THE IMPACT OF POPULATION AGING ON
PER CAPITA CONSUMPTION IN CHINA

by

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ABSTRACT

Chinese economy has grown rapidly since the “Reform and Opening up” policy beginning in 1978. However, in 2014, the aggregate consumption of Chinese residents was only $2,150 (US), far below the world average consumption of $5,750 (US). Meanwhile, population aging is a global problem; China ushered in the era of population aging in 2000. The purpose of this report is to examine the impact of Chinese population aging (old dependency ratio) on resident’s consumption by using China’s provincial panel data (30 provinces) from 1997-2014 and fixed effect regressions. The results show that the old dependency ratio has a positive impact on resident’s consumption in China. This means resident’s consumption will increase with population aging in China. Furthermore, results also show that Chinese resident’s consumption was influenced by internal policy change and external shock. In particular, when 2005 and 2009 used as dummy variables for analyzing the impact of China access to the WTO and the global financial crisis on China’s resident’s consumption, we found that China’s accession to the WTO has positive impact on Chinese resident’s consumption, while the global financial crisis has negative impact on Chinese resident’s consumption.
ACKNOWLEDGEMENTS

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I appreciate my father Liangqing Xia and my mother Jiqing Liu who gives me life and supports me accepted education. I would also like to thank my grandmother Ruixiang Huan who gives me meticulously care.
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I. Introduction

The Chinese economy has grown rapidly since the economic reform that began in 1978. From 1978 to 2014, the Gross Domestic Product (GDP) of China increased from $148.38 billion (US) to $10.35 trillion (US). China has been the world’s second largest economy since 2010, when China’s GDP was $6.04 trillion (US). At that time, the GDP of the USA was $14.97 trillion (US) and Japan’s GDP was $5.50 trillion (US) (World Bank 2016).

Despite the gains in GDP, individual consumption in China has been below the world average consumption level. In 2014, average consumption in China was $2,150 (US). Meanwhile, the average global consumption was $5,750 (US). Given the population size and economic growth, the average consumption in China accounted for 37.4% of the world average consumption in 2014 (World Bank 2016). However, China’s consumption as a share of GDP (final consumption rate) has been showing a downward trend. In 2014, the final consumption rate was 35.9%, lower than the world’s average final consumption rate of 58.3%. This rate is not only lower than that of developed countries such as the USA (68.4%), Canada (56.1%), Japan (60.7%) and Germany (54.6%) but also lower than that of emerging economies such as India (58%) and Thailand (52.1%) (World Bank 2016).

China enjoyed a period of high investment which contributed to rapid economic growth. However, China’s consumption remained low. This peculiar combination of high “hot” economic growth rates and low “frozen” consumption in China’s economy is referred to as “Fried Frozen Fish” (Lin, 2007).
China’s low consumption is a problem that has been troubling and difficult to solve. As this problem can have a negative influence on the Chinese economy overall, we need to explore the underlying causes of this problem and suggest some potential solutions. The inertia of historic consumption habits is one reason for low Chinese consumption. Here, the consumer is still following former consumption patterns, even when their income has increased. People may also increase precautionary savings due to the rapid change in China’s economic structure, which may also result in decreased consumption. Decreased consumption rates could also be related to the unequal distribution of income in China, where only a small proportion of people are wealthy. (Ai, 2004).

1.1 Population Aging

Due to population control policies and improved life expectancies, China’s natural population growth rate is showing a downward trend with lower birth and death rates from 1.02% in 1997 to 0.506% in 2014. An aging society typically occurs in a country or region when the number of persons 60 years and over account for 10% of the total population, or, the number of people 65 years and over account for 7% of the total population. China ushered in the era of population aging in 2000, when the number of people 65 years and over, accounted for 7% of the total population.

In 1997, China’s elderly, 65 years old and over, accounted for 6.18% of the total population and numbered 272.88 million. In 2014, China’s elderly, 65 years old and over, accounted for 9.18% of the total population and numbered 457.79 million. This corresponds to an increase of 67.76% from 1997 to 2014. However, the total population increased from 1.23 billion to 1.364 billion between 1997 and 2014, a population growth
rate of 10.89%. That is a significantly lower growth rate than the for those 65 years old and over, growth rate (World Bank 2016).

![Population Pyramids of China in 1997 (left) and in 2014 (right)](image)

**Figure 1: Population Pyramids of China in 1997 (left) and in 2014 (right)**

Figure 1 on the left shows China’s population age structure pattern in 1997, every 5 years old for a group. The total population of China in 1997 was 1,247,259,000 and the proportion of male and female was almost the same (Population Pyramids of the World from 1950 to 2100). Groups population of 5-9 and 25-29 were large, group population of 65 years old and older was small. Population structure pattern’s bottom was wider due to young age groups had more population. Population structure pattern gradually shrank following age increase.

Figure 1 on the right shows China’s population age structure pattern in 2014, every 5 years old for a group. The total population of China in 2014 was 1,369,435,000 and the proportion of male and female was almost the same (Population Pyramids of the World from 1950 to 2100). Young age population was lower than 1997, such as group
population of 5-9; age group population 25-29 is almost same as 1997; group population of 40-49 is greater than 1997.

Corresponding features of China’s population aging include retirement before getting rich (delayed wealth), large-scale population aging, fast population aging, and maintenance burdens of old person. According to the Office of National Committee on Aging (2007), the forecasted trends for China’s aging population are even more severe. China’s population 65 years and over could be over 400 million by 2050, a growth of over 30%.

![Figure 2: Population Pyramid in 2050](image)

Figure 2 shows China’s population age structure pattern in 2050, every 5 years old for a group. The total population of China in 2050 is projected to be 1,348,056,000 (Population Pyramids of the World from 1950 to 2100). While group population of 0-50 is projected to decrease and, old-age population is projected to increase substantially. China’s population age structure pattern in 2050 is projected to be almost like a tower.
1.2 Consumption Patterns

Figure 3 shows the real per capita consumption trends of eleven Chinese Provinces from 1997 to 2014. The eleven provinces selected are: Beijing, Tianjin, Shanghai, Chongqing, Guangdong, Jiangsu, Shandong, Henan, Hebei, Zhejiang and Sichuan. Among them, Beijing, Tianjin, Shanghai and Chongqing are municipalities that directly controlled by the central government. These cities have obvious economic and political advantages and large populations, playing a pivotal role in China. Guangdong, Jiangsu, Shandong, Henan, Hebei and Zhejiang are the top six GDP provinces in 2014. Guangdong, Jiangsu, Shandong, Henan, Hebei and Sichuan are the top six population provinces in GDP and in total population (China Statistics Year Book).
Figure 3: Real per capita Consumption in Selected Provinces, 1997-2014

As shown in Figure 3, all provinces’ real per capita consumption rates are trending upward although with some fluctuations between 1997 and 2014. Shanghai’s real per capita consumption is the highest in the eleven provinces. Beijing’s real per capita consumption is second. Henan’s real per capita consumption is the lowest, Sichuan’s real per capita consumption is slightly higher than Henan.

Figure 3 also shows that from 2004 to 2008 period, all provinces’ real per capita consumption increased possibly due to China’s accession to the WTO in 2001, with the transition period effects beginning to show in 2004. From 2008 to 2009, all provinces’
real per capita consumption rates became stagnant, likely influenced by the Global Financial Crisis.

The objective of this report is to explore the relationship between population aging and consumption rates in China over the past two decades. The analysis uses provincial panel data and fixed effect regressions. To test if China’s access to the WTO and the Global Financial Crisis had an impact on China’s resident’s consumption, we included two year dummy variables 2005 and 2009. The results show that population aging had a positive impact on resident’s consumption; China’s accession to the WTO had a positive impact on China’s resident’s consumption, while the global financial crisis had a negative impact on China’s resident’s consumption.

II. Literature Review

2.1 Theoretical Foundations

Theoretically, the relationship between population aging and consumption rates can be explained by either micro- or macro- models. One of the most famous micro models is the “Life-cycle hypothesis” (Modigliani and Brumberg, 1954). In this model, people were hypothesized to allocate their consumption according to expected incomes at different stages of life, in order to maximize their lifetime utilities. The authors’ argued that people’s whole lifetime has three stages: (1) early years, (2) middle years and (3) later years. Here, people’s consumption is thought to be not only affected by current income but also related to the consumer’s initial assets, expected income, and age. Early years have less income, so their consumption is greater than their income. In middle years, people’s consumption is typically less than income. In late years, people will
depend on their offspring’s funds and their own savings for consumption, and thus their consumption is more than their income. Early years and late years have matched negative savings rates, whereas middle years have positive savings rates.

The consumption function proposed by Modigliani and Brumber’s (year) is:

\[ C = a \cdot WR + c \cdot YL, \]

where \( WR \) is assets, \( YL \) is income, \( a \) is marginal consumption of assets and \( c \) is the marginal consumption of income. Marginal consumption will change when population structure changes, marginal consumption will increase when the population of teenagers and seniors increase; marginal consumption will decrease when middle age people increases. In a population aging society, older people consume more, so the country’s consumption will increase.

An additional micro mechanism, the Precautionary Demand for Saving (Leland, 1968), extra saving is caused by future income being random rather than determinate. Leland argued that people would not allocate income for their whole lifetime; rather, people would save part of their income to avoid the risk of uncertain future income. In general, more uncertainty leads to more precautionary savings. Population aging will bring more uncertainty of the future. So, population aging has a negative effect on consumption based upon the Precautionary Demand for Saving theory.

Population aging can also influence consumption through macro mechanisms (Weil, 1999). At the macro-level, Weil showed that a higher proportion of elderly can lead to a lower saving rate. Individual consumption will rise if they expect to receive remittances under a permanent income constant; evidence supports the view that even if seniors save money by themselves, they lower the saving of young via remittances. Weil used panel
data from fourteen countries over the period 1960 to 1985. The results suggest that population aging has a significantly negative effect on savings. This means savings will decrease following a rise in population aging, individual’s consumption decreased when the saving rates increased. Therefore, Weil argued the relationship between population aging and individual consumption were negative.

Another analysis suggested that population structure has two effects on consumption (Cutler et al., 1990). First, an increase in population aging lowers output per person, thus reducing consumption per capita. Second, a smaller proportion of the labor force reduces investment requirements, thus reducing saving and increasing consumption per capita. Cutler et al. argued population aging always follows reduced birth rate, but the effect of population aging is always lower than the effect of birth rate. Per capita consumption per capita will increase if the consumption increase is caused by reduced birth rate, more than if it is from the reduced consumption caused by an increase in population aging.

The consumption function of Cutler et al. is

\[
\frac{\Delta c}{c} = \frac{\Delta \alpha}{\alpha} - \left[ \alpha \cdot \left( \frac{k}{c} \right) \cdot \Delta n + \Delta \alpha \cdot \left( \frac{k}{c} \right) \cdot \Delta n \right],
\]

where \( C \) is consumption per capita, \( \alpha \) is support ratio defining as the effective labor force, \( LF \), divided by the effective number of consumers, \( CON: \alpha = LF/CON \), \( k \) is capital-labor ratio and \( n \) is the labor force growth rate. \( C, k \) and \( \alpha \) are evaluated at the initial steady state. This equation shows the two steady-state effects of population structure change. A reduction in the labor force population ratio (\( \alpha \)) reduces the per capita consumption per capita. Meanwhile, per capita consumption will increase when the growth rate of the labor force (\( n \)) decline. Society receives a consumption dividend
when it is able to invest less and still maintain a given level of per capita output. Thus, Cutler et al. argues that old age dependency has a negative effect on consumption.

2.2 Empirical Studies

Senior citizen’s consumption trends, structures and levels have characteristics that are different from youth and middle-age consumption. Seniors are a special group, where aging has a complex interaction with respects to consumption. There are three different views on the relationship between aging and consumption that are found in empirical studies: positive effects, negative effects, and indeterminate effects.

**Positive effects of population aging on resident’s consumption:**

In a classic article, Leff (1969) studied the relationship between population age structure and saving rates, creating what is now known as the LEFF model. Leff used a multinational cross section of 74 countries, including 47 underdeveloped countries, 20 developed western countries and 7 Eastern European communist countries, to estimate the relationship between population age structure and saving rates. The results of this analysis show that the youth dependency ratio and old-age dependency ratios had a negative relationship with saving rates, where consumption would increase if the young dependency ratio and old dependency ratio increased.

In a more recent article, Wang (2004) used 1982-2002 provincial panel data for China, applying OLS and FGLS to analyze the influence of population aging on the economy, savings, and consumption. The results show population aging has decreased the labor-force supply, reduced savings rates, and slowed technological development. The decreasing saving rate has resulted in a rise in consumption; whereby population aging
promotes the rise in consumption rates. Further to this, Wang (2011) used panel data of Chinese provinces from 2001 to 2008 to analyze the relationship between consumption and population age structure by OLS regression. The results show that old-age dependency rate and average propensity of consumption having a positive relationship.

**Negative effects of population aging on resident’s consumption:**

In contrast, Kerr and Beajout (2004) argued that population aging is negative on consumption in Canada. Their study found that more people will leave the labor-force because of population aging, which results in a higher ratio of pensioners to working-age, and possibly a more rigid demand in the labor force. Their results suggested that a greater percentage of pensioners means a tendency to convert investments into old-age pension, which is negative for the economy. This is compounded by the fact that pensioners are greater consumers of public expenditures, leaving the governments with less funds to support the economy. Additionally, an older labor force has limited ability to adapt to economic changes as older workers are less geographically and occupationally mobile. This study also showed that there is a large gap between productivity and earnings by age, where young workers have more earnings and higher productivity than older workers, which would require older aged workers to increase their productivity through retraining. In turn, the government will spend more time and resources for retraining of older workers than for higher younger ones.

Modigliani and Cao (2004) studied the relationship between the demographic dependency rate and consumption rate in China from 1953 to 2000. They use co-integration relation theory to analyze the relationship between Chinese household savings rate and dependency ratios. In this study, they found the results of the
relationship between dependency rate and consumption to be negative. This study is based on the Life-cycle hypothesis, where Modigliani and Cao argue that consumers will allocate their consumption in order to maximize their lifetime utilities. The results show the dependency rate had positive effects on people’s savings. However, because the relationship between the saving rate and consumption rate is negative, the relationship between dependency rate and per capita consumption rate is negative.

Following the above study, Liu and Liu (2013) use 1982 to 2010 Chinese time series data including old-age dependency ratio, per capita consumption, and per capita income to analyze how China’s population aging affects per capita consumption through co-integration analysis. The results showed population aging had negative effect on people’s consumption in China.

Schultz (2005) studied the relationship between age composition of a nation’s population and it’s saving rates using the Life-cycle hypothesis and time series data of 16 Asian countries from 1952 to 1992. The results show the saving rates had positive relationship with old-age dependency, where consumption rates decreased when the saving rates increased. Therefore, the relationship between consumption and population aging is negative.

Wilson (2000) used time series data of Canada from 1877 to 1988 to analyze the effect that population structure has on saving rate. Wilson used an error-correction model regression and the results showed that the population aging had positive effect on saving rate. Therefore, the relationship between people’s consumption and population aging is negative.
Li and Shen (2013) studied the relationship between consumption and population aging in China. They used panel data of Chinese provinces from 1997 to 2007 and fixed effect model, and found population aging has negative effect to per capita consumption.

**Indeterminate effects of population aging on resident’s consumption:**

While the above studies showed either positive or negative relationships between demographic change and per capita consumption, the following articles show inconclusive results. Karry (2000) used panel data of Chinese provinces from 1978 to 1989 to analyze the Chinese saving rates change. He included GDP per capita, real interest rate, inflation and old dependency rate as independent variables. The results show the old-age dependency ratio’s coefficient was negative but not significant, which suggests that saving rates in China do not correlate with the old-age dependency ratio. Moreover, saving rates directly affect consumption. Karry argued that population aging is not the reason for low consumption rate.

Horioka and Wan (2006) also applied the Life-cycle model to a panel data of Chinese provinces from 1995-2004. Using the generalized method of moments (GMM), they found that the coefficient of old-age dependency ratio was insignificant. As we know, the consumption will change after the saving rates change; therefore, the relationship between population aging and consumption is indeterminate.

Finally, Li et al. (2008) studied the effects of population age structure in China on resident’s consumption. They use panel data of Chinese provinces from 1989 to 2004 reduced form function, and dynamic GMM to estimate the relationship between Chinese population structure and per capita consumption. In this study, the coefficient of the old-
age dependency ratio was not significant. Thus, they argued that population aging is not
the reason for low consumption rate.

The above studies provide a range of examples from numerous countries, with no
consensus on the relationship between demographic dependency ratios, household
savings, and per capita consumption rates. Thus, this paper will take up the challenge of
examining this question further in China, where the demographic effects of population
aging will be acutely felt in the coming decades.

The studies of the impact of population aging on consumption has both micro- and
macro-effects. In terms of macro effects, Culter et al. studied the relationship per capita
consumption, labor and population aging index. For micro effects, has Modigliani’s
“Life-cycle hypothesis” studying different life stages consumption behavior.

From the literature review, independent variables used these studies are almost all saving
rates, individual consumption rates, and old-age dependency ratios. The majority of the
literature is based on fixed consumption theory, regression models are used to study the
relationship between population age structure and consumption. However, throughout
the research as a whole on consumption and population age structure, and independent
of what of data and econometric methods, the results are not reconciled between positive,
negative or indeterminate impacts.

This report uses a reduced form function not based on one fixed consumption function,
as different consumption theories have different hypothesis, and China’s national
conditions are complex. Consumption can be affected by many factors, such as interest
rates.
This report uses provincial panel data running fixed effect regression and random effect regression, including unit root tests for each variables and the Hausman test to determine appropriateness of the random effect model. The primary explanatory variable is real per capita consumption, with the old-age dependency ratio used as a measure of population aging. This report is not able to use real per capita consumption, but instead uses the growth rate of real per capita consumption, as real per capita consumption fails the unit roots test.

The political, economy and sociality aspects of China have obvious development and change after China’s reform and opening policy. Comparing with the above literature’s data time selected (e.g. 1978-1989, 1989-2004), this report select panel data of China from 1997-2014. Because a large proportion of the data from 1949 to 1977 are missing and not exact; while China began economic reforms and opening up policies in 1978, until 1997 the Chinese government still issued some policies that influenced China’s economy. For instance, Deng’s South Talk in 1992 that further affirmed China’s economic policy; in 1997, Chongqing as a municipality separated from Sichuan province and the return of Hong Kong to China. Therefore, we use provincial panel data of China from 1997-2014.

III. Data and Methodology

This report focuses on demographic change, consumption, and savings in China between the years 1997 and 2014. The report uses provincial panel data from 1997 to 2014 for 30 China provinces to test the correlation between demographic factors and per capita consumption rates.
The methodology for this analysis follows several steps. First, HT unit root tests were performed to determine whether all variables follow a unit root process. Second, fixed effect and random effect regressions were run along with a Hausman test to determine which model is more appropriate in estimating the relationship between the dependent variable and independent variables. Dummy variables for the years 2005 and 2009 were included to test for how the economic events of these two years influenced the real per capita consumption.

3.1 Data

The data were collected from several sources including the China Statistics Year Book, China Population and Employment Statistics Year Book, the World Bank, and the Chinese “Wind Info” (Statistics China 2016a; 2016b; World Bank 2016; China Securities Regulatory Commission 2016). The total number of data points is 6480 and the total number of observations is 540, which include 18 years’ (1997-2014) of observations for every province.

The data set includes real per capita consumption (RPCC), real per capita income (RPCI), old-age dependency ratio (OADR), youth dependency ratio (YADR), ratio of high school and higher education level (RHH), unemployment rate (RUR), real per capita investment (RPCIV), real interest rate (RIR), Shanghai composite index (SCI), bond rate of China treasury (BRCT) and dummy variables for 2005 and 2009 (Y2005, Y2009).

The data from 1997 to 2014 were selected for this study for the following reasons: 1) a large proportion of the data from 1949 to 1977 are missing. 2) while China began
economic reforms and opening up policies in 1978, until 1997 the Chinese government still issued some policies that influenced the makeup of the Provinces, which had impacts on the accuracy of the statistics. For example, in 1997, Chongqing as a municipality separated from Sichuan province.

China Statistic Year Book is published by Chinese National Bureau of Statistics, which documents China’s economic and social development indicators. This yearly release records the last year’s economic and social statistical data of the whole country, every province, autonomous regions, and municipalities. China Statistic Year Book is the most comprehensive and the most reliable statistical year book for China.

The China Population and Employment Statistics Year Book is an additional publication from the Chinese National Bureau of Statistics, which fully reflects China’s population and employment status. An annual year-book, the China Population and Employment Statistics Year Book documents the last year’s population and employment statistical data for the whole country, every province, autonomous region, and municipalities. In addition, this publication records data for some other counties and regions of the world. China Population and Employment Statistics Year Book has eight parts: comprehensive data, the main labor force sample survey data, employees in urban unit statistics, the national statistical population census register data, the National Family Planning statistical population data, international and regional parts of the world population, employment statistics and changes in population and labor force survey system description, and main statistics indicators.
The World Bank indicators system includes data from the United Nations system and international financial institutions which provide loans for developing countries, and also provides a number of economic and financial data.

The Chinese “Wind Info” was approved by the China Securities Regulatory Commission and is the most comprehensive and powerful tool for financial professionals who need the most complete information on Chinese stocks, bonds, funds, futures, RMB rates and the economy.

**3.1.1 Variables Selected**

The real per capita consumption rate (RPCC) is the primary dependent variable for this research, and is used to model the consumption levels for Chinese Provinces. The China Statistics Year Book directly listed the normal per capita consumption of Chinese currency (Yuan) and the total urban and rural population from 1997-2012 (China Statistics Year Book provided normal per capita consumption for every province from 2013-2014). The consumer price index (CPI) was provided by China Statistics Year Book for every province of China in every year from 1997-2014. The normal per capita consumption for every province for every year (1997-2012) was calculated as the weighted average of normal per capita consumption of urban and rural to population via the ratio of urban and rural. This study uses 1997 CPI as the base period, and normal per capita consumption over the CPI for calculating real per capita consumption.

While, other authors such as Ai, Xu & Li (2008) use the logarithm of real GDP as the proxy variable of real per capita consumption. Instead, this study uses real per capita consumption as a dependent variable. The reason for this choice is because Keynesian
theory of consumption suggests that the consumption function is: \( C_t = a + b \times Y_t \), where C means total consumption, Y means total income and t means period, a and b means parameters.

The real per capita income (RPCI), as opposed to real per capita consumption, is the explanatory variable for this research, used to measure income levels for China. The China Statistics Year Book directly listed the normal per capita income of Chinese currency (Yuan) and population of urban and rural from 1997-2012 (China Statistics Year Book provided normal per capita income for every province from 2013-2014), Consumer price index for every province of China in every year from 1997-2014. The normal per capita income for every province for every year (1997-2012) was calculated by weighted average of normal per capita income of urban and rural to population ration of urban and rural.

The two demographic factors that will be used are the old-age dependency ratio and youth dependency ratio. All variables are directly collected from China Population and Employment Statistics Year Book.

The old-age dependency ratio (OADR) is the variable of interest in this research. This demographic measure is the ratio of the population who are 65 years and over to the working population between 15 and 64 years old. The youth dependency ratio (YADR) is the ratio of the population between 0 and 14 years old to the working-age population between 15 and 64 years old.

In addition to these three demographic variables, we also include other explanatory variables including the ratio of high school and higher education levels for the adult population (RHH), registered unemployment rate (RNR), the real per capita investment
(RPCIV), real interest rate (RIT), Shanghai composite index (SCI,) and bond rate of China treasury bills (BRCT). These variables were selected based on previous empirical studies on the relationship between aging and consumption.

The ratio of high school and higher education level (RHH) is calculated by the population in high school, college and university divided by the population aged 6 and over, in every province from 1997-2014, which was from the China Population and Employment Statistics Year Book. The rationale for including this variable is due to Li & Shen (2013) who argued that education levels would impact people’s consumption when they analyzed the relationship between people’s consumption and population aging of China.

The registered unemployment rate (RNR) taken from China Population and Employment Statistics Year Book was included in this student because Li & Shen (2013) argued that unemployment would influence people’s consumption.

Real per capita investment (RPCIV) was calculated by per capita investment per region from 1997-2014 divided by the CPI by region from 1997-2014; normal per capita investment by region was calculated by gross capital formation for every province from 1997-2014 over the population at year-end by region from 1997-2014. The gross capital formation by region and population at year-end by region from 1997-2014 was directly given by China Statistics Year Book. This variable is included in this study based on Liang (2008) who argued investment and consumption influenced each other.

Following Ai, Xu & Li (2008), the real interest rate (RIR) of China from World Bank was included in this student RIT is same for all provinces included in this study.
The Shanghai composite index (SCI) is from the Chinese “Wind Database” which is also the same for all provinces. The closing index of December 31st for each year is selected as the SCI in this study. This variables was selected as Lettau & Ludvigson (2001) argued that the stock index would influence aggregate consumption.

The bond rate for the Chinese treasury (BRCT) was calculated using the three-year average bond rate, which is from the Wind Database. This variable is included since Lettau & Ludvigson (2001) argue that the treasury bill rate can influence aggregate consumption.

Finally, as explained before two year-dummy variables Y2005 and Y2009 are used to capture the effects of China entering into World Trade Organization and the global financial crisis respectively. China’s accession to the WTO in 2001, with the transition period effects beginning to show in 2004. Then we lagged real per capita consumption, so we choice 2005 as a dummy variable.

The growth rate of real per capita consumption is used as the dependent variable. The growth rate of real per capita income and the growth rate of real per capita investment are used independent variables to eliminate the unit root of those level variables, which will be explained in the methodology below.

3.2 Methodology

3.2.1 Unit Root tests

Panel data plays an important role in the analysis of economic model. However, non-stationary panel data may lead to spurious regressions and misleading statistical inference. Before we proceed to regression analysis, we need to do unit root test for all
the variables selected in this study. If the variables are found to have a unit root, we need to take measures such as logarithmic transformation, differencing, or a combination of the two to make the series stable. In this study, the HT unit root test (Harris and Tzavalis, 1999) is used to determine if the variables are stationary due to the relatively shorter time period of the our panel data. Other panel unit root tests include LLC test (Lin and Chu, 2002), Breitung test (Breitung, 2000), IPS test (Im, Pesaran and Shin, 2003), Fisher type test (Choi, 2001) and Hadri LM test (Hadri, 2000), those unit root tests require long panel data.

**Table 1: The results of HT unit root tests**

<table>
<thead>
<tr>
<th>Variables</th>
<th>P-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>real per capita consumption</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Growth rate of real per capita consumption</td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>real per capita income</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Growth rate of real per capita income</td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>Young age dependency ratio</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Old-age dependency ratio</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Ratio of high school and higher education level</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Register unemployment rate</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>real per capita investment</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Growth rate of real per capita investment</td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Shanghai composite index</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Bond rate of China treasury</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>
The $P$-values in the middle of Table 1 is the HT unit root tests results for variables real per capita consumption, real per capita income, young age dependency ratio, old-age dependency ratio, ratio of high school and higher education level, register unemployment rate, real per capita investment, real interest rate, Shanghai composite index and bond rate of China treasury. The $P$-values in the right of Table 1 is the HT unit root tests results for variables growth rate of real per capita consumption, growth rate of real per capita income and growth rate of real per capita investment.

The HT unit root tests’ results show the variables old-age dependency ratio, young age dependency ratio, ratio of high school and higher education level, register unemployment rate, real interest rate, Shanghai composite index and bond rate of China treasury are stationary variables.

However, the real per capita consumption (RPCC), real per capita income (RPCI) and real per capita investment (RPCIV) are non-stationary variables while all other variables tested are stationary. To deal with this problem, we did logarithmic first order differences follows:

\[
\ln(RPCC_t) - \ln(RPCC_{t-1}) = \ln\left(\frac{RPCC_t}{RPCC_{t-1}}\right) = \ln\left(\frac{RPCC_t - RPCC_{t-1}}{RPCC_{t-1}}\right) = \ln\left(1 + \frac{\Delta RPCC}{RPCC_{t-1}}\right) \sim \frac{\Delta RPCC}{RPCC_{t-1}}
\]

\[
\ln(RPCI_t) - \ln(RPCI_{t-1}) = \ln\left(\frac{RPCI_t}{RPCI_{t-1}}\right) = \ln\left(\frac{RPCI_t - RPCI_{t-1}}{RPCI_{t-1}}\right) = \ln\left(1 + \frac{\Delta RPCI}{RPCI_{t-1}}\right) \sim \frac{\Delta RPCI}{RPCI_{t-1}}
\]
\[
\ln R_{PCIV_t} - \ln R_{PCIV_{t-1}} = \ln \frac{R_{PCIV_t}}{R_{PCIV_{t-1}}} = \ln \frac{R_{PCIV_t} + R_{PCIV_t} - R_{PCIV_{t-1}}}{R_{PCIV_{t-1}}}
\]

\[
= \ln(\frac{R_{PCIV_{t-1}}}{R_{PCIV_{t-1}}} + \frac{R_{PCIV_t} - R_{PCIV_{t-1}}}{R_{PCIV_{t-1}}})
\]

\[
= \ln (1 + \frac{\Delta R_{PCIV}}{R_{PCIV_{t-1}}}) \sim \frac{\Delta R_{PCIV}}{R_{PCIV_{t-1}}}
\]

In the end, we use the growth rate of real per capita consumption \(\frac{\Delta R_{PCCC}}{R_{PCCC_{t-1}}}(DRPCC)\), the growth rate of real per capita income \(\frac{\Delta R_{PCI}}{R_{PCI_{t-1}}}(DRPCI)\) and growth rate of real per capita investment \(\frac{\Delta R_{PCIN}}{R_{PCIN_{t-1}}}(DRPCIN)\) in our regression analysis.

The growth rate of real per capita consumption, growth rate of real per capita income and growth rate of real per capita investment became stationary variables.

### 3.2.2 Fixed effect Vs. Random effect models

Following Ai, Xu & Li (2008), we use a reduced-form model for analyzing the relationship between per capita consumption and population aging. Reduced form model is not dependent on a specific consumption function, which is better for us because different consumption functions are based upon different assumption. For example, Hall (1978) holds that young aged people aged between 0-14 years old, labor force people aged between 15-64 years old, and old-age people who aged 65 and older have the same consumption and saving behaviors. Conversely, Modigliani and Brumberg (1954)’s Life-cycle hypothesis assumes young aged people aged between 0-14 years old, labor force people aged between 15-64 years old and old-age people aged 65 and older have different consumption and saving behavior. Furthermore, due to
policies changes and external shocks, people’s consumptions may not be stable (Ai, Xu & Li, 2008).

The general model for panel data set is:

\[ y_{it} = x_{it} \beta + u_{it} \]  

(1)

\( t = 1, 2, ..., T, \) and \( i = 1, 2, ..., I, \) where \( y_{it} \) are dependent variables and \( x_{it} \) are independent variables. The variables \( u_{it} \) are the residuals of the model.

When including an time-invariant unobserved effect \( \alpha_i \) in the equation (1), \( \alpha_i \) denotes unobserved individual heterogeneity, for instance geographic location, we get the so-called fixed effect model:

\[ y_{it} = \beta x_{it} + \alpha_i + u_{it} \]  

(2)

For each \( i \), taking the average over \( t \) in equation (2), we get:

\[ \bar{y}_i = \beta \bar{x}_i + \alpha_i + \bar{u}_i \]  

(3)

Where \( \bar{y}_i = \frac{1}{T} \sum_{t=1}^{T} y_{it}, \bar{x}_i = \frac{1}{T} \sum_{t=1}^{T} x_{it}, \bar{u}_i = \frac{1}{T} \sum_{t=1}^{T} u_{it} \). Subtracting (3) from (2), we get:

\[ y_{it} - \bar{y}_i = \beta (x_{it} - \bar{x}_i) + \alpha_i - \alpha_i + u_{it} - \bar{u}_i \]

or

\[ \tilde{y}_{it} = \bar{y}_{it} \]

\[ \tilde{x}_{it} = x_{it} - \bar{x}_i \]

and \( \tilde{u}_{it} = u_{it} - \bar{u}_i \) are the demeaning variables. We remove time-invariant variables from the model to eliminate omitted variable bias.

For the random effect model, the general equation of random model is:

\[ y_{it} = \beta_0 + \beta_1 x_{i1t} + \cdots + \beta_k x_{ikt} + \gamma_i + v_{it} \]  

(5)
where $y_{it}$ and $x_{ij}$ are dependent variables and independent variables for observation $i$ in time $t$, $v_{it}$ are the residuals of the model and $\gamma_i$ is unobserved individual heterogeneity, $v_{it}$ is uncorrelated with $\gamma_i$.

If we assume $\text{COV}(x_{ij}, \gamma_i) = 0, t = 1, 2, ..., T; j = 1, 2, ..., k$, then the equation (5) is a random effects model.

When we define the composite error term as $\delta_{it} = \gamma_i + v_{it}$, then we can write (5) as

$$y_{it} = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_k x_{ik} + \delta_{it}$$

Because $\gamma_i$ is in the composite error in every time period, the $\delta_{it}$ are serially correlated across time.

When we define $\lambda = 1 - \left[\frac{\sigma_e^2}{\sigma^2 + T \sigma^2_f}\right]^{\frac{1}{2}}$, which is between 0 and 1, the transformed equation to become:

$$y_{it} - \lambda \bar{y}_i = \beta_0 (1 - \lambda) + \beta_1 (x_{i1} - \lambda \bar{x}_1) + \cdots + \beta_k (x_{ik} - \lambda \bar{x}_k) + (\delta_{it} - \lambda \delta_i) \tag{7}$$

Where $\bar{y}_i = T^{-1} \sum_{t=1}^{T} y_{it}$, $\bar{x}_i = T^{-1} \sum_{t=1}^{T} x_{it}$, $\bar{u}_i = T^{-1} \sum_{t=1}^{T} u_{it}$.

The fixed effect model for our study is:

$$\text{DRPCC}_{it} = \beta_1 \text{DRPCI}_{it} + \beta_2 \text{OADR}_{it} + \beta_3 \text{YADR}_{it} + \beta_4 \text{RHH}_{it} + \beta_5 \text{RUR}_{it}$$

$$+ \beta_6 \text{DRPCIV}_{it} + \beta_7 \text{RIR}_{it} + \beta_8 \text{SCI}_{it} + \beta_9 \text{BRCT}_{it} + \beta_{10} y_{2005}$$

$$+ \beta_{11} y_{2009} + \gamma_i + u_{it}$$

And

The random effect model for our study is:

$$\text{DRPCC}_{it} = \beta_1 \text{DRPCI}_{it} + \beta_2 \text{OADR}_{it} + \beta_3 \text{YADR}_{it} + \beta_4 \text{RHH}_{it} + \beta_5 \text{RUR}_{it}$$

$$+ \beta_6 \text{DRPCIV}_{it} + \beta_7 \text{RIR}_{it} + \beta_8 \text{SCI}_{it} + \beta_9 \text{BRCT}_{it} + \beta_{10} y_{2005}$$

$$+ \beta_{11} y_{2009} + \gamma_i + v_{it}$$
Where: $DRPCC_{it} =$ real per capita consumption growth rate in province i and year t,
$DRPCI_{it} =$ real per capita income growth rate in province i and year t,
$YADR_{it} =$ young age dependency ratio in province i and year t,
$RHH_{it} =$ ratio of high school and higher education level in province i and year t,
$RUR_{it} =$ registered unemployment rate in province i and year t,
$DRPCIV_{it} =$ real per capita investment growth rate in province i and year t,
$RIR_{it} =$ real interest rate in province i and year t,
$SCI_{it} =$ Shanghai composite index in province i and year t,
$BRCT_{it} =$ bond rate of China treasury in province i and year t,
$y_{2005} =$ dummy variable for 2005,
$y_{2009} =$ dummy variable for 2009.

$\alpha_i, \gamma_i =$ unobserved time-invariant individual specific effects in province i, $u_{it}, v_{it} =$ error terms of model in province i and year t.

### 3.2.3 Hausman test

Hausman test can tell us if should we use fixed effect model or random effect model. If the Hausman test rejects the hypothesis: $COV(x_{itj}, \gamma_i) = 0$, then we need to do random effect regression. If we cannot reject $COV(x_{itj}, \gamma_i) = 0$ then we should use the FE estimates to reduce the omitted variable bias. The Hausman test is conducted for several specifications in this study. In each specification, the hypothesis that $COV(x_{itj}, \gamma_i) = 0$ can not be rejected. Therefore, the fix effect models are estimated. Results are report in the next section.
Table 2: Hausman test results

<table>
<thead>
<tr>
<th></th>
<th>Without dummy variables</th>
<th>With dummy variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H₀</strong>: fixed effect estimates and random effect estimates are not significantly different.</td>
<td>Chi²=25.53</td>
<td>Chi²=27.82</td>
</tr>
<tr>
<td><strong>H₁</strong>: fixed effect estimates are preferred.</td>
<td>P-value=0.0013</td>
<td>P-value=0.0019</td>
</tr>
</tbody>
</table>

Table 2 shows the Hausman Test results. The P-value of the reduced-form function without year dummy variables is 0.0013, which is less than 0.01, which means we should reject the null hypothesis (H₀) and accept H₁. The P-value of the reduced-form function without year dummy variables is 0.0019, which is less than 0.01, which means we should reject the null hypothesis (H₀) and accept H₁. Thus, based on the Hausman test results, we should run fixed effect regression for all functions.
IV. Results

Table 3 presents the summary statistics of all the variables used in this study. The total number of observations are 540, except the growth rate of real per capita consumption, growth rate of real per capita income, and growth rate of real per capita investment. As we did logarithmic and taking first-difference for eliminating unit root, we lost 30 observations. Note all variables are measured in %, except for Shanghai composite index, which uses points. The growth rate of real per capita consumption’s minimum and maximum variables are -0.155 and 0.168, respectively; the mean variable is 0.036. The growth rate of real per capita income’s minimum and maximum variables are -0.062 and 0.126, respectively; the mean is 0.039.

The minimum and maximum variables of old-age dependency ratio are 6.145 and 21.877, respectively. The mean variable of old-age dependency ratio is 11.744. Young age dependency ratio’s mean variable is 27.401, minimum variable and maximum variable are 9.646 and 50.095, respectively. Ratio of high school and higher education level’s mean variable is 21.235, minimum variable and maximum variable are 6.142 and 21.877, respectively. Mean variable, minimum and maximum variable of registered unemployment rate are 3.527, 0.600 and 7.400, respectively. Mean variable, minimum and maximum variable of growth rate of real per capita investment are 0.054, -0.067 and 0.195, respectively. Real interest rate’s mean variable, minimum variable and maximum variable are 2.849, -2.320 and 7.310, respectively. Shanghai composite index’s mean variable, minimum variable and maximum variable are 2134.418, 1146.701 and 5261.56, respectively. Bond rate of China treasury’s mean variable, minimum variable and maximum variable are 4.288, 2.208 and 9.180, respectively.
### Table 3: Summary Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Obs</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate of real per capita consumption</td>
<td>510</td>
<td>0.036</td>
<td>0.035</td>
<td>-0.155</td>
<td>0.168</td>
</tr>
<tr>
<td>Growth rate of real per capita income</td>
<td>510</td>
<td>0.039</td>
<td>0.022</td>
<td>-0.062</td>
<td>0.126</td>
</tr>
<tr>
<td>Young age dependency ratio</td>
<td>540</td>
<td>27.401</td>
<td>8.636</td>
<td>9.646</td>
<td>50.095</td>
</tr>
<tr>
<td>Ratio of high school and higher education level</td>
<td>540</td>
<td>21.235</td>
<td>9.239</td>
<td>6.142</td>
<td>60.043</td>
</tr>
<tr>
<td>Register unemployment rate</td>
<td>540</td>
<td>3.527</td>
<td>0.792</td>
<td>0.600</td>
<td>7.400</td>
</tr>
<tr>
<td>Growth rate of real per capita investment</td>
<td>510</td>
<td>0.054</td>
<td>0.039</td>
<td>-0.067</td>
<td>0.195</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>540</td>
<td>2.849</td>
<td>2.990</td>
<td>-2.320</td>
<td>7.310</td>
</tr>
<tr>
<td>Shanghai composite index</td>
<td>540</td>
<td>2134.418</td>
<td>1016.749</td>
<td>1146.701</td>
<td>5261.560</td>
</tr>
<tr>
<td>Bond rate of China treasury</td>
<td>540</td>
<td>4.288</td>
<td>1.753</td>
<td>2.208</td>
<td>9.180</td>
</tr>
<tr>
<td>Y2005</td>
<td>540</td>
<td>0.056</td>
<td>0.229</td>
<td>0.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Y2009</td>
<td>540</td>
<td>0.056</td>
<td>0.229</td>
<td>0.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Hausman tests results show we should reject random effect model and run fixed effect model. Therefore, this report listed the results of fixed effect regression model for studying the impact of population aging on growth rate of real per capita consumption. Furthermore, fixed effect regression model can effectively solve endogenous problem when there are missing explanatory variables that are correlated with the error term.
## Table 4: Fixed effect regression results (1997-2014)

<table>
<thead>
<tr>
<th>Independent variables:</th>
<th>Coef</th>
<th>Robust Std Err</th>
<th>P-values</th>
<th>95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth rate of real per capita income</td>
<td>0.699***</td>
<td>0.096</td>
<td>&lt; 0.01</td>
<td>[0.503, 0.895]</td>
</tr>
<tr>
<td><strong>Old-age dependency ratio</strong></td>
<td>0.255***</td>
<td>0.086</td>
<td>0.006</td>
<td>[0.078, 0.431]</td>
</tr>
<tr>
<td>Young age dependency ratio</td>
<td>0.022</td>
<td>0.04</td>
<td>0.577</td>
<td>[-0.059, 0.104]</td>
</tr>
<tr>
<td>Ratio of high school and higher edu level</td>
<td>0.164***</td>
<td>0.041</td>
<td>&lt; 0.01</td>
<td>[0.08, 0.247]</td>
</tr>
<tr>
<td>Register unemployment rate</td>
<td>-0.076</td>
<td>0.189</td>
<td>0.691</td>
<td>[-0.463, 0.311]</td>
</tr>
<tr>
<td>Growth rate of real per capita investment</td>
<td>0.006</td>
<td>0.042</td>
<td>0.892</td>
<td>[-0.08, 0.091]</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>-0.337***</td>
<td>0.034</td>
<td>&lt; 0.01</td>
<td>[-0.407, -0.267]</td>
</tr>
<tr>
<td>Shanghai composite index</td>
<td>0.000***</td>
<td>0</td>
<td>&lt; 0.01</td>
<td>[0, 0]</td>
</tr>
<tr>
<td>Bond rate of China treasury</td>
<td>0.323***</td>
<td>0.075</td>
<td>&lt; 0.01</td>
<td>[0.169, 0.477]</td>
</tr>
<tr>
<td>Adjusted R2</td>
<td>0.377</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Observations</td>
<td>510</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: ***indicates significance at the 1% confidence level, **at 5% and *at 10%.

Table 4 shows that the coefficient of growth rate of real per capita income is statistically significant at the 1% level, and is positively correlated with growth rate of real per capita consumption, with an adjusted R squared of 0.3770. This shows that as the growth rate of real per capita income increases by 1%, the growth rate of real per capita consumption increases by 0.7%, holding other variables constant. As old-age
dependency ratio increases by 1%, the growth rate of real per capita consumption increases by 0.25%, holding other variables constant. The youth dependency ratio is positively correlated with the growth rate of real per capita consumption, but it is not statistically significant. The estimates further indicate that the ratio of high school and higher education levels are positively correlated with the growth rate of real per capita consumption and statistically significant at the 1% level. Thus, by increasing 1% in the proportion of people with high school and higher education level, the growth rate of per capita consumption will increase 0.16%, holding other variables constant. Not surprisingly, the registered unemployment rate is negatively correlated with growth rate of real per capita consumption albeit insignificant. The growth rate in real per capita investment is positively correlated with growth rate of real per capita consumption, but not significant. The coefficient of the real interest rate is statistically significant at the 1% level and is negatively correlated with the growth rate of real per capita consumption. As the real interest rate increases 1%, the growth rate of real per capita consumption decreases 0.34%, holding other variables constant. The coefficient of Shanghai composite index is statistically significant at 1% level and is negatively correlated with growth rate of real per capita consumption. This indicates that for every 1000 points the Shanghai composite index increases, the growth rate of real per capita consumption will increase 0.013%, holding other variables constant. Clearly, the influence of Shanghai composite index is not very strong. Finally, the bond rate of the Chinese treasury is positively correlated with the growth rate in real per capita consumption, and is statistically significant at the 1% level. This shows that the growth rate of real per capita consumption
consumption increases 0.32% if the bond rate of China treasury increases 1%, holding other variables constant.

**Table 5: Fixed effect regression results (1997-2014), include year dummy variables**

<table>
<thead>
<tr>
<th>Dependent variable: Growth rate of real per capita consumption</th>
<th>Coef</th>
<th>Robust Std Err</th>
<th>P-values</th>
<th>95% Conf. Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variables:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth rate of real per capita income</td>
<td>0.650***</td>
<td>0.099</td>
<td>&lt; 0.01</td>
<td>[0.447, 0.853]</td>
</tr>
<tr>
<td>Old-age dependency ratio</td>
<td>0.216***</td>
<td>0.067</td>
<td>0.003</td>
<td>[0.079, 0.353]</td>
</tr>
<tr>
<td>Young age dependency ratio</td>
<td>-0.033</td>
<td>0.044</td>
<td>0.451</td>
<td>[-0.122, 0.056]</td>
</tr>
<tr>
<td>Ratio of high school and higher edu level</td>
<td>0.129***</td>
<td>0.045</td>
<td>0.007</td>
<td>[0.038, 0.221]</td>
</tr>
<tr>
<td>Register unemployment rate</td>
<td>-0.148</td>
<td>0.18</td>
<td>0.416</td>
<td>[-0.515, 0.219]</td>
</tr>
<tr>
<td>Growth rate of real per capita investment</td>
<td>0.015</td>
<td>0.041</td>
<td>0.722</td>
<td>[-0.07, 0.099]</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>-0.217***</td>
<td>0.046</td>
<td>&lt; 0.01</td>
<td>[-0.312, -0.122]</td>
</tr>
<tr>
<td>Shanghai composite index</td>
<td>0.000***</td>
<td>0</td>
<td>&lt; 0.01</td>
<td>[0, 0]</td>
</tr>
<tr>
<td>Bond rate of China treasury</td>
<td>0.312***</td>
<td>0.074</td>
<td>&lt; 0.01</td>
<td>[0.16, 0.463]</td>
</tr>
<tr>
<td>Y2005</td>
<td>0.034***</td>
<td>0.004</td>
<td>&lt; 0.01</td>
<td>[0.026, 0.042]</td>
</tr>
<tr>
<td>Y2009</td>
<td>-0.022***</td>
<td>0.003</td>
<td>&lt; 0.01</td>
<td>[-0.029, -0.015]</td>
</tr>
<tr>
<td>Adjusted R2</td>
<td>0.4368</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Observations</td>
<td>510</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: ***indicates significance at the 1% confidence level, **at 5% and *at 10%.
Table 5 shows the regression results after adding year 2005 and 2009 dummy variables. As expected, with the additional variables there is an improvement in model fit with an adjusted R square of 0.4368. The regression results in table 5 show that the coefficient of the growth rate in real per capita income is statistically significant at the 1% level, and is positively correlated with growth rate of real per capita consumption. This shows that as the growth rate in real per capita income increases by 1%, the growth rate of real per capita consumption increases by 0.7%, holding other variables constant. The coefficient for the old-age dependency ratio is statistically significant at the 1% level, and is positively correlated with growth rate of real per capita consumption: as the old-age dependency ratio increases by 1%, the growth rate of real per capita consumption increases by 0.22%, holding other variables constant. As with the other models, the youth age dependency ratio is positively correlated with growth rate of real per capita consumption but it is not significant. The estimates indicate that the ratio of high school and higher education level are positively correlated with the growth rate of real per capita consumption; and, the coefficient is statistically significant at 1% level. By increasing 1% high school and higher education level, the growth rate of per capita consumption will increase by 0.13%, holding other variables constant. The registered unemployment rate is negatively correlated with growth rate of real per capita consumption but the coefficient is not significant. The growth rate of real per capita investment is positively correlated with growth rate of real per capita consumption but the coefficient of it is not significant. The coefficient for the real interest rate is statistically significant at the 1% level and it is negatively correlated with growth rate of real per capita consumption. As the real interest rate increases by 1%, the growth rate of
real per capita consumption decreases by 0.22%, holding other variables constant. The coefficient of Shanghai composite index is statistically significant at the 1% level is negatively correlated with growth rate of real per capita consumption. Shanghai composite index increases 1000 points, which will decrease by 0.0095% for growth rate of real per capita consumption, holding other variables constant, however the influence of Shanghai composite index is not very strong. The bond rate of the Chinese treasury is positively correlated with the growth rate in real per capita consumption, and is statistically significant at the 1% level. The growth rate of real per capita consumption will increase by 0.31% as the bond rate of China treasury increases 1%, holding other variables constant. The year 2005 dummy variable is positively correlated with the growth rate of real per capita consumption and is statistically significant at the 1% level. Growth rate of real per capita consumption increases by 0.034% more than other years in 2005, holding other variables constant. This results suggests that access to the WTO has had a positive influence on per capita consumption. Conversely, the growth rate of real per capita consumption decreases by 0.022% more in 2009 than in other years, holding other variables constant, which is indicates that the global financial crisis had negative influence on per capita consumption.

In comparing table 4 and table 5 whether including year dummy variables or not, it is clear that the old-age dependency ratio can influence per capita consumption. The growth rate of real per capita consumption will increase if old-age dependency ratio increase. The results show that the youth dependency ratio has no obvious influence on per capita consumption. The old-age dependency ratio’s coefficient in table 4 is larger than old-age dependency ratio’s coefficient in table 5.
Finally, China’s entry into the WTO and the global financial crisis were found to be positively and negatively correlated with growth rate of real per capita consumption, respectively.

V. Conclusions and Policy Suggestions

1. Conclusions

This report used provincial panel data from 30 Chinese provinces from 1997-2014 and fixed effect models for analyzing the impact of Chinese population aging (old-age dependency ratio) on per capita consumption. The report also studied the relationship between per capita consumption and demographic factors including the youth age dependency ratios. Moreover, this report includes other economic variables, such as the growth rate of real per capita income, the ratio of high school and higher education levels, registered unemployment rate, growth rate of real per capita investment, real interest rate, Shanghai composite index, and the bond rate of the Chinese treasury, all of which may influence per capita consumption. In addition, models were included that include dummy variables for the entry into the WTO (2005) and the global financial crisis (2009).

The results show that China’s population aging has positive impacts on per capita consumption. In comparing table 4 and table 5, table 5 includes two year dummy variables Y2005 and Y2009, the other variables in table 4 and table 5 are same, such as growth rate of real per capita income, old-age dependency ratio, young age dependency ratio, ratio of high school and higher education level, register unemployment rate, real per capita investment, growth rate of real interest rate, Shanghai composite index, bond
rate of China treasury. Growth rate of real per capita consumption increases 0.25% if old-age dependency ratio increases 1%, holding other variables constant (table 4).

Growth rate of real per capita consumption increases 0.22% if old-age dependency ratio increases 1%, holding other variables constant (table 5).

From the results presented in this report, the old-age dependency ratio has a positive relationship with the growth rate of real per capita consumption, which is same conclusion as Modigliani and Brumberg (1954), Leland (1968), Leff (1969), Weil(1999), and Wang (2004). From this, we conclude that population aging is not the reason that why China’s low resident consumption. The reasons why population aging can increase per capita consumption may be that elderly people’s consumption attitudes change over time and that their consumption habits change with increased consumption of entertainment culture, housing, and medical insurance.

Moreover, the regression estimates presented in report show that the internal policy and external shock of previous years can influence resident’s consumption. In 2005, China’s growth rate of real per capita consumption increased 0.034% more than other years, holding other variables constant, after China accessed to the WTO and passed the transition period. In 2009, China’s growth rate of real per capita consumption decreased 0.02% more than other years, holding other variables constant, under the influence of the global financial crisis.

2. Policy suggestion

Given the results that China’s population aging has a positive impact on growth rate of real per capita consumption, we expect to see rising consumption with aging population
in China. However, to promote continued economic growth, some polices should be put in place for stimulating and retaining old-age people’s consumption.

An additional policy suggestion is to decrease old-age people’s uncertainty of future life through improved social security system and, to facilitate a goods and services market directed at older persons.

1. Facilitate the development of goods related to older people. Many goods are catered to younger people (technology, vehicles, household goods, or fashion). Aiding the developing of high quality goods for older people could help stimulate consumption for people in these age groups. Additionally, health care technologies should be developed that cater to an aging population. This includes technologies that can assist in increasing the quality of life for older peoples, while stimulating consumption of high value-added goods.

2. Developing leisure consumption market catered to older people. Old-age people have more leisure time, but China’s entertainment places of old-age people are not perfect. Policies for older people can include the development of tourist industries, or mandating the inclusion of older people in domestic tourism. This would allow for older people to travel and thus increase their consumption.

3. Improved social security system. These policies would improve social insurance and medical insurance, which can reduce uncertainty in the later lifecycle. As such, people may increase their consumption due to increased willingness to spend given improved social security.

This report has some limitations. In terms of data, although coming from the Chinese government year book, there are still some problems. For example, Different methods
were used in different year books. Year books from 1998 to 2013 only included every provinces’ urban residents’ consumption and rural residents’ consumption from 1997 to 2012, but the year book from 2014 to 2015 included every provinces’ residents’ consumption from 2013 to 2014. This report calculated every province’s residents’ per capita consumption, per capita income and per capita investment by weighted average from 1997-2012. The real per capita investment was calculated based on every year’s provincial GDP since the year books contained no resident’s direct investment data. The results on the coefficient of growth rate of real per capita investment may not be reliable.

The registered unemployment rate is another data problem; the unemployment rate is calculated as follows: the proportion of the end of every year’s urban registered unemployment population divided by the sum of the end of every year’s urban registered employment population and urban real registered unemployed population, which does not include the rural unemployment population. China’s year books do not record information about the rural unemployment population. Therefore, the data on unemployment rates for urban and rural combined were used as approximate measures.

The insignificant coefficient estimates of registered unemployment rate of table 4 and table 5 could be due to the inaccurate measure of the unemployment rates.

On the econometric side, the adjusted R-squared is not very high. The reason may be attributed to missing explanatory variables that can directly influence people’s consumption, which will cause biased estimates. For instance: location, some people live in big and rich city, those people’s income and consumption will be higher. Gender, male and female has different concept. People’s social status, businessman, government
officer and regular people has different consumption concept. Unequal distribution of income in China, people’s income is high in some regions and low in others.
VI. References


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