The Impact of Population Aging on Residents' Consumption

The case of China
Abstract

The purpose of this paper is to examine the impact of population ageing on consumption. We chose to put our focus on China as it is a rapidly growing economy and has the largest elderly population in the world that since 2000 has been classified as having an aging population. To continue analyzing the effect an ageing population has, we used our collected panel data from different regions in China to make fixed effect model. The results show that the age structure has an important role in China's per capita consumption and the current situation in China is that an ageing population will inhibit the consumption of the population. we put forward some suggestions to increase residents' consumption demand in the context of China's ageing population in the light of empirical analysis.
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1. Introduction

In this section, we introduce the demographic and consumer background of the topic of this paper, on the basis of which the purpose and practical implications of the study are described.

According to the classification criteria established by the United Nations, a country or region in which a population over 65 years of age exceeds 7% of the total population is called an "ageing society (Pham, 2006), which has become a global phenomenon that afflicts many countries.

In our case, China has the largest number of people over the age of 65 in the world, with a population of 168 million in 2020, which represents 11.96% of the total population. By 2050, the percentage of China's population aged 65 and over is expected to increase to 27.6%, while the proportion of people over retirement age will reach 39% of the total population (WorldBank, 2021). Compared to most ageing countries, China's entry into an ageing society is influenced by more complex factors. This is primarily because China implemented a family planning policy of one-child in the 1970s, following which the birth rate continued to decline, combined with an increase in the standard of living of the population and innovations in medical technology, resulting in an increasing overall life expectancy (Leng, 2019). The confluence of these two factors has led to an increasingly serious problem of population ageing. Even after the gradual relaxation of family planning in 2015 and 2021, the two- and three-child policies have been put in place (Goldman, 2021), China will remain an ageing society for a longer period. Also, in terms of characteristics, China's ageing population is large-scale, fast-growing, and has a heavy dependency burden (Feng, et al 2018).

On the economic side, China's economy has continued to grow rapidly since its reform and opening up, with total GDP increasing and surpassing Japan to become the world's second-largest economy in 2010, but Chinese GDP per capita has not yet reached the world average now. Developed countries around the world generally have a GDP per
capita of over $10,000 when they enter an ageing society (Wang, 2021). For example, South Korea and Singapore both entered an ageing society in 2000 with a per capita GDP of $17,380 and $23,356 respectively. In the meantime, China came into an ageing society in 2000, with a GDP per capita of only $946, which was 16 times less than that of South Korea and 22 times less than that of Singapore (WorldBank, 2021). Moreover, China's economic growth has been mainly driven by imports, exports and investment, while consumption has remained at a low level for a long time, and the growth rate of consumption is much lower than the growth rate of GDP (Xu et al, 2010. In 2020, China's final consumption expenditure is at 54% of GDP, which is under the world average and far less than those developed countries where the final consumption rate is at 80% (WorldBank, 2021). The lack of consumption not only affects the total GDP but also the structure of GDP, it makes the country more dependent on investment and exports, thus becoming a very important constraint to sustainable and rapid economic development.

Nevertheless, McKinsey, a management consulting company, believes that China's consumer market has good future prospects and potential for growth through its annual market observations, research and data analysis, etc (Ho et al, 2019). In addition, China has a high level of savings in contrast to low consumption, which represents a shortage of domestic demand in China on the negative side, on the positive side, it also indicates that China's residents still have a lot of room to release their consumption power.

Global awareness of the ageing population issue and the shortage of domestic consumption are two issues that have been the concern of many governments. Overall, the population is the prime driver of social production and residents are the main consumers. In view of the background of changing population structure, to a large extent, it will have an effect on the consumption of the population. According to previous studies, they have not been able to reach a consistent conclusion on the influence of population ageing on consumption. The data from different time periods or different regions can also lead to different conclusions, thus making it difficult for the government to provide policy
guidance accordingly. In this paper, we use data from 31 provinces in China from 2014 to 2020 to construct panel data. The aim of this work is to study the impact of China's ageing population on residents' consumption. This will not only give us a clearer understanding of the relationship between ageing and consumption in China at this stage but also has important implications for how to better develop the economy by releasing the consumption power of residents and solving the problem of under-consumption in the context of China's ageing.

This paper is structured as follows: Section 2 gives literature reviews and theoretical background about population ageing and residents’ consumption. Section 3 includes a description of the data sample we selected. Section 4 describes our sample and the empirical model selected. Section 5 presents the statistics and discussion of the results of the regressions conducted. Section 6 is the conclusion and adds the concluding remarks of the article.
2. Literature Review

This chapter is a literature review, which briefly summarizes some of the theories and literature on the impact of population aging on residents' consumption, and on this basis identifies gaps in existing research and directions for future research.

2.1 Life cycle hypothesis

In economics, the life cycle hypothesis is a theoretical study of the relationship between the changing age structure of the population and consumption. Modigliani & Brumberg (1954) argued that people always expect to maximize the utility of their income and therefore allocate all their lifetime income between consumption and investment. He pointed out that human life can be divided into three periods: youth, adulthood, and old age as the propensity to consume varies across the life cycle for individual consumers. For instance, in the teen years when income is low, consumption may be greater than income. In the prime of life, consumers earn income for their work to society and accumulate wealth during this period, which reduces the tendency to consume less than their income. During old age, consumers rely more on the savings they have accumulated in their youth for their consumption activities, and as there is no pressure in their retirement life, people are more likely to concentrate on consumption, that is, consumption is greater than income.

In addition, they propose a household consumption function: 

\[ C = aW + bY \]  

(1)

where \( a \) is the marginal propensity to consume in terms of wealth, \( W \) is property income, \( b \) is the marginal propensity to consume in terms of income and \( Y \) is labor income. If the ratio of middle age in society increases, then the propensity to consume decreases. If the
ratio of young to old in society increases, the propensity to consume increases (Ando &

Nevertheless, the life-cycle hypothesis has certain shortcomings, such as ignoring the
influence of unpredictable income on the consumption behaviour of the population, like
property transfers, labour supply and savings, as well as other forms of wealth holding,
and the fact that no consumer is fully rational and able to completely understand his
income and future life plans (Douglas Bernheim, 2002).

2.2 Precautionary savings theory

Leland (1978) believes that Modigliani did not take into account certain consumer
psychology and habits when he used the life-cycle hypothesis to analyse consumption
problems. One of these very important ones is the precautionary motive.

Residents' consumption behaviour is more rational when considering expected future
income and other uncertainties, such as reducing non-essential expenses in daily life.
Consumer saving is no longer about allocating wealth over the entire life cycle;
consumers' consumption tends to increase savings to protect against unknown risks,
which is known as precautionary saving. When it comes to uncertainty and risk,
consumers will consume differently throughout their life cycle if they have the same level
of original wealth and anticipations. Hence, the path of consumers' spending will be
different as the effects of uncertainty accumulate. Just as people with fewer financial
assets and unstable labour income have a higher incentive to save preventively (Kimball,
1989).

Hence, the path of consumers' spending will be different as the effects of uncertainty
accumulate. Just as people with fewer financial assets and unstable labour income have a
stronger incentive to save preventively (Kimball, 1989). Furthermore, the inadequacy of
the social security system, the habitual preference for frugality, health risks, business risks, retirement savings and children's education are all probable reasons for precautionary savings (Kimball & Carroll, 2001). During those stages, consumers will become more cautious and sensible in their expenditure to safeguard against the effects of increased future uncertainty. As such, the challenging situation of an ageing population will inevitably have a weakening or even a negative impact on the positive effects of household consumption.

2.3 Previous empirical studies

Population ageing has afflicted many countries around the world and has brought many challenges to their social and economic development. Since some countries have already entered an ageing society at a very early stage, researchers have attached great importance to the issue of ageing and carried out research on it at an early stage. However, there are not many studies on consumption in the direction of ageing. In the following, we briefly review the studies that have been carried out by scholars on this issue. The conclusions of this research are classified into three categories.

In the first view, population ageing has a significant positive effect on consumption. Many studies have been performed on the life cycle hypothesis following its introduction by Modigliani. Loayza et al. (2000), using time series data including over 150 developing countries over the period 1965-1994 and on the basis of the Generalised-Method-of-Moments model, found that an increase in the old-age dependency ratio led to a decline in residential savings, and since the savings rate and consumption are in a reciprocal relationship, the old-age dependency ratio has an influence on consumption and is positively correlated, which supports the predictions of the life-cycle hypothesis.

Similarly, in the empirical study with a cross-sectional data sample of 74 countries in
1969, 47 of which were least developed countries, Leff (1969) takes household savings, old-age dependency ratio and child dependency ratio as variables for analysis. It was obtained that the old-age dependency ratio and child dependency ratio was negatively related to the saving rate, while the increase in child dependency ratio and old-age dependency ratio increased the consumption of the population (Leff, 1969). In addition, Schulz (2005) developed a GMM dynamic panel regression model to empirically explain the relationship between population ageing and consumption in Asia based on data from 16 Asian countries and regions from 1952-1992 consistent with the life-cycle hypothesis theory.

Conversely, the second viewpoint argues that population ageing has a significant negative effect on the consumption of the population. Cutler et al. focus their attention on the impact of demographic change on the level of national saving consumption and productivity growth. In the long run, a growing elderly population and a declining working-age population will reduce the level of social generation and hence, the rate of residential consumption will decline (Cutler et al, 1990). In the literature by Hock and Weil (2011), they divide the population into three types: young, working-age and old, and structure an overlapping generations model over a continuous period of time which clarifies that the fiscal burden of ageing will lead to a further decline infertility, which will generate an additional decline in consumption in the long run (Hock & Weil, 2011). Thus, the findings of this study support the results of the precautionary savings theory.

Thirdly, the view that there is no significant relationship between population ageing and residential consumption. Ram (1982) builds ordinary least squares model by selecting data using 121 countries from 1970 to 1977 to demonstrate that the effect of population ageing on household consumption is not significant. Through panel data for India, Korea and China, Curtis (2015) nested an empirical study with a savings decision model based on life-cycle theory, and likewise obtained the result that the age composition of the population has no significant effect on savings and consumption.
The different research perspectives show that academics are unable to reach consistent in their conclusions about the impact of population aging on consumption. Given that most of the data above-mentioned past literature spans multiple countries and are overly dated. In this paper, we focus on the most recent provincial panel data for China to cover a more modern time period to argue for studying the relationship between population aging and residential consumption.
3. Data and variables

This chapter shows the data collection methods and descriptive statistics and provides an explanation of each variable

We will use panel data for 31 provinces, municipalities and autonomous regions of China, derived from the China Statistical Yearbook for each year. As China's statistics are always changing with different policies, the content, methodology and calibre of the statistics are subject to change and many of the data are not consistent. Therefore, in this paper, data for the period 2014-2020 has been chosen in order to maintain rigour and accuracy (National Bureau of Statistics of China, 2021).

Dependent variables

The dependent variable in our data set is per capital resident consumption, which is available in the China Statistical Yearbook from the National Bureau of Statistics of China. This indicator is measured in RMB/year and measures the level of consumption of the population. Compared to the other independent variables it has a larger value therefore it is provided as a natural logarithm in the estimation model. More Descriptive Statistics regarding the dependent variable can be found in Table A.

Independent variables

Old-age dependency ratio

The old-age dependency ratio is the main explanatory variable in our study, which is the ratio of the number of older people in a country or region to the number of people of working age, that is, calculated as the share of people aged 65 and over in the working population aged 15-64. It gives an indication in percentage terms of how many non-working older people are afforded for every 100 working-age people and is one of the indicators that capture the social consequences of population ageing from an economic perspective (OECD (2017).
Child dependency ratio

As the child dependency ratio, like the old-age dependency ratio, also represents the population composition compared to its labour force, we believe it is also worth consideration as an indicator that measures the ratio of children to the working-age population in a country or region. This is the number of people aged 0-14 years as a proportion of the working population aged 15-64 years.

Income growth rates

Modigliani and Cao (2004) suggest that it is the growth rate of real income that affects consumption. Changes in real income affect the purchasing power of consumers and thus changes in the demand for goods or services, changing the impact on consumption. We collected annual disposable income per capita from the Chinese Statistical Yearbook for each province and then calculated the growth rate of real annual income per capita for inclusion in the model.

Urbanization rate

The urbanisation rate is the proportion of the urban population in the total population (both agricultural and non-agricultural) and is an important indicator of the economic level of a region. In the process of urbanization, people's living standards change, leading to a corresponding change in their consumption choices (Hannah & Max, 2018). We obtain the urbanisation rate for each region from the China Statistical Yearbook. This is expressed as a percentage. Most regions in China have shown a positive trend in urbanisation rates over the past few years.
4. Method

In this section, we present the structure and methodology of the empirical evidence on the relationship between population ageing and consumption based on panel data, the main approach being to perform relevant diagnostic tests using STATA program followed by a fixed effects model for econometric analysis.

4.1 Estimated Model

The aim of our work is to investigate the significant impact of age-dependent changes in the population on consumption. Our theoretical hypothesis is based on the life-cycle hypothesis, which suggests that changes in population ageing should have a significant impact on consumption and show a positive correlation, thus initially we propose the following hypothesis.

H0: There is a significant positive relationship between population ageing and consumption in China

H1: There is a significant negative relationship between population ageing and consumption in China

In response to the above hypothesis, we constructed a fixed effects model, set as follows

\[
\ln con_{it} = \alpha + \beta_1 eld_{it} + \beta_2 chi_{it} + \beta_3 inc_{it} + \beta_4 urb_{it} + \epsilon_{it} \\
(i=1,2,3...31, t=1,2...8)
\] (2)

In the model, \(\alpha\) is the intercept term for individuals. \(\beta\) is the parameter for each explanatory variable. the variable subscript indicates the value taken by the ith individual in period t. \(\epsilon\) is a random error term and follows a normal distribution with zero mean and equal variance.

In order to investigate further, the second model is based on the first hypothesis with a slight modification. We add the time trend variable year to the panel fixed effects regression equation in hypothesis 1, in other words, we include time in the individual fixed effects model and thus construct a two-way fixed effects model. The presence or absence of a time effect is determined by the significance of the time trend term.
\[ lncon_{it} = \alpha_1 + \beta_1 eld_{it} + \beta_2 chi_{it} + \beta_3 inc_{it} + \beta_{14} urb_{it} + yeart_t + \epsilon_{it} \quad (3) \]

\[(i=1,2,3...31, t=1,2...8)\]

Before we do the regression analysis, we need to perform correlation analysis, multicollinearity and check for heteroskedasticity, autocorrelation, and cross-sectional correlation problems in order to determine whether our model meets all the requirements for plausibility and to prevent falling into misleading results. Besides, we do not do unit root and co-integration tests in this paper due to the relatively short time period of our sample.

### 4.2 Correlation-Matrix

*、**、*** indicates significant at the 10%, 5% and 1% levels respectively

(\textbf{Table 1: Pearson correlation coefficient})

<table>
<thead>
<tr>
<th></th>
<th>con</th>
<th>eld</th>
<th>chi</th>
<th>inc</th>
<th>urb</th>
</tr>
</thead>
<tbody>
<tr>
<td>con</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eld</td>
<td>0.318***</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chi</td>
<td>-0.569***</td>
<td>-0.214***</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>inc</td>
<td>-0.326***</td>
<td>-0.437***</td>
<td>0.235***</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>urb</td>
<td>0.895***</td>
<td>0.331***</td>
<td>-0.727***</td>
<td>-0.429***</td>
<td>1.000</td>
</tr>
</tbody>
</table>

In order to grasp the degree of linear correlation between the dependent variable and the independent variable, and between the independent variable and the independent variable, as well as to test and judge the reasonableness of the regression model setting, we should analyze the correlation between the variables. The range of the correlation coefficient between variables is [-1,1]. The closer the absolute value of the coefficient is to 1, the stronger the linear relationship between the two variables. Table 1 shows the correlation coefficient matrix between the variables. We can see that there is a highly
significant correlation between annual consumption per capita and the urbanization rate, and between the juvenile dependency ratio and the urbanization rate, compared to the other variables, which indicates that there may be multicollinearity between the two variables, that is, one independent variable can be a linear combination of one or several other independent variables (Gujarati & Porter, 2009).

Variance Inflation Factors

If multicollinearity between variables is ignored, the statistical significance of the variables may be reduced, the stability of the regression model reduced, etc. To ensure that the model is correctly specified and run correctly, we will perform a diagnostic of the severity of multicollinearity between variables using a variance inflation factor (VIF). The variance inflation factor is determined by a VIF of more than 5 or 10 indicating a high degree of multicollinearity between the independent variable and other variables. (Gujarati & Porter, 2009)

In Table A2, the variance inflation factor statistics for eld chi Inc urb are 1.28, 2.15, 1.41, and 2.53 respectively, so we can conclude that there is no significant multicollinearity between the independent variables in the estimated model. The data and the model are valid.

4.3 Hausman Test

A panel data model is a type of model that uses parallel quantities to analyse the interrelationships between variables and predict their trends. For models built from panel data, we use the Hausman test to determine whether the regression model
described above is a fixed effects model or a random effects model.

The results of the Hausman test are shown in Table 2, the value of P is 0.0016, rejecting the null hypothesis at 0.1 level of significance. In summary, the fixed-effects regression model was chosen as the better choice.

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>(b)</th>
<th>(B)</th>
<th>(b-B)</th>
<th>sqrt(diag(V_b-V_B))</th>
</tr>
</thead>
<tbody>
<tr>
<td>fe_result</td>
<td>49151.23</td>
<td>35151.28</td>
<td>13999.94</td>
<td>3980.041</td>
</tr>
<tr>
<td>chi</td>
<td>-18715.63</td>
<td>9430.072</td>
<td>-28146.51</td>
<td>7205.078</td>
</tr>
<tr>
<td>inc</td>
<td>12692.76</td>
<td>16128.9</td>
<td>-3436.144</td>
<td>.</td>
</tr>
<tr>
<td>urb</td>
<td>58021.45</td>
<td>55840.25</td>
<td>2181.201</td>
<td>3830.206</td>
</tr>
</tbody>
</table>

Test:  Ho: difference in coefficients not systematic

\[
\chi^2(4) = (b-B)'[\text{V}_b - \text{V}_B]^{-1}(b-B) = 17.45 \\
\text{Prob} > \chi^2 = 0.0016 \\
(V_b-V_B \text{ is not positive definite})
\]

(Table2: Hausman Test)

The results of the Hausman test are shown in Table 2, the value of P is 0.0016, rejecting the null hypothesis at 0.1 level of significance. In summary, the fixed-effects regression model was chosen as the better choice.

4.4 Error term test

Furthermore, the error term of the fixed-effects model was tested for heteroskedasticity, intra-group autocorrelation, and inter-group cross-sectional correlation, which required further identification and treatment.

Heteroskedasticity test.

The random error terms in the overall regression function satisfy homoskedasticity, i.e. they all have the same variance. If the random error terms have different variances, the model is said to have heteroskedasticity. For heteroskedasticity, we use the modified
wald test (Baum, 2000).

As can be seen from the table A3, the P-value in the heteroskedasticity test is 0.00, so we reject the null hypothesis to conclude that there is a heteroskedasticity problem.

**Autocorrelation test**

Autocorrelation refers to the presence of correlation between residual terms. For within-group autocorrelation, we used Wooldridge (2010) to derive a simple test for autocorrelation in a panel data model, a test that is considered to be a robust test because there are fewer behavioural assumptions about heterogeneous individual effects. From the result in Figure A4, it can be seen that $p = 0.0000 < 0.01$, therefore we reject the null hypothesis and come to the view that autocorrelation is present.

**Cross-sectional correlation**

Cross-sectional correlation refers to the presence of randomly perturbed terms that are correlated across individuals in the same period. It is possible to get the results of the test using the frees' test (Frees, 1995).

As can be seen from the table, the frees' test rejects the null hypothesis indicating the existence of the cross-sectional correlation problem.

Based on the three tests above, we know that the fixed effects model suffers from heteroskedasticity, autocorrelation and cross-sectional problems, so we need to deal with these problems and report the econometric results below. We apply the Driscoll-Kraay standard errors to control for heteroskedasticity, autocorrelation and cross-sectional correlation in short panel data models (Driscoll & Kraay, 1998).
5. Results and analysis

In this section, we present and analyze the results of the empirical models described in Equations 2 and 3 and the limitations of our study.

5.1 Estimated Results

<table>
<thead>
<tr>
<th>VARIABLES</th>
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</tr>
</thead>
<tbody>
<tr>
<td>con</td>
<td></td>
</tr>
<tr>
<td><strong>eld</strong></td>
<td>1.161***</td>
</tr>
<tr>
<td></td>
<td>(3.96)</td>
</tr>
<tr>
<td><strong>chi</strong></td>
<td>-0.690**</td>
</tr>
<tr>
<td></td>
<td>(-3.53)</td>
</tr>
<tr>
<td><strong>inc</strong></td>
<td>0.780</td>
</tr>
<tr>
<td></td>
<td>(1.45)</td>
</tr>
<tr>
<td><strong>urb</strong></td>
<td>4.697***</td>
</tr>
<tr>
<td></td>
<td>(22.27)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>6.855***</td>
</tr>
<tr>
<td></td>
<td>(46.01)</td>
</tr>
</tbody>
</table>

Observations 217
Number of groups 31
city FE YES

*、**、*** indicates significant at the 10%, 5% and 1% levels respectively

(Table 3 Result from fixed effect model)

Table 3 are the results of the regression of equation 2 on the fixed effects model used in this paper, Based on the results, it can be concluded that the effect of the explanatory variable Chinese population old age dependency ratio on the consumption of residents is significant at the 1% level and positively correlated, which is consistent with the findings of the life cycle hypothesis. The beta coefficient of the old age dependency
ratio shows that for every 1% increase in the old age dependency ratio, the consumption of residents increases by 1.161%. In contrast, the effect of the child dependency ratio on the consumption of the population is negative, with a 0.69% decrease in the consumption of the population for every 1% increase in the child dependency ratio. The coefficient of the income growth rate reveals a value of 0.78 with a p-value of 0.185, which is not statistically significant at the 5% level of significance. For the urbanization rate, we know from the results in the table that it is statistically significant and has a positive correlation;

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>two-way Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td></td>
</tr>
<tr>
<td>eld</td>
<td>-0.540***</td>
</tr>
<tr>
<td></td>
<td>(-3.97)</td>
</tr>
<tr>
<td>chi</td>
<td>0.314**</td>
</tr>
<tr>
<td></td>
<td>(3.42)</td>
</tr>
<tr>
<td>inc</td>
<td>1.004**</td>
</tr>
<tr>
<td></td>
<td>(3.32)</td>
</tr>
<tr>
<td>urb</td>
<td>1.440***</td>
</tr>
<tr>
<td></td>
<td>(7.42)</td>
</tr>
<tr>
<td>Constant</td>
<td>8.623***</td>
</tr>
<tr>
<td></td>
<td>(73.53)</td>
</tr>
</tbody>
</table>

Observations 217  
Number of groups 31  
city FE YES  
year FE YES  
t-statistics in parentheses  
*、**、*** indicates significant at the 10%, 5% and 1% levels respectively  
*** p<0.01, ** p<0.05, * p<0.1  
(Table 4 Result from two-way fixed effect model)  
In the second equation, we add a time trend, i. e. a two-way fixed effect, in which case

17
we can see that there is some variation in the impact of the variables on residents’ consumption. The fixed effects model of traditional panel data only takes into account individual effects and does not consider the correlation of residuals across different regions in different periods, which may in turn lead to large errors in the estimation results. We add year dummy variable to reflect the impact of year-specific economic data, in the sense that events that occur in different years have an effect on the issue under study, for instance, trade disputes between China and the United States and the COVID-19 epidemic in 2020, which largely affect the development of the Chinese economy so it needs to be studied in depth as a control variable to reduce bias and improve the goodness of fit of the model. This study chooses to discuss the results of a two-way fixed effects model that is able to simultaneously take into account both individual fixed effects and time fixed effects.

As can be seen from the Table 4, the effect of the old-age dependency ratio on residential consumption is statistically significant at the 5% level of significance and the 1% level of significance, with a coefficient of -0.54, indicating a negative relationship between the old-age dependency ratio and residential consumption, which is inconsistent with the theory of the life cycle hypothesis. However, it is also justified because the income level of the elderly will decrease after retirement compared to the previous one. What is more, the consumption of the population will decrease with the decrease of the income level (Kmenta & Thomas, 1988). In additional, as mentioned in the literature review, older people have a stronger incentive to save preventively due to their relatively low income levels, and we looked at data from World Bank and found that China has one of the highest savings rates in the world, with a total savings rate of 45.71%, well above the world average savings rate of 26.08% (World Bank, 2021). This shows that older Chinese people are more inclined to save to cope with uncertain events that they may face in the future, thus reducing their consumption expenditure. On the other hand, the influence of frugal consumption habits also reduces the demand for products and services, which in turn discourages consumption expenditure, so that the life-cycle hypothesis is not suitable for the current situation in China.

In addition, we can see that an increase in the dependency ratio of young children will contribute to an increase in the consumption level of the population at the 5% level of
significance. Now that China has gradually relaxed its family planning policy, the second and third child policies have promoted the upgrading of the consumption structure, which will undoubtedly lead to an increase in the proportion of newborn children that will be spent on subsistence and developmental consumption.

The coefficient of the income growth rate is 1.004, with a p-value of 0.016. The estimated coefficient is statistically significant at the 5% level, and every 1% increase in the income growth rate will increase the consumption of the population by 1.004%, confirming the absolute income hypothesis: income determines the consumption level.

As for the urbanization rate, it is also positively and significantly correlated at the 1% level in terms of its effect on the level of consumption of the population. If the urbanization rate is higher, it represents a higher level of socio-economic development and a higher standard of living for residents. When more and more rural people, information, capital, technology and other factors of production converge in cities, it will generate huge aggregation and scale benefits in cities, enabling better development of factor of production markets, especially labor markets, and promoting the flourishing development of urban service industries, thereby raising the income level of urban residents, and coupled with a more diversified range of consumer goods, the development of urbanization is conducive to promoting the upgrading of consumption structures and consumption environments.

5.2 Robustness test

The two-way fixed effects model only controls for individual and time fixed effects. There may be other endogeneity issues between the variables. In order to test the robustness of the above results, We have used a test of replacement of the explanatory
variables, replacing the urbanization rate with the urban-rural income ratio

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two-way</td>
<td>Two-way</td>
</tr>
<tr>
<td></td>
<td>FE</td>
<td>FE</td>
</tr>
<tr>
<td>eld</td>
<td>-0.603***</td>
<td>-0.394***</td>
</tr>
<tr>
<td></td>
<td>(0.121)</td>
<td>(0.065)</td>
</tr>
<tr>
<td>chi</td>
<td>0.675**</td>
<td>0.359**</td>
</tr>
<tr>
<td></td>
<td>(0.193)</td>
<td>(0.097)</td>
</tr>
<tr>
<td>inc</td>
<td>1.107**</td>
<td>0.832**</td>
</tr>
<tr>
<td></td>
<td>(0.307)</td>
<td>(0.283)</td>
</tr>
<tr>
<td>ill</td>
<td>-0.917***</td>
<td>-0.757***</td>
</tr>
<tr>
<td></td>
<td>(0.209)</td>
<td>(0.191)</td>
</tr>
<tr>
<td>Urban-rural income</td>
<td>1.371***</td>
<td></td>
</tr>
<tr>
<td>ratio</td>
<td></td>
<td>(0.184)</td>
</tr>
<tr>
<td>Constant</td>
<td>9.402***</td>
<td>8.697***</td>
</tr>
<tr>
<td></td>
<td>(0.040)</td>
<td>(0.111)</td>
</tr>
</tbody>
</table>

Observations       | 217     | 217     |
R-squared          |         |         |
Number of city     |         |         |
Hausman p-value    |         |         |
Number of groups   | 31      | 31      |

* t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(Table 5)

The results in Table 5 indicated that the regression coefficient of the old-age dependency ratio was significantly negative, regardless of whether the dependent variable was added or removed, the other variables also have no change in significance and sign. This means that our results are robust to whether the evaluation method and indicators remain consistent with the evaluation results when certain parameters are changed.
5.3 Limitation

The uneven development of China's regions or towns and rural areas, which is not grouped leaves room for further research. Moreover, the samples were not expanded to cover a wider range of time intervals. The short-term sample in our study restricts the explanatory power of our model. The reasons for this are the poor availability of data from the Chinese government.

Due to the short time period and the slow-changing nature of the main variables, there may be unobserved time-invariant heterogeneity across regions, which is difficult for us to control of. Also, in our case, it may involve omitted variable bias leading to endogeneity risk in the regression.
6. Conclusion

This chapter provides a summary of the full research, presents the main ideas of the paper and makes recommendations for improving consumption in China.

Consumption needs vary across age groups and are changing as China's population ages. In this paper, we use panel data from 31 provinces in China to make an empirical analysis of the impact of China's ageing population on residential consumption through model screening and testing. The results confirm that the ageing of China's population reduces residential consumption. Resident consumption and old age dependency ratio are inversely correlated and show a negative correlation.

The findings of this research above provide insights of:

Reducing the uncertainty of the future life of the elderly through a sound social security system, focusing on a sound rural pension system. Accelerating the development of the elderly industry, develop the elderly consumption market rationally and promote the upgrading of the consumption structure. Enable the supply of consumer goods to be absorbed by demand, thus releasing the consumption power of the elderly.

Raising the level of income, which is one of the important factors in determining the level of consumption.

Accelerating the process of urbanization, it can promote consumption according to the findings of this paper. Cities can provide a better consumption environment and unleash consumption power to a greater extent.

Appeal to the public to raise birth rates, improve the effectiveness of the implementation of the two- and three-child policy, in consideration of the fact that population is a strategic and long-term issue, increase parenting subsidies and relax the fertility policy again to ease the pressure of ageing.


the aggregate association in Asia. Available at SSRN 639187.


# Appendix

Table A1 descriptive statistic

<table>
<thead>
<tr>
<th>variable</th>
<th>N</th>
<th>mean</th>
<th>p50</th>
<th>sd</th>
<th>min</th>
<th>max</th>
<th>range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita consumption</td>
<td>21</td>
<td>18368.3</td>
<td>16148.3</td>
<td>7079.53</td>
<td>7317.00</td>
<td>45605.1</td>
<td>38288.1</td>
</tr>
<tr>
<td>Elderly dependency ratio</td>
<td>21</td>
<td>0.153</td>
<td>0.149</td>
<td>0.0380</td>
<td>0.0700</td>
<td>0.255</td>
<td>0.185</td>
</tr>
<tr>
<td>Children dependency ratio</td>
<td>21</td>
<td>0.235</td>
<td>0.239</td>
<td>0.0650</td>
<td>0.120</td>
<td>0.384</td>
<td>0.264</td>
</tr>
<tr>
<td>Per capita Income growth rate</td>
<td>21</td>
<td>0.0850</td>
<td>0.0890</td>
<td>0.0200</td>
<td>-0.0150</td>
<td>0.142</td>
<td>0.158</td>
</tr>
<tr>
<td>Urbanization rate</td>
<td>21</td>
<td>0.600</td>
<td>0.588</td>
<td>0.122</td>
<td>0.262</td>
<td>0.893</td>
<td>0.631</td>
</tr>
<tr>
<td>Logarithm of per capita consumption</td>
<td>21</td>
<td>9.758</td>
<td>9.706</td>
<td>0.336</td>
<td>8.898</td>
<td>10.73</td>
<td>1.830</td>
</tr>
</tbody>
</table>

Table A2  Variance Inflation Factors

<table>
<thead>
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<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>urb</td>
<td>2.53</td>
<td>0.395865</td>
</tr>
<tr>
<td>chi</td>
<td>2.15</td>
<td>0.464760</td>
</tr>
<tr>
<td>inc</td>
<td>1.41</td>
<td>0.709523</td>
</tr>
<tr>
<td>eld</td>
<td>1.28</td>
<td>0.784092</td>
</tr>
</tbody>
</table>

| Mean VIF | 1.84  |
Table A3 Heteroskedasticity test.

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

$H_0: \sigma(1)^2 = \sigma^2$ for all $1$

$\text{chi}^2 (31) = 1386.91$
$\text{Prob}>\text{chi}^2 = 0.0000$

Table A4 Autocorrelation Test

Wooldridge test for autocorrelation in panel data
$H_0$: no first-order autocorrelation

$F(1, 30) = 146.018$
$\text{Prob } F = 0.0000$

Table A5 Cross-sectional correlation test

Frees' test of cross sectional independence = 4.574

<table>
<thead>
<tr>
<th>Critical values from Frees' $Q$ distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>alpha $= 0.10$ : 0.3563</td>
</tr>
<tr>
<td>alpha $= 0.05$ : 0.4923</td>
</tr>
<tr>
<td>alpha $= 0.01$ : 0.7678</td>
</tr>
</tbody>
</table>