

## Empirical Analysis on the Relation Between Population Aging and Resident Consumption in China: Based on the Data From 1981 to 2011

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### Abstract

Human is the object of social activities. The change of population age structure will impact on the level of collective consumption. Nowadays, the situation of population aging in our country presents the obvious acceleration, which brings a multiple of unexpected troubles. In conclusion, study the influence of the population aging in China consumption, not only enables us to the relationship between the two has a clear theoretical knowledge. At the same time can also be for the current response to provide the corresponding reference and reference. Based on the time series data of consumption, GDP and the ratio of the old to the teenager from 1981 to 2011. Using co-integration theory, an error correction model, vector auto-regression model, this paper does an empirical analysis on the relation between population aging, GDP and old—teenager ratio in China. The analysis shows that there is long-rim stable relation among resident consumption, GDP and old-teenager ratio. Population aging has negative influence on resident consumption.

**Key words:** An aging population; Residents consumption; Johansen cointegration; AVR

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### INTRODUCTION

The so-called population aging refers to the ratio of the elderly population in the total population rising relative. According to the internationally recognized metric, one country or region can be called aging society if the population above 60 years old account for over 10% of the total population, or population above 65 years old account for 7% of the total population. The latest Sixth Population Census results show that, the elderly above 60 years old (included) in China account for 13.26% of the total population, among which, the elderly above 65 years old (included) account for 8.87%, China has entered into aging society as a whole. Currently, the elderly population in China is around 169 million, which makes China become the country with the largest aging population in the world; the ratio of the population above 60 years old has increased 2.93% during the past decade. These data indicate that China has been in a stage with low fertility level in the past ten year, and its aging process has been sped up.

The 18<sup>th</sup> National Congress of Communist Party of China clearly raised the strategic guideline and target of “we should cope with the population aging, and strive to develop the aging service business and industry”, and pointed out that the population aging is not only a realistic problem that we should face together in 21 century, but also a long lasting problem which will significantly influence the development of human society. Therefore, correctly understanding the relationship between population aging and economic development and clearly realizing the relationship between the aging and consumption needs has important practical significances on promoting consumption, enhancing economic performance and pushing social sustainable development.

## 1. LITERATURE REVIEW

For the relationship between the aging and consumption, the western scholars have studied on it in an earlier time, and have come up with some relatively well-developed theories. The absolute income hypothesis proposed by Keynes (1936) believes that there exists a stable functional relationship between the actual consumption expenditure and real income, we can say that the aged has lower consumption propensity, assuming the population is fixed, then the increase of elderly ratio will result in the decline of consumption propensity of the whole society. This hypothesis makes a significant contribution to the consumption function theories while it still has serious theoretical defects, mainly because it is just a model on demand, which focus on subjective conjecture and mental analysis, thus it is lack of a firm foundation. On this basis, the relative income hypothesis proposed by Duesenberry (1949) became one of the relatively influential consumption theories in the earlier time, the classic business cycle theory (Modigliani and Brumberg, (1954) considers the labor force and capital as the key variable affecting the economic development, it believes that people usually works when they are young and balance their lifetime consumption through saving his earnings, however, the population aging will reduce the quantity of labor force, cut down the social savings and investments, which goes against the economic growth in the long-term . It is a pity that this hypothesis doesn't try to endogenize the technical progress. In the late 20<sup>th</sup> century, based on the rethinking on the new classical economic growth theory, Samuelson (1958) and Dai (1965) proposed the overlapping generations model, which divided the human's life into two or three discrete stages. After that, Blanchard (1985) proposed a continuous overlapping generations model, which is one of the theoretical models that widely used in the study of this issue. Barro (1991) built the economic growth convergence model, and brought factors of birth rate, mortality rate, population growth rate, population density and others into this model, which laid the foundation for the study of population structure and economic growth. Based on the analysis of reasons of Japan's economic recession in the nineties, Hewitt (2003) believes that population aging will result in reducing the quantity of labor supply, thus affecting the economic growth. Bloom (2008) discussed Asian population transformation during the years of 1960 to 2005 and population dynamic evolution formed under this condition from 2005 to 2050, and estimated statistical relationship between ratios of the young population and elderly population in the long-term and short-term and economic growth, finally, he found out that the long-term elderly population will not have significant impacts on the economic growth, but the short-term elderly population will have negative impacts on the economic growth.

Currently, there are mainly two kinds of opinions on the impacts of population age structure changes and population aging among scholars in China, some scholars believe that the negative impacts of population aging on social and economic development overweight the positive ones; while the others hold the opposite opinions. Wu and Xu (1988) present their opinions in the book named *The Impacts of China's Population Aging on Social and Economic Development and Family* that the implementation of family planning policy will contribute to the slowing of population growth, while it will also cause a series of problems such as the changes of population age structure changes, the increase of ratio of the aged population, the decrease of ratio of labor force population and children population, the intensifying of population aging problem and the worsen of society's burden of supporting the aged and so on, those problems will have bad impacts on the sustainable development of social economy. Fang (2009) believes that the increase in alimony for the aged will reduce the savings ratio; the enhancing of the dependency burden will result in the decline of working time. Yu (1995) studied the impacts of population aging on society' economy systematically in the book named *Economics Research on China's Population Aging* , he believes that in the 21st century with population aging rising continuously, especially after 2025, the negative impacts of China's population aging overweight the positive impacts.

In the analysis of population aging impacts on economy and society, one of the important impacts lies in the residents' consumption. The scholars in China started to do research on the impacts that population aging brings to the residents' consumption since 1990s. Qin (1990) built the error correction model of Chinese residents' total consumption based on the dynamic modeling theory, and carried out the empirical test by making use of the statistical data from 1952 to 1987. Yuan and Song (2010) built an overlapping generation model with two-period to explain the decline of consumption tendency, after the comparative static analysis on first order conditions and numerical simulation, they found that the changes of population age structure are important reasons for the variation of consumption behaviors in China's urban residents, and the technical progress will make the saving rate decrease significantly. Zheng (2009) analyzed the China's aging impacts on newspaper consumption market, and believed that aging issue is a double-edged sword for the newspaper market, which means, on the one hand, it will increase the circulation of China's newspaper, but on the other hand, it obstacles the quality improvement in newspaper industry, therefore, drawing on the advantages and avoiding the disadvantages is an essential choices. Based on the life cycle hypothesis theory and household savings demand theory and adopting qualitative research method, Zhang (2009) and Li (2010) and other scholars believe that the elderly' savings is negative, which will

enhance the family's consumption level, thus promoting the consumption.

The research literatures mentioned above do not carry out stationary test for the time series such as ratio of aged population, residents' consumption and GDP and so on, but analyze the time series by making use of classical regression theory, which may cause spurious regression, that is to say, there does not exist a sort of relationship between the variables in original, some favorable related relationships or causal relationship may appear due to some kind of common tendency or opposite tendency between variables. To solve this kind of problem, we need to use the quantitative analysis methods such as unit root test and co-integration theory and so on.

Based on the differences of the research method and emphasis of existing research achievements, this paper tries to develop the argument on what impacts will the population aging bring to China's economic development from the angle of theory and demonstration based on the China's actual situation of economic and social development. Then, by adopting the time series data such as average spend, average income, and the ratio of old-teenager which reflects the population aging from 1981 to 2011, and with the help of analysis tool such as co-integration theory, error correction model, Granger causality and VAR model and so on, the empirical analysis on relationship between residents' consumption in China and population aging, as well as average GDP has been carried out, meanwhile, we fully consider about the impacts of population aging on residents' consumption, finally, the influential effects the population aging in China have on residents' consumption have been obtained.

## 2. THE MECHANISM OF ACTION OF THE POPULATION AGING ON CONSUMPTION

It is just an indisputable fact that the development of economy in China faces severe challenges of population aging. China is thrown into a Challenging situation by the accelerated aging process, deficient resources, and the pension system remaining to be perfected. Impacts of population aging on consumer demand can be divided into the direct impact and indirect impact. The direct impact refers to the impact on consumer demand and consumption structure which is brought by the up of elderly consumer demand resulted from the increased proportion of elderly population from the population aging, while the indirect impact means that Population aging influences economic growth by acting on capital accumulation, labor supply, which will affect consumer demand indirectly.

### 2.1 The Direct Impact of the Population Aging on Consumption Level

Generally, the elderly's purchasing power, consumption habits and behaviors are different from that of other ages.

#### 2.1.1 A lower Purchasing Power

Purchasing power of Chinese aging population comes from pension, alimony, savings and so on. Relative to purchase ability before retirement, their purchasing power has a significant decrease, which is more obvious in rural areas. Meanwhile, the rural elderly have a self-sufficient life resulting in fewer purchasing behavior. It can be seen that the per capita purchasing power of aging population is quite low.

#### 2.1.2 Steady and Inertial Consumption Motives

Inertial thinking often exists when the elderly choose goods and services. The consumption habit is so hard to change that they tend to choose the brand they often use and they pay more attention to product quality and brand effect. "Demonstration effect" is also represented in the consumption activities of the elderly. They will accept the products recommended by friends and relatives with pleasure, and form the consumption inertia to the brand. In the process of purchasing, the elderly are usually dominated by the rational purchasing behaviors with impulsive purchases rarely happening on them. Steady and inertial consumption motives of the elderly are adverse to the promotion of the consumption level, which impedes the enhancement of their own consumption level to some extent.

#### 2.1.3 Consumer Psychology of the Pursuit of Practical and Altruism

In daily consumption, the elderly pursue the practicability of consumption goods while they require little about the product design and innovation feature. The consumption psychology of practicability reduces the pursuit of new products and new scientifically features, which goes against the updating and upgrading of consumption goods. Altruism is the consumption behavior mostly acted by the elderly who have heavily traditional concepts or by those whose children are hard to be independent due to various reasons. They focus on reducing the children's life burden instead of taking their own needs into account. The consumer psychology of altruism widely exists in China, for which the elderly consumption level is hard to get a rapid enhancement. Because of the low purchasing power, specific consumption habits and consumption psychology of elderly people, per capita consumption of the elderly population level is relatively lower than labouring population. When the proportion of the elderly rises to a certain extent, the low level of consumption of population aging will lower the level of consumption of the whole society.

#### 2.1.4 The Direct Impact of Population Aging on Consumption Structure

##### A. The effects of population aging on food and clothing consumption

In general, A series of physiological changes such as metabolism reducing, digestion function abate will happen to the elderly's bodies, which result in a decreased demand for food in the elderly. In addition, because of the lack of



specialized manufacturers who are engaged in developing and producing aged-food, the kind of food specialized for the elderly is fewer in China's food market. With the intensification of population aging in China, aged-food consumption demand will continue to rise, which will challenge the supply scale of aged-food market in China at present. Meanwhile, the same problem exists in the old-aged clothing market. Firstly, the supply is difficult to meet the increasing demand of the middle and old-aged people. Secondly, many products are shoddy and in old styles on the middle and old-aged clothing market. Finally, the infrastructure of the middle and old-aged clothing market is not perfect to provide the humanized service. The middle and old-aged clothing consumption market is not in an optimistic situation, which restrains the consumption of elderly population to this kind of consumer goods.

#### **B. The impact of population aging on the consumption health care**

Because the elderly are in a high age with more symptoms of the body, they are more prone to all kinds of diseases so that they have higher needs for medical treatment and health care. Under normal circumstances, the elderly medical expenses will increase with age, for which the main reason is that the incidence is rising at the same time. According to the survey of Japan Institute of Population, the incidence of the elderly of 65-74 is about 2 times of the middle-aged people, and about 2-5 times of young people. China's previous total health service survey also indicates that the incidence of over 60 is significantly higher than adolescents. Moreover, they are suffering from 2 to 3 kinds of chronic diseases per capita. The high prevalence, the high rate of restricted movement and the high disability of the old-aged people make the elderly increase the demand for health care, resulting in the increase of consumption on these health and medical products of the elderly.

#### **C. The impact of population aging on services in education, culture and entertainment and the expense of traffic and communication**

After retirement, the elderly have abundant spare time during which reading books and magazines, traveling, taking an active part in recreational activities are important parts of the elderly life. Most old-aged people have the habit of reading books and magazines, and some old-aged people decide to travel. Consumption of elderly people in education, culture, entertainment and tourism will also drive the consumption of other related projects, such as catering, passenger transport, and so on at the same time.

### **3. THE INDIRECT IMPACT OF POPULATION AGING ON CONSUMPTION**

The indirect impact refers to that the population aging affects the economic growth by acting on accumulation of capital, labor force as well as the consumption.

#### **3.1 Population Aging and Saving Ratio**

The life cycle theory believes that population aging will lead to lower savings ratio, which is the important factor that can contribute to slow down the economic growth. People always save part of their salaries when they are in the working age. This part of savings is the important source of funds for the workers' pension after retirement. When a certain period of the birth rate is high and this part of population's income will come from a negative value to a positive one which can satisfy the consumption with surplus savings in the process of children to mature, the total saving ratio will reach a peak and then it will decline gradually with this part of the population aging. As a consequence, the negative effects on the future economic development brought by population aging will become increasingly apparent accompanied by population aging aggravated. On the one hand, under the background of population aging, the labor supply will decline to be shortage, which will cause serious negative effects on the production circulation market of the whole economic system, make the economic growth to slow down or even appear a negative growth. On the other hand, the retirees who have no source of income or low-income are forced to use their savings, thus resulting in a decrease of national savings. When this part of the population increases to a certain size, it will cause a decline in gross national saving ratio, slow accumulation of capital and a relative shortage of capital, thus the economic growth will slow down and economic benefits will decline.

#### **3.2 Population Aging to the Labor Productivity**

The population aging has both positive and negative effects on the labor productivity. The negative impact of population aging on the labor productivity performances can be represented as: the labor capacity may decline and the average age of the working population may rise in the process of population aging. This part of the population has a relatively low receptivity for new equipment, new technology, new skills, which have an adverse effect on the promotion of production capacity. The positive impact of population aging on labor productivity is shown as: This portion of the population has the rich work experience and they can play leading and exemplary roles for young workers. It is conducive to inspire innovative employee's productivity.

However, with the increase of an aging labor force, labor force resources will be relatively shrunk and laboring population aging will also be aggravated, which can eventually affect the improvement of labor productivity.

The changes of saving ratio (capital accumulation), laboring population relative supply and labor productivity will have a direct impact on economic growth. When economic growth becomes slow, growth rate of per capita national income will be reduced accordingly, which can further affect the improvement of per capital consumption

level. From the view of micro families, family population aging will reduce household per capital income, which further affect the household per capital consumption level, meanwhile, household consumption will also gradually incline to the elderly consumption, which further influence other family members' consumption levels. When all household consumption preferences change towards the elderly consumption preferences, consumption preferences of the whole society will also change accordingly. Therefore, population aging has an indirect impact on household consumption.

## 4. THE CONSTRUCTION OF THE MODEL

### 4.1 Basic Assumption

Human being is the main body in social activities because economic and social development is achieved by people's participation. Due to different consumer demands and preferences among different ages, the change of population age structure will influence resident consumption. As a whole, the young in pursuit of fashion are paying more attention to brand and appearance with excessive consumption and loan consumption, while the elderly place more emphasis on the practicability and cost performance during shopping, and most of them often make ends meets and strive for economy in consumption. In addition, young and middle-aged people spend more of their money on cars, housings, clothes and investments with higher income level, while the elderly tend to spend more on health care, so their consumption level is lower than that of young and middle-aged people because of lower income. Similarly, children's consumption has its own characteristics, and generally speaking, their consumption level is lower than that of young and middle-aged people.

In terms of ratio of the amount of consumption of children, young and middle-aged people or the elderly, different countries or regions have different research conclusions because big differences remain in economic development levels, cultural traditions, religious faith and social systems etc.. On the basis of acknowledging and referring to Wang Jinying and Fu Xiubin's assumption of differences in consumer demands among different ages, this paper represents that differences in consumption ability exist among different ages by introducing the old-teenager ratio, thus the model takes the impacts of population aging on resident consumption into account.

### 4.2 Model Setup, Index Selection and Data Sources

In consideration of the difficulties in attaining data of relative income of the relative income hypothesis and

permanent income of the permanent income hypothesis, the theoretical basis of the model refers to the theory of consumption function of Keynes absolute income hypothesis. Two relations shall be defined before the model is established:

$$XF_t = xf_t * P_t$$

$$GDP_t = gdp_t * P_t$$

Among them,  $xf$  refers to the total amount of resident consumption within  $t$  year(s),  $xf$  refers to per capita consumption within  $t$  year(s),  $GDP_t$  refers to total GDP within  $t$  year(s) which is measured by spending,  $gdp_t$  refers to per capita GDP within  $t$  year(s),  $P_t$  refers to the total population within  $t$  year(s).

According to the economic theory, there are many factors affecting per capita consumption. In order to make the model simple with better description ability, this paper only introduces three variables,  $gdp$ ,  $xf$  and  $ls$ :

$$xf_t = \alpha_0 + \alpha_1 * gdp_t + \alpha_2 * ls + \mu_t$$

Regarding the choice of data indicators,  $ls$  refers to the ratio of the old and the young to the Teenager within  $t$  year(s), that is to say, it divides the population of 65 and older by the population of 0-14 years old within  $t$  year(s), as a reflection of aging population index. Total consumption depends on per capita consumption and population size, and consumption in the consumption function refers to per capita consumption, which can better reflect individual consumption level. Therefore, the index  $xf$  referring to per capita consumption is used in the model in this paper. Total GDP depends on per capita GDP and population size, but per capita GDP can better reflect individual absolute income level. Therefore, the index  $gdp_t$ , namely per capita GDP, is used in the model.

In the respect of data sources, data of per capita consumption  $XF$  and per capita GDP from 1981-2008 and data of per capita GDP from 2009-2011 can be adapted directly because Statistical Yearbook has original data; per capita consumption from 2009-2011 is shown by that very year of total consumption of the urban and rural divided by total population of the urban and rural. Data in the paper from 1981-2011 are empirical, whose original data is from the state statistical bureau website, *China Statistical Year and 60 Year of New China Statistical Data Collection*. Considering the change of statistic standard, on the basis of original data, data has been recalculated, and both per capita consumption and per capita GDP are calculated according to the constant price of 1981, which can eliminate price factors' effects on per capita consumption and per capita income, then actual consumption and income levels can be measured more accurately. In addition, in order to avoid heteroscedasticity of time series data, this paper has carried out some

**Table 1**  
**The Data of Consumption, GDP and the Ratio of the Old and the Young From 1981 To 2011** (Unit: Yuan, Based on the Constant Price of 1981 )

Year	Old-teenager ration	Per capita consumption	Per capita GDP	Year	Old-teenager ration	Per capita consumption	Per capita GDP
1981	0.123	243.7673	492.0	1997	0.268	2872.7273	6420.0
1982	0.137	269.6629	528.0	1998	0.282	2983.0028	6796.0
1983	0.143	292.3219	583.0	1999	0.306	3089.5660	7159.0
1984	0.136	322.3214	695.0	2000	0.319	3344.3831	7858.0
1985	0.131	392.9515	858.0	2001	0.304	3660.3595	8622.0
1986	0.125	474.6896	963.0	2002	0.348	3855.3991	9398.0
1987	0.163	533.0189	1112.0	2003	0.348	4141.7840	10542.0
1988	0.167	662.3377	1366.0	2004	0.418	4585.6611	12336.0
1989	0.172	789.5792	1519.0	2005	0.418	5063.0213	14185.0
1990	0.207	803.2787	1644.0	2006	0.464	5600.3650	16500.0
1991	0.207	858.1952	1893.0	2007	0.498	6445.5535	20169.0
1992	0.199	984.9956	2311.0	2008	0.435	7507.3394	23708.0
1993	0.203	1285.0554	2998.0	2009	0.459	7991.6848	25608.0
1994	0.227	1752.3901	4044.0	2010	0.534	8921.9555	30015.0
1995	0.227	2184.6011	5046.0	2011	0.554	10317.2380	35181.0
1996	0.251	2549.3601	5846.0				

Note. d 60 Year of New China Statistical Data Collection

logarithm transformations on the basis of eliminating price factors, so the final index is consumption index ( $\ln x_f$ ), income index ( $\ln gdp$ ), aging index ( $\ln ls$ ).

## 5. QUANTITATIVE ANALYSIS

It is shown clearly that in the long run, there will have remarkable rising tendency towards three variables which are per capita income, per capita consumption and old-teenager ratio. If regression is made directly in the model, it's possible that spurious regression appear. Therefore, it shall be first to discuss the stability of the three variables' series.

### 5.1 Stationary Test of Series

Because of the inertia of the economic system and problems of time series span, simple linear regression equations will be easy to cause "spurious regression", that is to say, due to the non-stationary of time series, the statistical magnitude of T in simple linear regression equation will unduly reject uncorrelated assumption when analyzing time series. In order to avoid "spurious regression phenomenon" and make the empirical analysis results more reliable, we shall firstly test stability of time series. Unit root inspection of stability of the three variables is carried out by means of eviews 6.0 software and ADF test method. Inspection results are seen in Table 2.

**Table2**  
**Inspection Results of ADF Unit Root**

Variable	ADF test value	5% critical value	10% critical value	Conclusion
$\ln x_f$	-1.4545	-2.9718	-2.6251	Non-stationary
$\ln gdp$	-0.6026	-2.9810	-2.6299	Non-stationary
$\ln ls$	-0.2910	-2.9640	-2.6210	Non-stationary
$\Delta \ln x_f$	-3.5399	-2.9718	-2.6251	Stationary
$\Delta \ln gdp$	-3.4026	-2.9719	-2.6251	Stationary
$\Delta \ln ls$	-4.4493	-2.9981	-2.6388	Stationary

According to the test results, at the significant level of 5% and 10%, per capita, per capita GDP and old-teenager ratio, the three time series are non-stationary, while after the first-order difference test on the variables, results show that at critical level of 5% and 10%, the first-order difference of each variable is stationary, which can conduct co-integration test for them.

### 5.2 Co-Integration Test

The co-integration refers to the stability of a certain linear combination of multiple non-stationary variables. There are two ways of co-integration test: One is based on regression residual; the other, the Johansen co-integration test, is based on the perfect information of coefficient of

regression. According to the OLS model, we will choose the latter to test the co-integration relationship in the sequences of the variables. And then, we will locate the best lag phase which is 2 by the Akaike AIC and Schwartz SC so as to conduct the tests of the co-integration of the sequences of the variables. The test results are as follows:

**Table 3**  
**Inspection Results of Johansen Cointegration**

Null hypothesis $H_0$	Statistics of the trace ( $P$ value)	Statistics of the largest eigenvalue ( $P$ value)
NJo co-integration vector quantity	36.6225(0.0070)*	27.6190(0.0053)*
One co-integration vector quantity at most	9.0036(0.3650)	8.9027(0.2943)
Two co-integration vector quantity(ies) at most	0.1008(0.7508)	0.1008(0.7508)

Note. "\*" means the null hypothesis will be rejected below 5% of the significant level

The results of Johansen co-integration indicate that there exists the co-integration relationship or the so-called long-run equilibrium relationship among  $\ln ls$ ,  $\ln x f$  and  $\ln g d p$ .

### 5.3 Error-Correction Model

The co-integration equation reflects the long-term stable relation of variables, but it is not able to describe the short-term undulation of variables. However, both the long-run equilibrium relationship of the per capita consumption and the short-term undulation of variables can be analyzed with the error-correction model. In this model, the idea which contains co-integration relationship and has ability to correct the model for the equilibrium error of the combination of co-integration can be summarized that the phenomenon of deviation in a certain phase will be corrected in the next time.

When the residual term  $C$  is regarded as the error correction term ECM and the error correction model is evaluated with OLS method, we can get the following results:

**Table 4**  
**Inspection Results of Granger Causality**

Null hypothesis $H_0$	Lag phase	Observed value	F-statistics	P value	Null hypothesis (10%)
$\ln x f$ is not the reason for $\ln g d p$	2	29	5.0713	0.0146	refuse
$\ln g d p$ is not the reason for $\ln g d p$	2	29	18.1546	2.E-05	refuse
$\ln x f$ is not the reason for $\ln g d p$	2	29	1.7397	0.1970	accept
$\ln ls$ is not the reason for $\ln x f$	2	29	4.4299	0.0230	refuse

### 5.5 Impulse Response Function

Impulse response function is the forceful impact on the system from the VAR when it suffers some shocks. The Granger causality test has confirmed that GDP and  $XF$  are each other's Granger causality the second lag phase. The

$$\Delta \ln XF = 0.012 - 0.075 \Delta LS + 0.812 \Delta \ln GDP + 0.2509 ECM$$

$$(0.0283) \quad (0.0873) \quad (0.1859) \quad (0.2224)$$

$$t = (0.4248) \quad (-0.8582) \quad (4.3661) \quad (1.1282)$$

$$R^2 = 0.7388 \quad D.W. = 1.2974$$

The coefficient of the error correction term is 0.25. Its economic implication is that if the per capita consumption for former year in the economy is of the long-term equilibrium level of the per capita consumption, 25% of the departure will be corrected this year. Specifically, if the per capita consumption of last year lowers 100 yuan of that of this year, this year's per capita consumption will increase about 25 yuan in average to make the per capita consumption circle around the equilibrium level and balance in a long-run stability.

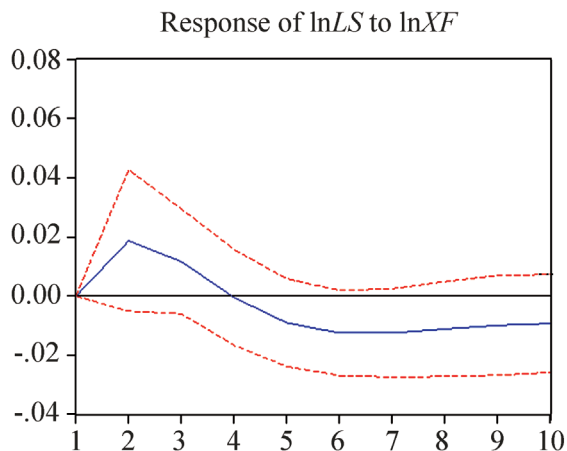
### 5.4 Granger Causality Test

In order to further study the quantitative relation of variables, we continue our Granger causality test. The Granger cause is not anything like the causality in economics. That variable  $y$  is the cause of variable  $x$  only means that  $x$  changes before  $y$ . That is to say,  $x$  with its lagged variable is able to give a better explanation to the change of  $y$  while  $y$  and its lagged variable cannot describe the change of  $x$ . From the analysis on the demonstration above, it is known that there is a co-integration relationship among the per capita consumption, the old-teenager ratio and the per capita GDP. In order to make a more accurate analysis on the quantitative relation among them three, we conduct a test on the relation among the three variables of the Granger causality test with selecting a significance level 10% and the second lag phase. The results are shown in Table 3. Combined with the  $F$  test and the  $P$  value test of the econometric analysis,  $\ln x f$  and  $\ln g d p$  are the Granger causality to each other at the second lag phase.  $\ln ls$  causes  $\ln x f$  while there are no data supporting the influence of  $\ln x f$  on  $\ln ls$ , which means that the consumption has no significant impact on the old-teenager ratio of the lag phase. However, the consumption is obviously influenced by the old-teenager ratio or in other words by the intensification of aging.

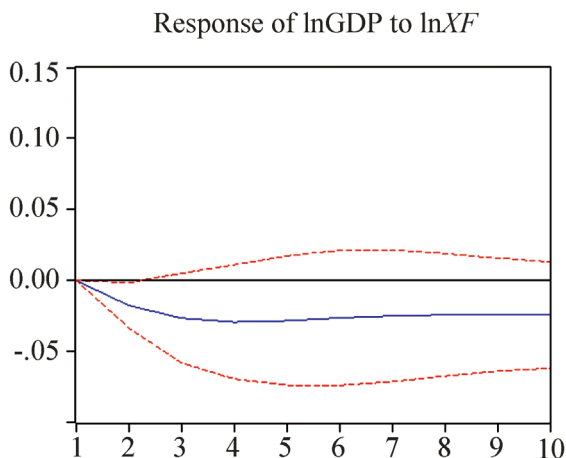
$LS$  is the Granger cause of  $XF$  while  $XF$  is not the Granger cause of  $LS$ . And on this basis, if we continue to analyze the shock pulse by the VAR, we will see that when the GDP suffers from the negative shock at the current period, the negative shock will have an influence on  $XF$  in a



short term and when the shock of the forth lag phase is maximizing, the progressive increase will appear later on (as seen in Figure 1). This means that  $XF$  will have a major impact on consumption in a short term. However, this effect will gradually diminish with the income increasing. When  $LS$  suffers from the positive shock, the positive shock will have an influence on  $XF$ . When the second lag phase is maximizing, the progressive decrease will rise (as seen in figure 2). This means that the  $LS$  will exert a positive effect on the  $LS$  in a short term. However, the positive effect will weaken slightly with  $LS$  increasing. The result is consistent with the co-integration analysis.



**Figure 1**  
Response of Aging to Consumption



**Figure 2**  
Response of GDP to Consumption

## 6. CONCLUSION AND POLICY SUGGESTION

### 6.1 Analysis on the Conclusion

In this paper, we establish an error correction model on the data of population aging, per capita GDP and consumption from 1981 to 2011 to analyze the relationship among them three by the methods of the unit root test, co-integration

theory, the vector auto-regression, the Granger causality test and others in a stable correlation sequences of econometrics and the conclusion is shown below:

At first, the variables of  $xf$ ,  $gdp$  and  $ls$  all have a trend of increasing, but they have a co-integration relationship or in other words they have a long-run stable equilibrium relationship. When using the error correction model to analyze the long-term equilibrium and the short-term undulation of the  $xf$ , we know that if 25% of the deviation of  $xf$  can be corrected, the  $xf$  will be able to remain stable by the error correction model in a rapid fluctuation.

Then, when using the Granger causality test to make a further study on the quantitative relation among variables, we find that consumption and GDP per person are Granger causality to each other. The old-teenager ratio is the Granger cause of consumption per person while there are no data showing that the consumption per person has an influence on the old-teenager ratio. That is to say, the consumption has no significant impact on the old-teenager ratio in the lag phase while the latter affects the former obviously. In other words, the intensification of aging has an obvious impact on the consumption.

Finally, the old-teenager ratio has a negative influence of -0,075 on the consumption, which can be explained that as our population aging is more intensive, it will exert some negative effects on consumption in a certain period. The per capita GDP has a positive influence of 0.812 on the consumption, which means that the income plays a positive role in people's consumption. By comparing the two influence coefficients, we conclude that the influential effect of the old-teenager ratio to the consumption lowers that of the GDP per person to the consumption.

### 6.2 Policy Suggestions

The population aging will go through the 21<sup>st</sup> century from beginning to the end of China, and the degree of aging will maintain at a high level. According to the above empirical results, combining perspectives of sociology and economics, the following policy suggestions are proposed:

First, strengthening the public's awareness of aging. Firstly, do the national census data; make the data public and people aware of China's present population structure and age structure; an advocate present situation, characteristics and development trend of population aging. Secondly, propagandize the work for the population aging which has the strategic significance for building a harmonious society, view population aging as human capital. Finally, guide the formation of correct treatment of the population aging concept; realize that the opportunities come with the population aging, so does the challenges, so we should accurately grasp the opportunities brought by the population aging and make use of them. We should fully understand that serving the elderly well is conducive to maintaining the stability and development of society and promoting the construction of socialist spiritual civilization



at first; besides, it helps to allocate the limitation of the social resources reasonably to the aged cause; what is more, it beneficial to fully exert the advantages of their intellectual resources and make the contribution to the social and economic development.

Second, develop aging-related industries, expand elderly consumer market. Developing the elderly health care career and elderly education entertainment industry, developing and producing products for the elderly, and providing elderly services to meet consumer needs of the elderly and enriching spiritual and cultural life of the elderly is the requirements of an aging society. Specific ideas: first, change and guide the development of the elderly consumption concept. Most old-aged people have no housing, education and other rigid expenditure burden so that the long-term consumption will not occupy immediate consumption. The government should be aware of the elderly market opportunities, through cooperation with the manufacturers, propaganda and other means to encourage the elderly to transform from the traditional "altruistic consumption" into "dare to consumption", "selfish consumption", and strictly control product quality. The manufacturers can take advantage of free experience, issuance of trial products, introducing preferential activities to promote product promotion. Second, strengthen research and guidance for elderly industries; develop taxation, credit, investment and other policies which guide elderly industrial development; take tax incentives, fee waivers, and other special credit support policy to strongly support the elderly industries which are still in their infancy. Third, actively encourage, guide and regulate individual, private, foreign and other non-public capital to participate in developing aging industry, encourage and support the development of the elderly products, guide the elderly production enterprises to produce diverse varieties, complete economic applicable products to meet the various needs of the elderly such as develop elderly health industry and elderly sunset red tourism industry.

Third, improve the income of the elderly and increase its purchasing power to promote consumption.

Firstly, government should improve the aging population's income such as increase family income, the elderly subsidies, social pensions and health insurance system. In income allocation reform, optimize the national income distribution system and gradually expand the effective investment of the aging industries. With the establishment of "basic pension" security system, the elderly of 60 years old or above are able to receive a monthly pension to relieve the worries of the elderly, especially the rural elderly on their last years

Secondly, increase elderly property income. Increasing the elderly property income will help balance the needs of the elderly to their funds and promote pension career development and social harmony, which can make old age groups unable to share the great achievements of reform and opening up and economic development:

A. Explore effective ways of the multi-level property income of the elderly. Fully develop and use financial instruments to expand more channels and paths to increase support services to enable older age groups have different considerations and choices in terms of asset value. The basic idea: The one is to strengthen financial services for the elderly, and to encourage financial varieties already on the market, such as trust products, fund products, establish products designed for the elderly services; second is to control risk. Taking the older age group's low risk tolerance into account, we should adhere to the principles of moderating risk, casting capitals in a medium and long-term investment with a relatively low cost, making an efficient balance on short-term payment and others on related products, channels, etc..

B. Strengthen propaganda to improve the elderly financial sense. One is through financial and financial knowledge popularization to make older age groups understand the way to increase property income. Government departments and communities can organize seminars and consulting activities, and cooperate with the media to regularly propagandize relevant knowledge; the second is through community financial services to provide relevant advisory service and case service for the elderly. We can set up an integrated service station at the community and invite professionally qualified personnel to involve in the service; the third is to control risk to protect rights of the elderly. Financial services should be combined with the necessary legal services and professionals should give elderly instructions and guidance from a legal perspective toward assets, investments, disposition and others to prompt the risk and protect the legitimate rights and interests of older age groups.

C. Attempt to establish special institutions for the elderly group to manage money matters. The basic mode of operation of the organization is to bring the assets of older age groups together. Through different risk portfolios, select the appropriate financial institutions and financial variety, and commission qualified financial institutions to invest, so the assets commissioned by older age groups will reach the goal of preserving or increasing value. Though the aim of the agency is volunteer service, the management must get the basic elements of modern financial enterprises.

Finally, make full use of the aging population's huge advantage in human capital to develop aging industries, and establish a market that suits the aging population's employment, marketing services and investment in order to reach the goal of enriching the aging population's life and increasing the elderly income. Gradually establish and improve the government sector-led, community-based health care institutions to support re-employment platform of the aging population. Increase the income of elderly residents, especially the low income older age group, so as to enhance their purchasing power to promote consumption.

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