & -0.244 \end{bmatrix} \begin{bmatrix} \ln GDP_{1,t-2} \\ \ln K_{2,t-2} \\ \ln L_{3,t-2} \\ TFP_{4,t-2} \\ \ln EM_{5,t-2} \\ \ln LI_{6,t-2} \\ \ln NLI_{7,t-2} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \\ \varepsilon_{7t} \end{bmatrix}$$

The fitting coefficient of the model is $R^2 = 0.99$, and the adjusted $R^2 = 0.98$. According to the AR root chart, module of root of estimated VAR (2) model is less than 1, and within the unit circle, so the model is stable. Seen from VAR (2) model obtained from fitting of the quarterly data, life insurance has a negative pull effect on economic growth in lag phase 1, and has a positive pull effect on economic growth in lag phase 2, while non-life insurance has positive pull effect on economic growth in both lag phase 1 and 2. The results are like those obtained by Fan (2014) by establishing panel data model with simultaneous data in 30 provinces and cities in China.

It can be seen from the size of the coefficient that, in lag phase 1, the negative impact of life insurance on economic growth is greater than the positive pull effect of non-life insurance on economic growth; in lag phase 2, positive pull effect of non-life insurance is greater. Similarly, life insurance has a positive pull effect on non-life insurance in lag phase 1, and negative pull effect on non-life insurance in lag phase 2; while non-life insurance has negative pull effect on life insurance in both lag phase 1 and 2.

6. Granger causality test

The Granger causality test examines whether lag phase of a variable influences the current value of other variables. In this paper, Granger causality test is used to verify whether there is a significant causal relationship among life insurance, insurance and TFP and GDP. The original hypothesis is that there is no Granger causality. We get the following coupled results of the Granger causality test, as shown in Table 3.

Null hypothesis	Degree of freedom	Lag phase periods	F statistics	P value
Ln (GDP) is not Granger cause of Ln (LI) Ln (LI) is not Granger cause of Ln (GDP)	60 60	8	2.21165 3.64783	0.0453** 0.0025***
Ln (GDP) is not Granger cause of Ln (GI) Ln (GI) is not Granger cause of Ln (GDP)	60 60	8	3.07285 2.69228	0.0079*** 0.0171**
TFP is not Granger cause of Ln (LI) Ln (LI) is not Granger cause of TFP	60 60	8	3.21084 1.63493	0.0060*** 0.1432
TFP is not Granger cause of Ln (GI) Ln (GI) is not Granger cause of TFP	60 60	8	3.10085 1.27447	0.0075*** 0.2819

Table 3: Granger causality test results

It can be seen from the above results that in the Granger causality test of ln (GDP) and ln (LI), ln (GDP) and ln (GI), when the lag phase periods are 8, p value is less than 5%. That is, it can be considered as a rejection of the original hypothesis that there is no Granger causality, indicating that at 5% significance level, there is direct two-way Granger causality relation among life insurance, insurance and economic growth. That is, the lagged variable can marginally predict another variable. In the Granger causality test of TFP and ln (LI), TFP and ln (GI), when the lag phase periods are 8, total factor productivity is Granger cause of life insurance and insurance growth at the 5% significance level, while life insurance and insurance industry development help little to promote quality of economic growth.

7. Impulse response function

As the model of this paper has stability, the impulse response function can be used to further analyse the impact of life insurance and non-life insurance on economic growth. Impulse response function and impact effect of output delay phase 10 are shown in Figures 2-7.

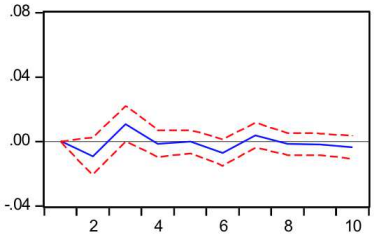

Figure 2 GDP fluctuation response function caused by the the impact of life insurance structure

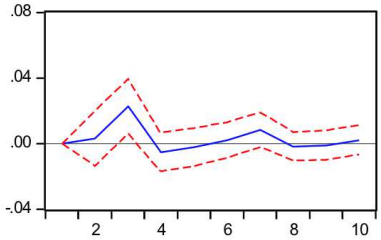

Figure 3 GDP fluctuation response function caused by impact of non- life insurance structure

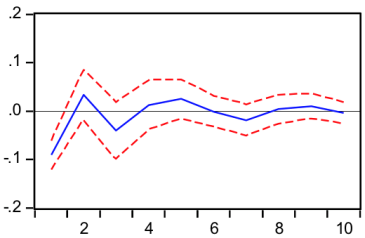

Figure 4 TFP fluctuation response function caused by the impact of life insurance structure

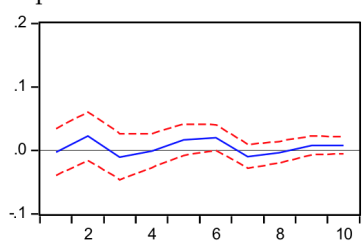

Figure 5 TFP fluctuation response function caused by the impact of non-life insurance structure

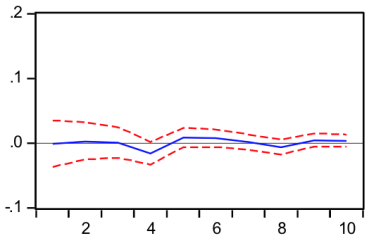

Figure 6 Fluctuation response function of non-life insurance structure caused by the impact of life insurance structure structure

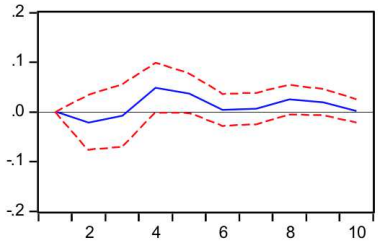

Figure 7 Fluctuation response function of life insurance structure caused by the impact of non-life insurance

Figure 2 and 3 shows that a positive impact on life and non-life insurance has a certain effect on scale of economic growth, and the effect shifts between positive and negative impact, but gradually weakens at about tenth period. Figure 4 and 5 shows that life insurance and non-life insurance have a negative effect on quality of economic growth in short-term, which gradually changes to positive effect after fifth or sixth period. Figure 6 and 7 shows that: a positive impact on non-life insurance does not cause obvious impact on life insurance; similarly, a positive impact on life insurance causes significant impact on non-life insurance, it has negative pull effect on non-life insurance in initial periods, which shifts to positive impact after third period, but gradually weakens.

8. Limitations and Future Research

In this paper, we use the quarterly data of the insurance industry from 1999 to 2015 to analyse, and we are trying to get more monthly data for analysis, which will help improve the accuracy of our conclusions and help us better understand the relationship between the development of China 's insurance industry and economic growth.

In the future research, we will consider adding the breakpoint detection in the analysis process. China's insurance industry and economy are undergoing reform and development, through the technology of breakpoint detection, we can further analyse whether the relationship between the two changes, but also can test the effectiveness of Chinese policy.

9. Basic conclusions and policy recommendations

This paper uses the quarterly data from 1999 to 2015 to confirm the important role of the insurance industry in China's economic development under the premise of independent measurement of national capital stock and total factor productivity. The concrete conclusions are as follows:

First, there is a two-way causal relationship among life insurance, non-life insurance and economic growth from the perspective of economic growth scale (GDP). In the short term, life insurance has a negative effect on economic growth, and non-life insurance has a positive effect on economic growth. In the long run, the negative effect of life insurance will be changed to positive. When other conditions remain unchanged, the positive effect of non-life insurance on economic growth will soon surpass the negative effect of life insurance on economic growth, which makes insurance industry have a significant positive impact on scale of economic growth in the long term.

Second, there is a two-way causal relationship among life insurance, non-life insurance and economic growth from the perspective of economic growth quality (TFP). In the short term, life insurance and non-life insurance have a significant negative effect on quality of economic growth. In the long run, life insurance has a significant positive long-term effect on quality of economic growth, while non-life insurance has a significant negative long-term effect on quality of economic growth. When other conditions remain unchanged, promotion effect of life insurance on TFP is greater than the back action of non-life insurance, so the insurance industry can be considered to have significant positive effect on economic growth quality in the long term.

Third, there is a two-way causal relationship between life insurance and non-life insurance, that is long-term significant positive interaction between life insurance and non-life insurance, and

the effect of life insurance on non-life insurance is greater than the effect of non-life insurance on life insurance. The positive interacting relationship between life insurance and non-life insurance shows development of non-life insurance can better promote a substantial increase in life insurance, serving scale and quality of economic growth together.

Under the long-term trend of L-type economy, the above conclusions will help us to regain confidence in economic growth. In view of the fact that insurance industry can change family and business consumption and investment behaviour from micro perspective, bring financial stability and industrial efficiency from intermediate perspective, and promote economic growth and economic quality from macro perspective, the government should take macro and micro multi-policy measures to accelerate development of the insurance industry and contribute to steady growth during the economic downturn.

In this way, this paper suggests that under the premise of reshaping importance of economic growth, on the one hand, we should encourage insurance industry to change its own development mode and enhance contribution of the insurance industry to scale and quality of economic growth. On the other hand, we should promote intensive efforts of the insurance industry in the following four areas: First, more proactively support economic restructuring and upgrading. Take "replacing sales tax with value-added tax" in insurance industry as an opportunity, encourage insurance companies to actively implement "Made in China 2025", and provide comprehensive protection for R & D and production of high-end manufacturing equipment in large and key industrial enterprises, independent innovation and financing merger in science and technology enterprises. Second, more actively support modern agricultural development. Gradually improve policy-oriented agricultural insurance system, appropriately increase agricultural insurance premium subsidies and financial support for local special agricultural products insurance. Third, more forcibly stimulate consumer demand. Leveraging income distribution system reform, guide families and enterprises to make better use of the insurance tools; deepen management mechanism system reform, expand innovation space of the insurance products and services, dock with consumption hot spots to meet consumer demand. Fourth, more effectively serve protection of people's livelihood. Give play to the leverage role of land and tax policy, and achieve integration development of the insurance industry and pension services industry, health care industry; make full use of government procurement services, etc. to make commercial insurance more promising, so that it gradually becomes an important pillar of the social security system.

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