MEASURING CHINESE RISK AVERSION

--Based on Insurance Data

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Abstract—In the literature risk aversion has been widely studied by many scholars. However, little research is done about China's market. In this paper we assume a model involves the data on property/liability insurance and estimate the risk aversion in China. We use data from 1997 to 2013 after modifying by deflators. The result comes out to support our hypothesis of increasing relative risk aversion.

I. Introduction

There is a consensus that absolute risk aversion decreases with wealth. It was established by Pratt (1964) and Arrow (1965), along with the measure of absolute and relative risk aversion. Many other studies have tried to derive similar hypothesis about relative risk aversion, but their results vary widely. Such studies include Friend and Blume(1975), Siegel and Hoban(1982), Morin and Suarez(1983), Szpiro(1986), Blake(1996), etc.

Szpiro(1986) used the time series data from 1955 to 1975 on property/liability insurance in the United States and concluded that relative risk aversion was constant and the degree was between about 1.2 to 1.8.

In this paper we use similar model and analyze the risk aversion in China. First we assume a risk aversion function revolves some variables and parameters. We modify the time series data[1] by deflators and do nonlinear regression. Then we choose the parameters which have the minimum sum of squared errors and evaluate the coefficient of China's risk aversion.

According to the result, we conclude that the relative risk aversion in China increases with wealth. Our result conforms to the hypothesis of IARA (increasing relative risk aversion.).

II. The model

[1] The data in this paper have been modified by deflators, so we think the results are comparable to those cross-section estimates.

We assume that the amount of insured assets has a form like

$$I = W - \lambda / r(W), \qquad (1)$$

where I is the insured assets, W is the individual's wealth, λ is the loading charged by insurance companies, and $r(W)$ donates the absolute risk aversion.

Denote $P = pI$ and $Q = qI$ respectively, because the amount insured assets I cannot be obtained directly. Here P is the total premiums, p donates the premium rate. Q is the total claims and q donates the claim rate.

Then we get a couple of equations:

$$P = pW - p\lambda / r(W), \qquad (2)$$

$$Q = qW - q\lambda / r(W). \qquad (3)$$

We assume the risk aversion function has the form

$$r(W) = c / W^h. \qquad (4)$$

Substituting equation (4) into (2) and (3), we get

$$P_t = pW_t - p\frac{1}{c}(\lambda_t W_t^h) = aW_t + m(\lambda_t W_t^h) \qquad (5)$$

$$Q_t = qW_t - q\frac{1}{c}(\lambda_t W_t^h) = bW_t + n(\lambda_t W_t^h) \qquad (6)$$

We obtain the premiums and claims data on property/liability as P and Q, after eliminating price fluctuation. We use GDP per capital with fixed base as W and $(P/Q)-1$ as λ.

By nonlinear regression we obtain the value of h, together with those for a, m, b and n. The range of h is from -5 to 5. The step size is 0.01. Moreover, there are some restriction conditions. The results should subject to $a > 0$, $b > 0$,[2] $m < 0$ and $n < 0$.[3] We choose the parameters which results the minimum S.E.of regression and use them to evaluate the coefficient of relative risk aversion.

III. Results

[2] Because of $a = p$ and p stands for the premium rate, there must be $a > 0$. So does b.

[3] Generally we agree that the coefficient of absolute risk aversion is positive. Then because of $r(W) = c / W^h$ >0, and our results prove h >0, so we have $c > 0$. $m = -p / c$, **so** $m < 0$**.** So does n.

The data after modified are presented in Table1.

Table1--Data after Modified[4]

YEAR	P	Q	W
2001	10.14766	5.504403	1972.93
2002	11.18747	5.940737	2167.948
2003	12.42772	6.45758	2403.002
2004	14.26367	7.387239	2706.358
2005	16.14889	8.49713	3057.19
2006	18.55891	9.947859	3503.122
2007	21.88552	11.63979	4086.196
2008	25.55093	14.0459	4535.626
2009	30.10224	16.63557	4934.014
2010	36.87963	19.29903	5598.778
2011	44.13377	22.40667	6229.697
2012	51.59049	26.44391	6634.374
2013	60.20909	30.85589	7045.66

The minimum S.E.of regression is obtained for $h_p = 0.11$ and $h_q = 0.18$ using premiums and claims as dependent variable. The signs of a and b are positive and the signs of m and n are negative, which meet the requirements.[5]

Then we estimate the coefficient of relative risk aversion.

$$c_p = -a / m = 0.001668$$

$$c_q = -b / n = 0.002932$$

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The results are presented in Table2.

The changing tendency can be observed by Chart1 and Chart2. Obviously, the coefficient of relative risk aversion increases gradually with wealth.

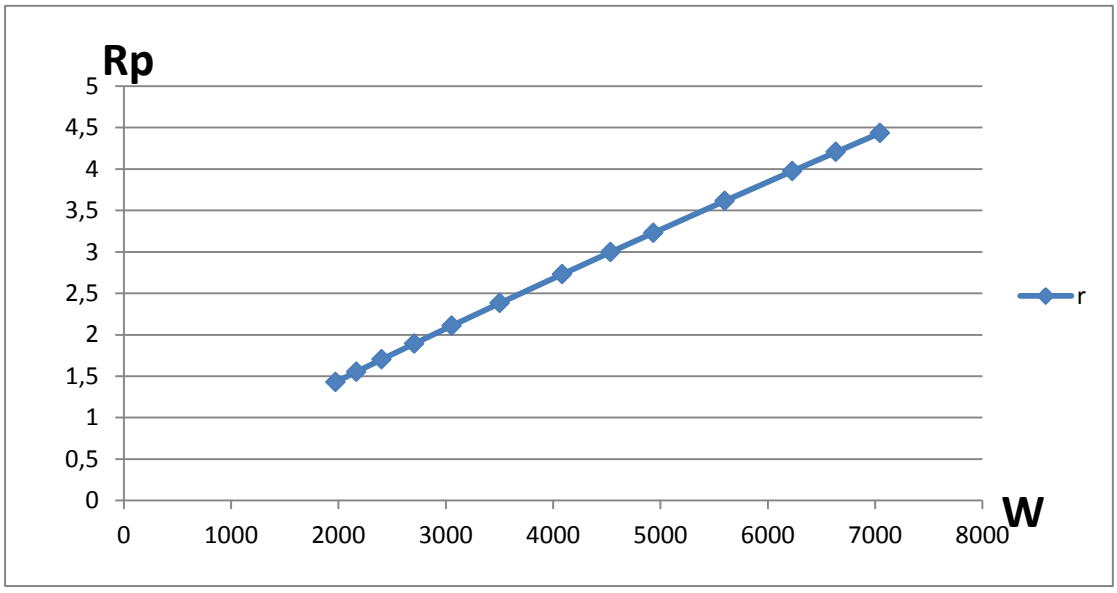
[4] We use five-year moving averages as proxies of annul premiums and claims, so the data start from 2001, not 1997 as mentioned before.

[5] Details are in appendix.

TABLE2--RELATIVE RISK AVERSION[6]

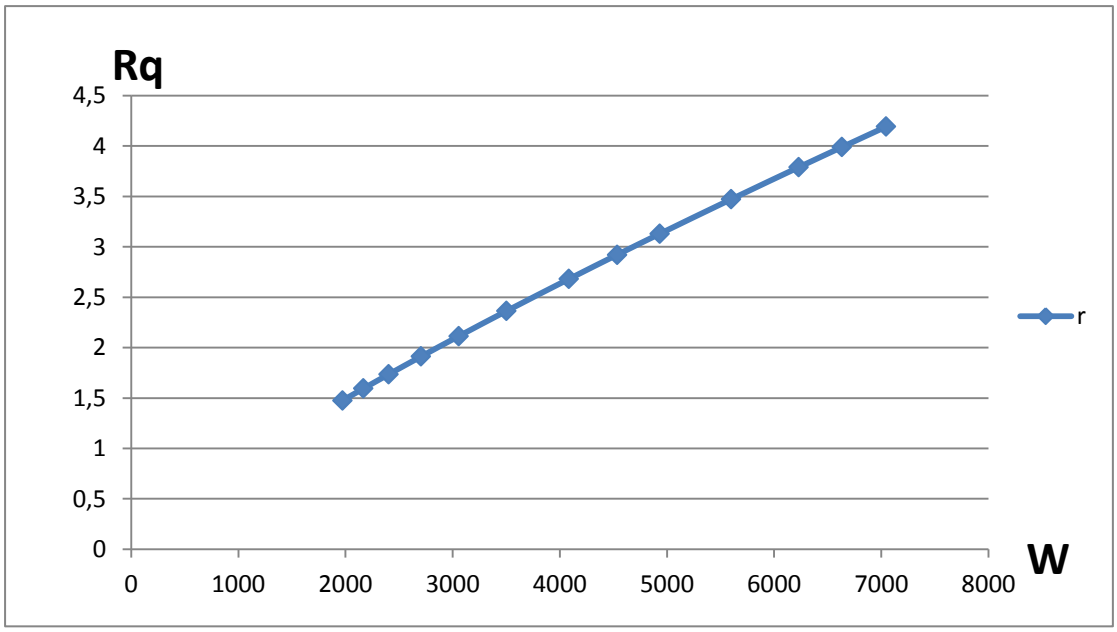
YEAR	W	r_p	r_q
2001	1972.93	1.428386	1.476235
2002	2167.948	1.553387	1.594865
2003	2403.002	1.702422	1.735331
2004	2706.358	1.892426	1.913021
2005	3057.19	2.109274	2.114114
2006	3503.122	2.38101	2.363836
2007	4086.196	2.730675	2.681919
2008	4535.626	2.996423	2.921504
2009	4934.014	3.229567	3.130316
2010	5598.778	3.61409	3.472165
2011	6229.697	3.9744	3.789892
2012	6634.374	4.203374	3.990616
2013	7045.66	4.434517	4.192371

CHART1 -- r_P WITH WEALTH



[6] $R_r = R_A \square W = c \square W^{(1-h)}$, r_p represents the R_r using premiums and r_q represents the R_r using claims.

CHART2 -- r_q WITH WEALTH



IV. Conclusion

Increasing relative risk aversion means that the wealthier the man, the more risk-aversion he is. In this paper IRRA means that people get richer with the time. Moreover they purchase insurance in a much faster increasing rate. We analyze the data on property insurance and try to explain the results by the following reasons from the insurance point of view.

The first reason is the external uncertainty increasing. In past two decades, great changes have taken place in China. With the blooming of economy and technology, many kinds of new risk are appearing, and the degree of loss is also increasing. For example, every 100 families had only 0.34 cars on average in 1999. This number is increased sharply to 16.9 in following 14 years. It is well known that more vehicles mean more possibilities of risk.

Moreover, the accumulation of wealth also affects risk aversion coefficient. On one hand, the accumulation of personal property, family property and enterprise property suffers more loss than in the past when some accident occurs. On the other hand, the influence of wealth on risk aversion coefficient can be classified. Some studies indicate that house property has positive effect on risk aversion coefficient and financial property has negative effect. Thus,

the more house property, the more risk aversion. In china, the price of house grew in incredible speed. According to National Bureau of statistic, the average price of commercial house was 2053 Yuan in 1999, but it was up to 6237 Yuan in 2013. People have to pay much more for house, which is about 22.7% of family income. The house property increased a lot, which means risk aversion coefficient is larger.

Another reason may be the perfection of insurance industry in China. Since 1990s, China's insurance industry is developing rapidly. It's becoming more professional, international and standardized. The sorts of insurance products have been diversified and specialized. Moreover, the quality of service has also been improved. Now the insurance needs for different people can be met. What's more, Chinese people's understanding of risk is becoming comprehensive and profound. Now they think insurance is much more important than in the past, as it is an effective way to protect them from risk.

There are still some open problems to be solved later. First we cannot determine the specific reasons that result IRRA in China. Second we can't distinguish how much each factor has the effect. Finally it is necessary to do cross-section estimates to examine our results.

Appendix

The regression result using premiums as dependent variable is this:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
W	0.009451	0.000787	12.01005	0.0000
L*W^0.11	-5.665239	1.601660	-3.537105	0.0047

R-squared	0.945392	Mean dependent var	27.16046
Adjusted R-squared	0.940427	S.D. dependent var	16.41609
S.E. of regression	4.006761	Akaike info criterion	5.754482
Sum squared resid	176.5955	Schwarz criterion	5.841397
Log likelihood	-35.40413	Hannan-Quinn criter.	5.736617
Durbin-Watson stat	0.331977		

The regression result using claims as dependent variable is this:

Variable	Coefficient	Std. Error	t-Statistic	Prob.
W	0.004986	0.000381	13.08354	0.0000
L*W^0.18	-1.700558	0.432871	-3.928555	0.0024

R-squared	0.958861	Mean dependent var	14.23552
Adjusted R-squared	0.955121	S.D. dependent var	8.336499
S.E. of regression	1.766052	Akaike info criterion	4.116008
Sum squared resid	34.30834	Schwarz criterion	4.202924
Log likelihood	-24.75405	Hannan-Quinn criter.	4.098143
Durbin-Watson stat	0.380719		