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Will China's population aging be a threat to its future consumption?

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ABSTRACT

Based on the household level survey data, the paper makes a projection on China's household consumption in 2049 with reasonable assumptions of disposable income, demographic structure, urbanization rate and total population in 2049. The results show that at annual income growth rates of 3%, 4% and 5%, China's total household consumption in 2049 will be 71.0, 97.8 and 133.8 trillion CNY, respectively, 3.1~5.8 times of the total household consumption in 2015. Moreover, our projection shows that even excluding the income growth effect, the future consumption increased by rapid urbanization is much larger than the consumption depressed by the demographic change. The result highlights that as long as the Chinese government can successfully eliminate institutional constraints imposed on rural-urban migration, such as Hukou system or residency permits in the urban areas, population aging would not be a major threat to its future development.

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1. Introduction

In the past 40 years, owing to the high-income growth and the legacy of the one-child policy, China has experienced a dramatic demographic shift. China's fertility rate has dropped from 2.57 in 1981 to 1.63 in 2017 (World Bank 2019), which is far below the replacement fertility rates, and the birth rate falls from 20.91‰ in 1981 to 12.43‰ in 2017 (National Bureau of Statistics of China 2019). The demographic shift has generated a rapidly aging population and the old dependency ratio in China has increased from 8.0% in 1982 to 15.9% in 2017 (National Bureau of Statistics of China 2019). By 2050 more than 40% of the population will be over 60 years (United Nations 2017).

The trend toward a rapidly aging population in China is unprecedented and its impacts on the future economic development can be profound. Many previous studies have shown the concern that China's aging population may slow down the economic growth (Hu, Liu, and Ma 2012; Liu and He 2012; Wang 2016), and entrepreneurship and new business formation (Liang, Wang, and Lazear 2018). The Time (2019) report on China's aging population describes the situation in fairly graphic terms: 'By 2050, 330 million Chinese will be over age 65. Good news perhaps for property owners in

Hainan, but dire news for the prospects of the world's second-largest economy—and for those around the world who rely on it. “It’s the No. 1 economic problem for China going forward” [...] Fewer people means less domestic consumption, and thus rapidly slowing economic growth.’ Faced with such evidence, one cannot but wonder, will China’s population aging choke on its success in the future?

As China’s economy moves forward, it is widely believed that in the next three decades, income growth, urbanization and aging population are the three most important forces that will shape the economy and society of China. Although population aging may generate negative impacts on the economy, income growth and urbanization may go the other way around. Relying on a prediction approach that uses the most recent micro-household survey data, we in this paper particularly investigate how the three factors affect China’s future household consumption in the year of 2049, the 100th Anniversary of the People’s Republic of China, and whether population aging will be the dominant effect, threatening the future domestic consumption.

Individual consumption is the expenditure on goods and services that are used for the direct satisfaction of individual needs, and is considered as one of the most important indicators that can reflect people’s living standards and welfares, as it reveals how an individual lives, including what he eats, where he lives, how he travels and so on. Consumption is mainly determined by the income, another commonly used welfare measure for individuals, but owing to the permanent income hypothesis (Friedman 1957), the literature has suggested that consumption is a better proxy for individual welfare measure because current consumption is a better guide to long-term resources than current income (Blundell and Preston, 1995; Brewer and O’Dea 2012), and income is likely to be under-reported by households (Meyer and Sullivan 2003, 2008). Therefore, studying the consumption of households is crucial to understand the welfare of the population in China.

Moreover, as the final consumption expenditure accounts for a large share in the national account of GDP, the study on household consumption can also help understand China’s economic growth in the future. China is now on a transition away from the growth model largely relying on investment and global trade surplus toward the one that relies more on domestic consumption. According to the Ministry of Commerce, consumption has become the largest driving force for economic growth in the last 5 years, contributing 76.2% to economic growth in 2018, an increase of 18.6 percentage points over the previous year.¹ Meanwhile, China is also going through consumption upgrades, mainly characterized by an increase of consumption on service and an increase in the consumption quality. A study on the change of consumption structure can also shed light on the ongoing industry upgrades.

The main goal of the paper is to forecast household consumption expenditure in 2049, both in the perspective of total consumption and consumption structure. In the following, we will proceed our analysis and projection by focusing on the impacts of income growth, urbanization and population aging on household consumption, as well as the consumption structure.

The remainder of the paper is organized as follows. Section 2 goes over China’s household consumption since 1980 and Section 3 looks into the consumption behavior of different population groups by urban-rural, income level and age. Section 4 predicts

the consumption in 2049 based on recent household survey data. Section 5 concludes with discussion on policy implications.

2. China's household consumption since 1980

Before making the projection for 2049 China, we first take a brief retrospect of household consumption since 1980s when China's reform started.

2.1. Total household consumption since 1980

Since China's reform and opening-up in the early 1980s, the household income has risen remarkably, which results in massive improvement in the living standards of the household measured by per capita consumption. The national sampling household survey conducted by the National Bureau of Statistics (NBS) provides comprehensive information on households' income and expenditure. We obtain the per capita income and consumption data for the urban and rural areas separately from NBS, and then calculate the national level household data by using the corresponding population as the weight.

The households' per capita disposable income in China was only 1,548 CNY in 1981, but continuously rose to 25,929 CNY in 2017, almost 17 times the income of 1981.² The average annual growth rate of real per capita disposable income was 8.27%. The fast income growth drives the fast growth in consumption. The residents' per capita consumption expenditure grows from 1,355 CNY in 1981 to 18,188 CNY in 2017, which was 13 times the level of 1981. The average annual growth rate of real per capita consumption expenditure was 7.63%.

The growth difference between income and consumption reflects decreasing average propensity to consume (APC), the fraction of income spent on consumption. In 1981, the APC was as high as 87.53% and continuously decreasing after a small increase during 1985–1991. In 2017, the APC decreased to 70.15%. Since household savings rate is defined by $1 - APC$, decreasing APC also means increasing savings rate in China. The household savings rate in China grows from 12.5% in 1981 to 30% in 2017 and becomes the world's highest savings rate. In contrast, the personal savings rate in U.S. is around 6.7% in 2017. There is a large economics literature exploring the puzzle of high savings rate in China from difference angles, such as dependency ratio (Kraay 2000; Modigliani and Cao 2004; Horioka and Wan 2007; Ang 2009 etc.) and future uncertainty induced precautionary savings (Kraay 2000; Meng 2003; Giles and Yoo 2007; Chamon, Liu, and Prasad 2013 etc.).

2.2. Household consumption structure since 1980

We now turn to examine the trend of consumption structure in the last four decades. NBS provides the household expenditure by eight different consumption purposes: (1) **Food, Tobacco and Liquor**; (2) **Clothing**, referring to expenditure related to clothing, including clothes, clothing materials, footwear, other clothing and accessories, processing services related to clothing; (3) **Residence**, which includes housing rents, water, electricity, fuel, property management, and converted self-owned housing rents; (4) **Household Facilities, Articles and Services**, which includes furniture and interior decoration, home appliances, home textiles, household miscellaneous daily articles, personal articles, and

family services; (5) **Transportation and Communication**, including expenditure on telecommunications and vehicles' purchase, maintenance and repairs, and vehicle insurance; (6) **Education, Culture and Recreation**; (7) **Health Care and Medical Services**; (8) **Miscellaneous Goods and Services**, referring to expenditure of all kinds of expenditure of other articles and services that are not included in the above categories. For convenience, we use food, clothing, residence, household facilities, transportation, education, health, and other goods to refer to these eight categories of consumption in the following. In these eight categories, food and clothing are generally considered as necessity goods.

China's households have undergone a great change of consumption structure in the last four decades. In 1981, the expenditure share (except consumption category 8) is ranked as the following: food (58.62%), clothing (13.35%), residence (11.95%), education (6.48%), household facilities (4.97%), health (1.6%), transportation (0.74%). In 2017, the ranking turns to be: food (29.25%), residence (22.45%), transportation (13.63%), education (11.42%), health (7.85%), clothing (6.8%), household facilities (6.13%). Since 1981, the four fastest-growing categories of consumption are transportation, health, residence, and education, the expenditure of which in 2017 was 247 times, 66 times, 25 times and 24 times the level of 1981 correspondingly. Their consumption shares increased significantly from 0.7%, 1.6%, 11.9%, 6.5% to 13.6%, 7.8%, 22.5% and 11.4%, respectively. In contrast, the expenditure on necessary goods including food and clothing was only increased by 7 times, and the consumption share of food and clothing decreased from 58.6% and 13.3% to 29.3% and 6.8%, respectively. These changes reveal the trend of consumption upgrading.

3. Household consumption of different population groups

As afore-discussed, income growth, urbanization and aging population are the three most important forces that will determine the household consumption in future China. Before making the projection, in the section we use data from NBS and a national representative household survey data, China Household Income Project (CHIP) 2013, to examine the impacts of these three forces on household consumption by exploring the consumption behavior of different population groups, i.e., urban and rural groups, different income groups and different age groups.

3.1. Household consumption by urban and rural groups

Since early 1980s, China has witnessed an unprecedented rural-urban migration in world history, with the urbanization rate increasing from 20.16% in 1981 to 58.52% in 2017. As China is expected to continue its rapid urbanization trend at least in the next 15 to 20 years, we believe urbanization will play an important role in future consumption. We in the following continue to use data from NBS to show the difference of income and consumption between the urban and rural.

The persistent and widening income inequality between urban and rural China is one of the most notable social phenomena (Démurger, Fournier, and Li 2006; Sicular et al. 2007; Park 2008). As shown in Figure 1, the urban-rural income ratio was 2.24 in 1981. This ratio fell in the early 1980s as China started the economic reforms from the rural areas through abandoning the communing system and adopting household responsibility system, which gave farmers freedom of production decisions and greatly improved

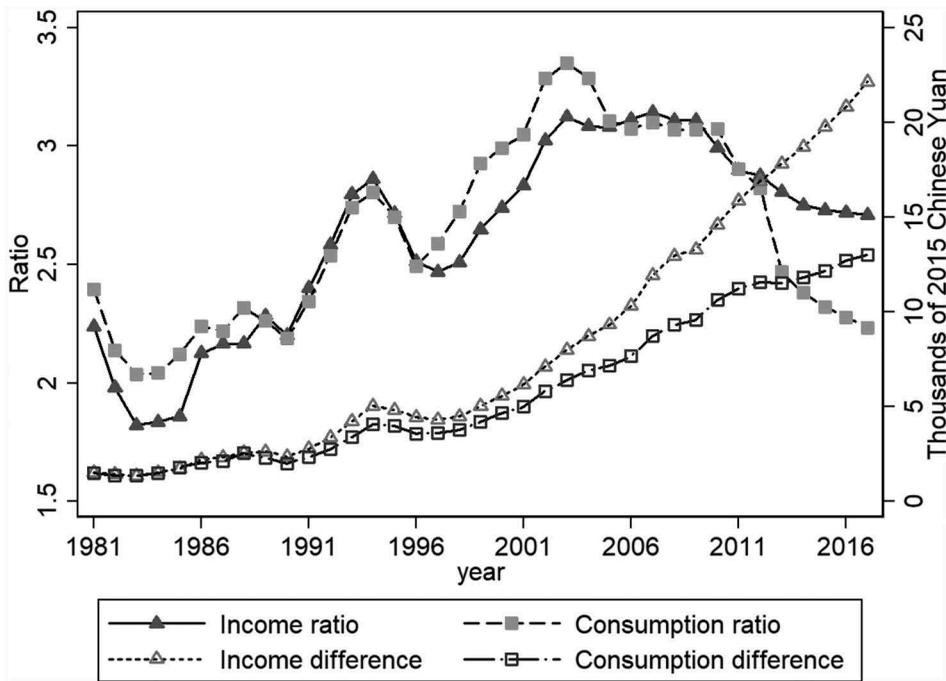


Figure 1. Income and consumption gap between urban and rural areas.

Source: NBS website at <http://www.stats.gov.cn/>.

agricultural productivity. From 1981 to 1984, the per capita disposable income of rural households increased from 1,238 CNY to 1,847 CNY, an increase of 49.1%, comparing to 22.1% increase for the urban households. In 1984, the urban-rural income ratio fell to 1.84, the lowest level since 1980.

However, the urban-rural income ratio began to increase in 1985 as China expanded its reform into urban areas. With the exception of 1994–1997, the urban-rural income ratio continuously increases until reaching its peak at 3.14 around 2007.³ Afterwards, owing to rising labor cost of rural migrants and supportive policies in the rural, the income inequality ratio continuously decreases to 2.71 in 2017. Note that although the income ratio between the urban and rural falls down, the absolute income gap between the urban and rural is still increasing. In 2017, urban resident on average earns 22,159 CNY more than a rural resident.

The income inequality drives the consumption inequality between urban and rural areas. The urban-rural consumption inequality shares a similar trend with the income inequality. In recent years, however, the urban-rural consumption inequality undergoes a faster decrease. From 2013 to 2017, the urban-rural income ratio fell from 2.81 to 2.71, experiencing a decrease of 0.1, while the urban-rural consumption ratio fell from 2.47 to 2.23, showing a decrease of 0.24. The urban-rural consumption inequality is decreasing faster than the income inequality because the average propensity to consume (APC), the fraction of income spent on consumption, in urban areas is decreasing. In 2017, urban households only consumed 67.16% of their disposable income but rural households consumed 81.55% of their disposable income.

The consumption structures of urban and rural residents also differ. There are some findings worthwhile to mention. First, the consumption category that has the largest expenditure share difference between the rural and urban is food. In 2017, owing to the income gap and Engels Law, the expenditure share of food in the rural is 31.2%, 2.6 percentage points larger than that in the urban. Second, the rural households' expenditure share of transportation is lower in 2013 but turns to be higher in 2017 than the urban households, which is relatively stable at around 13.5%. This shows that transportation is becoming more and more important in the consumption of rural households.⁴ Thirdly, notice that in 2017, the expenditure share of health for the rural households is 2.4 percentage points larger than the urban households, only next to share difference of food. The large gap in the expenditure share of health implies that, due to the insufficient coverage of public health-care system in the rural areas, the rural households have to proportionally bear more out-of-pocket health-care cost than the urban households. Finally, comparing to the rural households, the urban households have larger expenditure shares in clothing, residence and education.

3.2. Household consumption by income groups

Income plays the critical role in household consumption behavior as it determines the household's budget constraint. As China's economy continuously grows in the next three decades, we believe the income growth will be the most important factor that determines future consumption. We use the household income and consumption data from the latest wave of the CHIP in 2013 to study the consumption patterns of different income groups. CHIP collected detailed household and individual information both in urban and rural areas in selected provinces in China based on the sampling frame used by the NBS, and thus has national representability. We separate all household samples into five quintiles according to their disposable income per capita. We in the following first discuss the total consumption by income group and then discuss the consumption structure by income group.

The income and consumption of each quintile are shown in [Figure 2](#). As for the total consumption by different income group, there are several findings worth noting. Firstly, there is remarkable income inequality within urban and rural areas. In urban areas, the per capita disposable income of the top 20% of earners is 63,821 CNY, which is 5.9 times as high as that of the bottom 20% of earners, whose per capita disposable income is only 10,842 CNY. In rural areas, the income inequality is even larger, with the per capita disposable income of the top quintile being 8.2 times as high as that of the bottom quintile. In rural areas, the per capita disposable income of the top quintile is 24,561 CNY, while it's only 3,011 CNY for the bottom quintile.

Secondly, as low-income households tend to spend a higher fraction of income on consumption, the consumption inequality among different income groups is smaller than income inequality, which is also consistent with the permanent income hypothesis. The consumption ratio of the highest to the lowest quintile is 4.3 in the urban area and 3.3 in the rural area, much smaller than the income ratio. In urban areas, the top (bottom) quintile of earners spend 65.3% (89.1%) of their disposable income on consumption. In rural areas, consumption expenditure accounts for only 63.4% of disposable income for the top quintile earners but this ratio is as high as 156.8% for the bottom quintile. This implies that the wealth inequality is likely to be worse than income inequality because rich people tend to save a larger proportion of their income.

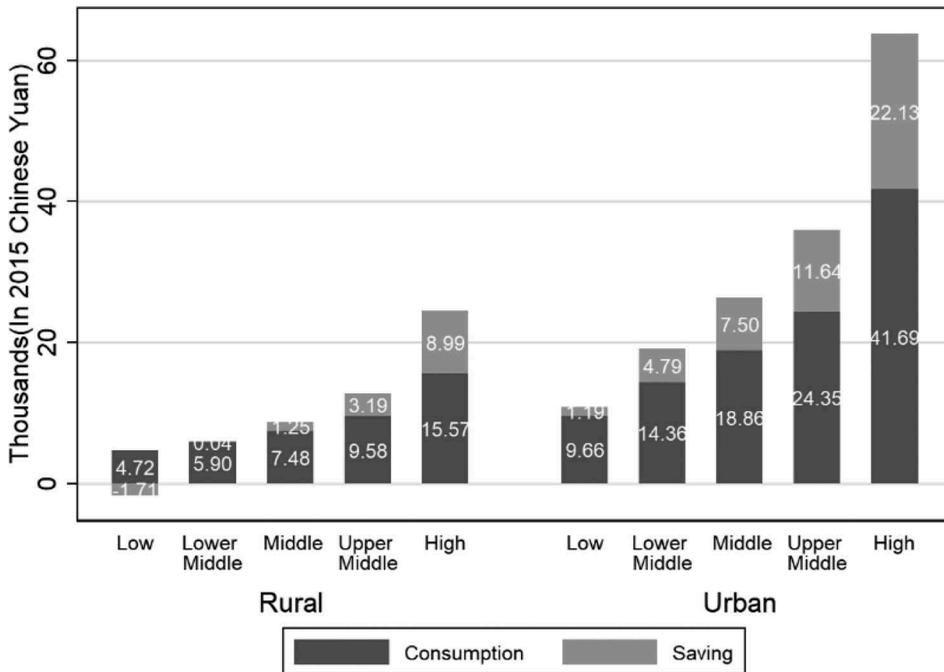


Figure 2. Consumption and saving by income group.

Data Source: CHIP 2013.

Thirdly, although owing to the low income, rural households have higher APC (or lower savings rate) than urban households in total, the rural households consume less even if they have the same income level as the urban households. On average, the APCs in the rural and urban are 78.7% and 69.8%, respectively.⁵ In order to compare the APC of rural households and urban households with the same income level, we mainly look at the households of the middle quintile in the rural area and the bottom quintile in the urban area, the disposable income of which are comparable and equal to 8,727 CNY and 10,842 CNY, respectively. If rural households share the same consumption pattern with urban households of the same income level, then the APC of the rural households in the middle quintile should be larger than that of the urban households in the bottom quintile. However, the APC values of the two groups are 85.7% and 89.1%, respectively. This implies that rural households with the same income have lower APC than urban households. Generally for the same income group, the rural households are facing higher future uncertainty in income, and meanwhile are lack of the coverage of social security and medical care and therefore have stronger incentive in precautionary savings. This finding can be further supported by directly studying the APC of households with per capita disposable income between 10,000 and 20,000 CNY, which is 74.3% in the rural and 79.1% in the urban.

Finally, the saving of the lowest income quintile is negative in rural areas, indicating that their income is not enough to cover current consumption expenditure. Macro data from NBS also shows that the savings rate for rural low-income households was negative during 2002–2012, which helps to illustrate that the negative saving is unlikely to be

caused by year-to-year income fluctuations. Then, the negative savings rate for these low-income households is not sustainable in the long run.

We next move on to discuss the consumption structure of different income groups. As income increases, the food share in total consumption decreases. This is consistent with the Engel's law, which states that the proportion of income spent on food falls as income rises. The expenditure share of clothing increases with income in rural areas and is inverted U-shaped with income in urban areas. The relationship between expenditure and income of the two consumption categories exactly reveals that both food and clothing are necessary goods, which by definition the consumption demand goes up by a less proportion than income. In contrast, the expenditure shares of residence and transportation both tend to be monotonically increasing with income, reflecting that they are luxury goods, the consumption demand of which goes up by a larger proportion than income.

The relationship between income and expenditure share of education and health care is not straightforward. An interesting phenomenon is that the consumption share on education is the lowest for the top quintile households in the rural area, but is the highest for the top quintile in the urban area, which may reflect that the rural is lack of relevant infrastructure constraining the consumption. The share of household expenditure on health shows a nonlinear relationship with income, and both poor and rich families spend more proportion on health care and medical services.

3.3. Household consumption by different age groups

Individuals have different income and consumption patterns during their lifecycle. As China's population is aging over time, the future consumption will be very likely to be strongly affected by the changed age structure of the society. To understand the relationship between age and consumption expenditure, we separate the households sample in CHIP 2013 into five groups based on the household heads' age: 20–30, 30–40, 40–50, 50–60 and over 60 age groups.

Figure 3 shows the income, consumption and saving behavior for each age group. Notice that for both urban and rural households, their per capita income is highest when young (at the age of 20–30), then firstly decreases, then increases a little and eventually falls down when old. Such an 'S' shape of per capita income among different ages may reflect the different dependency ratio during the lifecycle. As the rural population generally marry and have children earlier than the urban households, the rural households have rather stable per capita income during their lifecycle: the per capita disposable income is highest (11,628 CNY) for the 20–30 age group, and lowest (9,888 CNY) for the over-60 age group. In contrast, the urban households' per capita disposable income has more variations during the lifecycle. As the young (aged between 20 and 30) have low dependency ratio and high per capita disposable income, they also have the highest APC. The young aged 20–30 spend 85.4% and 71.7% of their disposable income for consumption in rural and urban areas, respectively, while the average consumption rate in rural and urban areas is 78.7% and 69.8% correspondingly. According to United Nations (2017), in 2015 the population of the 20–30 age group is 231 million in mainland China, only next to the 40–50 age group, the population of which is 243 million. The young adults have become an important force in the consumer market.

The consumption structure also varies across age groups. For the young aged between 20 and 30, although their income is the highest, the expenditure share of necessary items

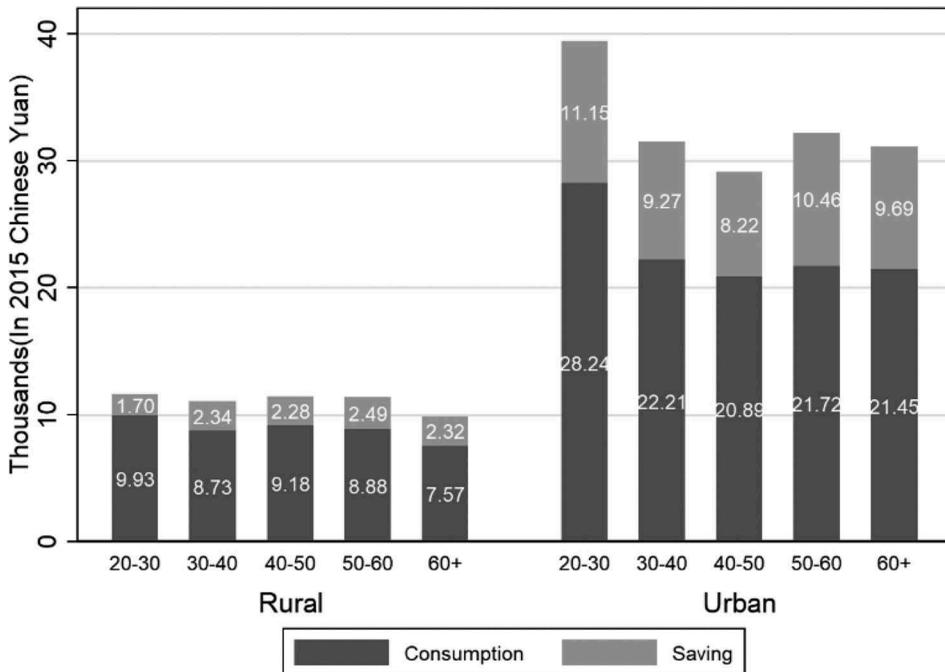


Figure 3. Consumption and saving by age.

Data Source: CHIP 2013.

like food and clothing is not the lowest. Moreover, as the young just start their career, they spend larger shares on clothing and transportation than other age groups. Contrary to clothing and transportation, residence claims a lower share of the young households' budget compared with older age groups, although it is still the highest in the absolute amount of money for the 20–30 group in urban areas.

For the population aged above 60, the expenditure shares of food, residence and health are the highest of all age groups, while the expenditure shares of clothing, household facilities, transportation, and education are the lowest. As the body function declines over time, the old overall have lower APC than younger generations and pay more on basic life needs such as food, health care and medical cost. The high expenditure share of residence owns to the converted self-owned housing rent, which accounts for a relatively large fraction of the elderly's budget as houses are indivisible and illiquid assets that the elderly cannot easily exchange for cheaper ones. It's not surprising that healthcare's share in the elderly's budget is the highest. Given China's fast aging process, the market demand for health care and service will be tremendous in the future.

One feature of the consumption behavior of the middle-age households is that, as they are in the age of supporting children for their middle and high school study or university study, educations take a large share in their budget. The education share of the 40–50 group is 13.7% and 14.2% in the rural and urban areas correspondingly, making it the third-largest consumption expenditure, only next to food and residence. Education expenditure is likely to be a heavy burden on them.

4. Projection of household consumption in 2049

4.1. Projection strategy

One simple way to make the projection is to use the consumption data of high-income countries to predict China's future consumption. However, even for the same income group countries, owing to the different consumption preference and culture, their consumption behaviors could differ a lot. For example, given 8,827 US dollars per capita GDP in 2017 and the assumption of 4% annual growth, China's per capita GDP will be 30,966 US dollars by 2049. In 2017, the countries with per capita GDP closest to 30,966 US dollars are, The Bahamas, Italy, South Korea, and Kuwait, the APC of which varies from 63% to 81% in 2017. Hence, if we want to make a reasonable prediction on China's future consumption, the projection strategy has to be based on the fundamental and rather stable parameters of people's consumption preference.

One commonly used approach to predict future household behavior is to model their consumption behavior based on current data and then use the model parameters to predict future values. Here the estimated model parameters actually capture the fundamental values of people's consumption preference. For examples, Zeng et al. (2015) uses recent survey data to project the future home-based care needs and costs for disabled elders in China; Morgan, Zhigang, and Hayford (2009) forecasts future fertility rate based on previous survey data in China; Huang (2014) employs the censuses data to project the trend of the marriage squeeze in China. We here project future household consumption based on household survey data from CHIP 2013.

Our projection is based under the assumption that after controlling for income, rural-urban residence and age, the households' consumption behavior in 2049 is the same as today's. In this way, we can first use CHIP2013 to study households' consumption behavior. Then based on this result, we are able to investigate the consumption changes brought about by future income growth, urbanization and demographic changes.

We first estimate the following regressions by age and region (urban and rural) for each consumption category using the household level data of CHIP 2013:

$$C = \alpha + \beta(I)I = \alpha + (\beta_1 + \beta_2 I)I \quad (1)$$

where C and I respectively denote per capita consumption and disposable income, $\beta_1 I + \beta_2 I^2$ is the induced consumption and α represents the autonomous consumption, defined as the minimum level of spending that must take place even if a consumer has zero disposable income. The autonomous consumption of a society is likely to increase with average income of the whole society because people's standards for minimum living will rise with the development of the economy. Using China Urban Household Survey from 2002 to 2009, we actually find that the average annual growth rate of households' autonomous consumption was only slightly smaller than that of their income. Hence when making prediction, we adjust the autonomous consumption by assuming that it shares the same growth rate as per capita income.

To use the estimated coefficients in Equation (1) to predict the consumption expenditure in 2049, three most important factors need to be taken into consideration: income growth, urbanization and population aging.

- (1) Income growth. As shown by the previous section, growing income will not only expand the households' budget constraint but can also influence their consumption behavior including propensity to consume and the structure of consumption. Since 1981, China has experienced an astonishing annual growth rate, 8% in its households' disposable income per capita and 9.5% in real GDP. As for China's future growth rate, the opinions widely differ. According to the projection by PricewaterhouseCoopers (known as PwC), the annual growth rate of per capita GDP in China will be 5.6% in 2016–2020 and 3.4%, 2.3%, and 2.5% during each decade from 2020 to 2050, which is equivalent to an average annual growth rate of 3.14% from 2016 to 2050.⁶ According to the projection by the Development Research Center of the State Council and The World Bank (2013), China's per capita GDP growth rate between 2020 and 2030 will be between 3.9% and 7.6%, compared to the growth rate of 3.4% in the same period predicted by PwC. In this paper, we base our predication on three scenarios where the average annual income growth rate is 3%, 4% and 5% during 2016–2049.
- (2) Urbanization. As afore-discussed, the consumption behavior differs between urban and rural households. Accompanying with China's extraordinary economic boom, China is also experiencing urbanization at a speed and scale that is unprecedented in human history. By the end of 2017, 58.52% of the total population lived in urban areas, a dramatic increase from 20.16% in 1981.⁷ According to the 2018 Revision of World Urbanization Prospects (United Nations 2018), by 2050 the percentage of population residing in urban China is projected to be 80%.
- (3) Population aging. Demographic change is another important factor that can shape an economy's consumption behavior. In 1990, the young population aged 20–30 accounted for 33.24% of the total population aged above 20.⁸ The ratio declined to 21.61% in 2015, and is projected to drop to only 12.55% by 2050 under the middle-fertility assumption according to the United Nations (2017). In contrast, the proportion of the population aged above 60 increased from 14.03% in 1990 to 20.08% in 2015, and is predicted to reach as high as 43.18% in 2050. The proportion of the population aged above 50 will be 58.77% in 2050, indicating that one in two adults will be over 50 years old.

Given the above assumptions, we then predict the future household consumption based on the estimated consumption functions. We first get the age-by-region coefficients through estimating the consumption function, i.e., equation (1), by ordinary least squares by age groups in rural and urban areas separately for each consumption category, the results of which are presented in Table 1.

Secondly, we use the age-by-region income projections, together with the age-by-region coefficients obtained in the first step, to calculate the predicted value of age-by-region household consumption, taking into account the growth of both autonomous consumption and induced consumption. This step only takes into account the income effect on future consumption.

Thirdly, using the predicted age-by-region household consumption calculated in the previous step and the predicted region-specific age structure, we get the predicted region-specific household consumption.⁹ This step considers the effects of demographic change on future consumption. Fourthly, using predicted region-specific household consumption and

Table 1. Regression results of the consumption functions.

□		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Food	Clothing	Residence	Facilities	Transportation	Education	Health	Others
Rural									
20–30	<i>I</i>	0.059*	0.051***	0.154***	0.043	0.241**	0.059***	0.063**	0.005
	<i>I</i> ²	0.003***	0.000	-0.001	-0.000	-0.002	-0.000	-0.001	0.000
30–40	<i>I</i>	0.151***	0.051***	0.114***	0.030***	0.118***	0.062***	0.022**	0.015***
	<i>I</i> ²	0.001***	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
40–50	<i>I</i>	0.153***	0.046***	0.110***	0.043***	0.121***	0.062***	0.038***	0.019***
	<i>I</i> ²	0.001***	0.000***	-0.000	-0.000**	0.001***	0.000***	0.000***	0.000***
50–60	<i>I</i>	0.179***	0.027***	0.140***	0.033***	0.059***	0.028***	0.113**	0.010***
	<i>I</i> ²	0.001***	0.000**	-0.000	-0.000	0.000	-0.000	-0.001	0.000
60+	<i>I</i>	0.191***	0.029***	0.135***	0.038***	0.047***	0.015***	0.045**	0.016***
	<i>I</i> ²	0.001***	-0.000	0.000	-0.000**	-0.000	0.000*	0.001**	-0.000*
Urban									
20–30	<i>I</i>	0.179***	0.107***	0.225***	0.037*	0.089	0.026	0.298***	0.015
	<i>I</i> ²	-0.000	-0.000	-0.001	0.000	-0.000	0.000	0.003***	0.000**
30–40	<i>I</i>	0.145***	0.041***	0.194***	0.043***	-0.010	0.076***	0.030***	0.016***
	<i>I</i> ²	0.000***	0.000**	0.000***	-0.000	0.001***	-0.000	-0.000**	0.000
40–50	<i>I</i>	0.148***	0.062***	0.180***	0.036***	0.141***	0.070***	0.025***	0.012***
	<i>I</i> ²	0.000***	0.000***	0.000***	0.000***	-0.000*	0.000*	-0.000**	0.000***
50–60	<i>I</i>	0.194***	0.058***	0.142***	0.031***	0.123***	0.056***	0.032***	0.026***
	<i>I</i> ²	0.001***	-0.000**	0.000**	0.000**	-0.000**	0.000	-0.000*	-0.000
60+	<i>I</i>	0.191***	0.049***	0.208***	0.037***	0.034**	0.090***	0.045**	0.022***
	<i>I</i> ²	0.001***	0.000***	-0.000	0.000	0.000	-0.000	0.001***	-0.000

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

the predicted urbanization rate, we are able to obtain the projection of per capita household consumption in 2049. This step considers the effects of urbanization on future consumption.

At last, multiplying the predicted per capita household consumption by the predicted total population yields total household consumption in 2049 China. This step takes into consideration the effect brought by the change of population size.¹⁰

4.2. Out-sample prediction for household consumption in 2015

To examine the performance of the forecasting strategy, we first use this approach to predict household consumption in 2015 and then compare it with the actual household consumption.¹¹

According to the 2016 China Statistical Yearbook, the per capita disposable income of rural and urban households in China were 11,422 CNY and 31,195 CNY, respectively, in 2015. Due to the lack of income information of different age groups, we assume that disposable income for each age group is the same. Thus, using the estimated consumption function, the consumption of each age group by rural and urban areas can be calculated.

Although we assume that household income is the same for different age groups, the predicted consumption in 2015 varies with age due to the variation in consumption behaviors across age groups. For instance, the elderly above 60 years old tend to consume more on food and health compared with other age groups, and less on clothing, household facilities, transportation and education, which is consistent with the findings in the previous section. The residence expenditure of the elderly is also higher than that of other age groups, consistent with the fact that houses are indivisible and illiquid assets which the elderly cannot easily exchange for cheaper ones.

Using the age-by-region consumption and the demographic structure provided by United Nations (2017), we can calculate the per capita household consumption in rural and urban areas, respectively, in 2015. We assume that the age structure is the same in rural and urban areas because the data provided by United Nations (2017) are nationwide and does not have the age structure in the rural and urban particularly.

It turns out that the predicted household consumption is very close to the actual value. According to our projection, the per capita consumption of rural households in 2015 is 9244.9 CNY, which is only 0.24% higher than its actual value of 9222.6 CNY. The prediction error can almost be ignored. The predicted per capita consumption level of urban households is 22,022.4 CNY, which is only 2.9% higher than its actual value of 21,392.4 CNY. Our forecasting method performs well when estimating household consumption levels. Using the actual urbanization rate of 56%, provided by the 2016 China Statistic Yearbook, the projected per capita consumption for the whole country in 2015 is 16,400 CNY, only 2.2% higher than the actual value.

We then go on to examine the performance of our projection strategy in estimating the consumption structure. As shown in Figure 4, it can be seen that the predicted consumption structure is slightly different from its actual value, but the overall trend is consistent. No matter in actual consumption or in predicted consumption, the three categories that account for the largest shares of consumption are food, residence and transportation, while the three categories with the smallest shares are other goods, household facilities, and health.

4.3. Household consumption in 2049

We now move on to use the above approach to predict household consumption in 2049. In terms of household income, we forecast the income in 2049 based on the per capita income in

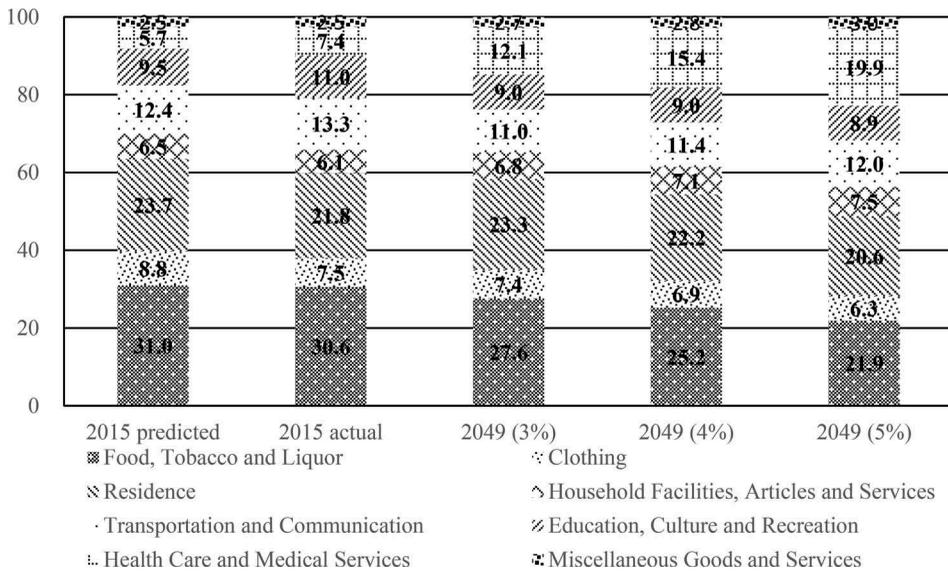


Figure 4. Predicted consumption structure.

Source: The actual value for 2015 is from NBS. The predicted value is from our projection.

2015, at an annual growth rate of 3%, 4%, and 5%, respectively. Specifically, since the per capita disposable income of urban and rural households in 2015 was 31,195 and 11,422 CNY, respectively, then under the annual income growth rate of 3%, the per capita disposable income of urban and rural households in 2049 was 85,222 and 31,204 CNY, respectively. A similar approach can also be used to calculate household income in 2049 under the 4% and 5% annual income growth scenarios. The urbanization rate and age structure in 2049 are, respectively, obtained from the predictions made by United Nations (2018) and United Nations (2017). According to United Nations (2018), China's urbanization rate will reach 80% in 2050.

4.4. Per capita household consumption in 2049

We first forecast per capita household consumption in 2049. In order to see the impact of different factors on per capita consumption, we will change the income, demographic structure and urbanization rate from the value in 2015 to the value in 2049 step by step. The results are shown in Table 2.

In the first step, we allow the disposable income to grow by 3%, 4% or 5% annually based on the actual income in 2015, but let the demographic structure and urbanization rate remain unchanged at their actual values in 2015. Under this circumstance, the per capita consumption in 2049 is projected to be 44,645, 61,872 and 85,406 CNY, respectively. Compared with the above-predicted consumption level in 2015, the per capita consumption in 2049 is predicted to increase significantly, and the growth of consumption is entirely driven by income growth.¹² Therefore, this part of consumption growth is called the income effect. For example, in the scenario of 4% annual income growth rate, the income effect will increase per capita consumption by 45,472 CNY.

In the second step, we let the age structure of the population change to the level in 2049. Compared with the first step, the only change in this step is the age structure of the population. Hence, the difference between the predicted results of these two steps is the demographic effect. China is aging rapidly, but as discussed in the second section, the consumption attitude of the young is more generous and their average consumption propensity is higher than the old. Therefore, the demographic change is likely to reduce per capita consumption. This is supported by the projection results. In the three income growth scenarios, demographic change will reduce per capita consumption by 1,107, 2,024, and 3,727 CNY correspondingly.

Table 2. Projection of the per capita consumption (CNY).

Annual income growth rate	3%	4%	5%
Predicted value			
In 2015	16,400	16,400	16,400
In 2049 (age structure and urbanization rate remains the same as in 2015)	44,645	61,872	85,406
In 2049 (urbanization rate remains the same as in 2015)	43,539	59,848	81,679
In 2049	52,026	71,661	98,082
Effect decomposition			
total effect	35,626	55,261	81,682
Income effect	28,245	45,472	69,006
Demographic effect	-1,107	-2,024	-3,727
Urbanization effect	8,487	11,813	16,403

At last, we let the urbanization rate change to the level in 2049. Compared with the second step, the only factor changed in this step is the urbanization rate so that the difference between the predicted results of the second and third steps is the urbanization effect. There are two channels for urbanization to affect per capita consumption. Firstly, the consumption behavior of rural and urban households is different. Since given the same disposable income, the urban households consume more than the rural households, the urbanization process will increase per capita consumption. Secondly, rural and urban households have different disposable income. The per capita disposable income of urban households is larger than that of rural households. Therefore, the increase in urbanization rate will increase the proportion of high-income population, leading to the increase of per capita consumption. From the projection results, urbanization process will significantly increase per capita consumption. In the three income growth scenarios, the urbanization process will increase the per capita consumption by 8,487, 11,813 and 16,403 CNY, respectively.

Given the above predictions, we finally can calculate the predicted savings rate in 2049, which is slightly higher than that in 2015 and equal to 30.1%, 30.7%, and 31.4%, respectively, in the three income growth scenarios. As the future annual household disposable income on average grows at 3%, 4% and 5% per year, the aggregate household savings in 2049 China will be 3.8 ~ 7.3 times larger than that in 2015 even if the savings rate remains unchanged. Given the fact that the household saving is the main domestic source of funds to finance capital investment, which is the major impetus for long-term economic growth, the high household saving rate in 2049 guarantees the capital supply for the economy and therefore China's long-run sustainable growth.

4.5. Aggregate household consumption in 2049

We are also interested in China's aggregate household consumption in 2049, as it measures the scale of the consumer markets of China which will be the largest in the world and thus have non-negligible impacts on the global economy. Similar to the prediction of per capita consumption, we change factors affecting total consumption from the level in 2015 to the level in 2049 step by step, so as to see the impact of different factors on total household consumption. In addition to the three factors mentioned above including per capita income, demographic structure and urbanization rate, the total population will also have an influence on total consumption. According to the United Nations (2017), the total population of mainland China in 2015 was 1.397 billion, and it will fall to 1.364 billion by 2050. The decline in the total population is supposed to have a negative impact on total consumption.

Table 3 presents the forecast results. The total household consumption varies a lot under different income growth scenarios. When income grows at of 3% annually, the total household consumption in 2049 is projected to be 71.0 trillion CNY, which is 3.1 times of the predicted value in 2015. If the annual income growth rate is 5%, the total household consumption in 2049 will be as high as 133.8 trillion CNY, which is 5.8 times of the total consumption in 2015. Both income growth and urbanization will increase total consumption, while population aging and a decline in total population will reduce consumption. Taking the 4% annual growth scenario as an example, the income effect and urbanization effect will increase total consumption by 63.5 and 16.5 trillion CNY,

Table 3. Projection of total household consumption (trillion CNY).

Annual income growth rate	3%	4%	5%
Predicted value			
In 2015	22.9	22.9	22.9
In 2049 (age structure, urbanization rate and total population remain the same)	62.4	86.4	119.3
In 2049 (urbanization rate and total population remain the same)	60.8	83.6	114.1
In 2049 (total population remain the same)	72.7	100.1	137.0
In 2049	71.0	97.8	133.8
Effect decomposition			
total effect	48.1	74.9	110.9
Income effect	39.5	63.5	96.4
Demographic effect	-1.5	-2.8	-5.2
Urbanization effect	11.9	16.5	22.9
Population effect	-1.7	-2.3	-3.2

respectively. The aging of the population and the decline in the total population will reduce total consumption by 2.8 and 2.3 trillion CNY, respectively.

It is without any doubt that income growth will contribute most to the consumption growth and therefore dominate other two effects. However, from the results presented in Tables 2 and 3, even if we keep income growth aside, the size of consumption depressed by population aging is much smaller than the size of consumption increased by urbanization. That means urbanization effect on future consumption can enough counter off the negative population aging effect on future consumption. According to Table 3, in the scenario of 4% growth, population aging will reduce the total household consumption by 5.1 trillion CNY while urbanization alone can stimulate the total household consumption by 16.5 trillion CNY. The result is robust even if we assume the urbanization rate in 2049 is 75% instead of 80%. Our findings may suggest that population aging in China will be an issue, generating negative impacts on the future growth, but its impacts should not be exaggerated and it may not be a deadly threat for China's future growth as many believed.

We can also predict the consumption structure in 2049. Figure 4 shows the actual and projected consumption structure for 2015, and the consumption structure for 2049 under different income growth scenarios. Compared to the consumption structure in 2015, a significant change in the consumption structure in 2049 is the decline in the proportion of food expenditure and the increase in the proportion of health expenditure. The share of food consumption declines from around 31% to 27.6%, 25.2% and 21.9% in the three income scenarios correspondingly. The decline in the food share mainly owes to the increase in disposable income. The share of health expenditure will increase to 12.1%, 15.4% and 19.9% in the three income scenarios correspondingly. The increase in the health share is driven by both income growth and population aging.

Our estimates of future household consumption are noteworthy in the following ways. First, our projection is based on the assumption that households' consumption behavior in 2049 will be the same as currently after controlling for their disposable income, rural-urban residence and age. In fact, with the development of society, people's consumption concepts may change. For example, the elderly in the future may have a more generous consuming attitude than the current elderly because of higher education level and growing up in a more open and wealthier China. What's more, with the technology development, people are likely to have access to more abundant consumption choices, which can also result in changes in consumption behavior. To alleviate these concerns

that people's standards for minimum living standards increases over time, we have allowed that autonomous consumption to grow at the same rate as per capita income.

Second, our projections are based on estimations of future income, age structure, urbanization rate and total population. Since these four variables can be affected by multiple factors, it is difficult to accurately predict their future values. Therefore, our projection results may differ from the real consumption level in the future due to the prediction error of these four variables. For example, the urbanization rate in the future may be higher or lower than expected. If the urbanization rate in 2049 is 75% instead of 80%, the per capita household consumption will be 3.4% lower under the three growth scenarios.

5. Conclusion and policy implications

The paper's main goal is to predict household consumption in 2049. We first estimate the consumption functions of households by age groups in urban and rural areas separately based on the household level data from CHIP2013. Then, we project the household consumption in 2049 based on these consumption functions and reasonable assumptions of disposable income, demographic structure, urbanization rate and total population in 2049. The results show that at annual income growth rates of 3%, 4% and 5%, the total household consumption in 2049 will be 71.0, 97.8 and 133.8 trillion CNY, respectively. What's more, the effects of income growth and urbanization on total consumption are positive, while the effects of population aging and decline in total population are negative. The projection of consumption structure shows that the share of food expenditure in total consumption will decrease in 2049 compared to that in 2015, but the share of health expenditure will increase.

Our findings have several policy implications. Firstly, there has been widespread concern that China's rapidly aging population would be a major threat to its future, but our projection shows that even excluding the income growth effect, the future consumption increased by rapid urbanization is much larger than the consumption depressed by the demographic change. The result highlights that as long as the China government can successfully eliminate institutional constraints imposed on rural-urban migration, such as Hukou system or residency permits in the urban areas, aging would not be a major threat to its future development.

Second, the predicted household consumption in 2049 is tremendously large and Chinese consumers will have large and important impacts on the global consumer markets. This sheds some lights on the current trade friction between U.S. and China. Since consumption has already replaced investment as key to China growth, our prediction shows that China's economic growth can rely more on domestic market and thus will be sustainable even if the export markets shrink. Moreover, the prediction shows that the problem of trading imbalance between U.S. and China can be eventually solved by the rise of China's domestic market. Finally, given the scale of China's future household consumption, China will be the major export market for most countries and thus will be an important growth engine for the world.

Thirdly, we project that the medical expenditure share will rise remarkably in the future, but the whole health-care system in today's China is still overburdened and struggles to cope with the rising demand. The large gap between the demand and the supply of medical and health service implies that the government should deepen and

accelerate the reform in the sector to increase the capacity of the supply, such as relaxing price regulations on medical services and streamlining the approval procedures for setting up private hospitals.

Fourthly, we find that the savings rate of the lowest income group in the rural areas is negative, which is not sustainable in the long run. This shows the need for poverty alleviation policy in rural areas to increase the income of the rural poor. Especially the government should expand the social welfare programs, such as social assistance and social security, from the urban areas to the rural areas.

Fifthly, owing to the poor education infrastructure in the rural, the highest income quintile households in the rural have the lowest expenditure share in education, which compared to the urban counterparts, is abnormal. Since the human capital is the engine for the growth of an economy as well as the income of households, the government should either increase the education investment in the rural, or reform the urban-rural dual education system, allowing rural residents and rural migrants to use and benefit from the high-quality education services in the cities.

Notes

1. <http://finance.people.com.cn/n1/2019/0212/c1004-30624783.html>.
2. All income and expenditure data measured by CNY in this paper are adjusted to 2015 prices.
3. During 1994–1997, the urban-rural income ratio undergone a small decrease, falling from 2.86 to 2.47, as a result of tight fiscal and monetary policies implemented to alleviate the high inflation that started at 1993, and an increase in the price of agricultural products and yields (Park 2008).
4. In fact, the rural households' per capita spending on transportation increased from 916 to 1,456 from 2013 to 2017, increased by 59.0%, while during this period, their per capita consumption only increased by 34.9%.
5. This is consistent with the findings in the previous subsection using data from the website of NBS, which shows that the consumption ratio in 2013 was 79.4% in rural areas and 69.9% in urban areas.
6. <https://www.pwc.com/gx/en/issues/economy/the-world-in-2050.html>.
7. Source: NBS website at <http://www.stats.gov.cn/>.
8. We consider the age structure of the population aged over 20 instead of total population because in CHIP, the consumption and expenditure data is at household level. We divide the sample into five age groups according to the age of the household head, most of which is over 20 (only 7 households have a household head aged below 20. We drop them in our analysis).
9. Limited by the availability of data, we assume the age structure is the same in rural and urban areas in 2049.
10. When making the prediction, we change per capita income, age structure, urbanization rate and total population one by one from the 2015 level to the 2049 level. It is worth noting that changing these four variables by different order would modify the values of their effects on consumption change, but the qualitative results always remain unchanged. More specifically, changing the per capita income first would enlarge the effects of the other three variables, but given changing per capita income first, changing the order of the other three variables have rather limited impacts on the effect size. An alternative approach to estimate the effect of one particular variable on future consumption change is to calculate the difference between the consumption in 2015 level and the consumption in the scenario of changing the value of the interested variable from 2015 level to 2049 level but keeping all other three variables at 2015 level. This approach is kind of like marginal analysis, but its

qualitative results again remain unchanged. Because the summation of the individual effects of income, urbanization and aging cannot be equalized to the total effect, we in the main text only report the results obtained from the former approach.

11. Due to the lack of demographic structure data, we cannot do this out-sample prediction for the year of 2017.
12. We compare the predicted value of household consumption in 2049 with predicted value in 2015 instead of actual value in 2015 because it helps eliminate the impact of the forecasting error. Since the projection strategies are the same, the difference between the projected values of 2049 and 2015 is only caused by changes in income, age structure, and urbanization rate. Therefore, we can directly decompose the consumption change into different effects. What's more, the difference between the predicted value and actual value of household consumption in 2015 is shown to be quite small in the last subsection.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- Ang, J. 2009. "Household Saving Behavior in an Extended Life Cycle Model: A Comparative Study of China and India." *Journal of Development Studies* 45 (8): 1344–1359. doi:10.1080/00220380902935840.
- Blundell, R., and I. Preston. 1995. "Income, Expenditure and the Living Standards of UK Households." *Fiscal Studies* 16 (3): 40–54. doi:10.1111/fisc.1995.16.issue-3.
- Brewer, M., and C. O'Dea. 2012. "Measuring Living Standards with Income and Consumption: Evidence from the UK (no. 2012-05)." ISER working paper series.
- Chamon, M., K. Liu, and E. Prasad. 2013. "Income Uncertainty and Household Saving in China." *Journal of Development Economics* 105: 164–177. doi:10.1016/j.jdeveco.2013.07.014.
- Démurger, S., M. Fournier, and S. Li. 2006. "Urban Income Inequality in China Revisited (1988–2002)." *Economics Letters* 93 (3): 354–359. doi:10.1016/j.econlet.2006.06.010.
- Development Research Center of the State Council and The World Bank. 2013. *China 2030: Building a Modern, Harmonious, and Creative Society*. World Bank Publications. <http://hdl.handle.net/10986/12925>
- Friedman, M. 1957. *The Permanent Income Hypothesis*. In *A Theory of the Consumption Function*, 20–37. Princeton University Press. <http://www.nber.org/chapters/c4405>
- Giles, J., and K. Yoo. 2007. "Precautionary Behavior, Migrants Networks and Household Consumption Decisions: An Empirical Analysis Using Household Panel Data from Rural China." *The Review of Economics and Statistics* 89 (3): 534–551. doi:10.1162/rest.89.3.534.
- Horioka, C. Y., and J. Wan. 2007. "The Determinants of Household Saving in China: A Dynamic Panel Analysis of Provincial Data." *Journal of Money, Credit and Banking* 39 (8): 2077–2096. doi:10.1111/j.1538-4616.2007.00099.x.
- Hu, A., S. Liu, and Z. Ma. 2012. "Population Aging, Population Growth and Economic Growth: Evidence from China's Provincial Panel Data." *Population Research* 36(3): 14–26. (in Chinese).
- Huang, K. 2014. "Marriage Squeeze in China: Past, Present, and Future." *Journal of Family Issues* 35 (12): 1642–1661. doi:10.1177/0192513X14538027.
- Kraay, A. 2000. "Household Saving in China." *World Bank Economic Review* 14 (3): 545–570. doi:10.1093/wber/14.3.545.
- Liang, J., H. Wang, and E. Lazear. 2018. "Demographics and Entrepreneurship." *Journal of Political Economy* 126 (S1): S140–S196. doi:10.1086/698750.
- Liu, Q., and Q. He. 2012. "Aging, Economic Growth and Fiscal Policy." *China Economic Quarterly* 12(1): 119–134. (in Chinese).

- Meng, X. 2003. "Unemployment, Consumption Smoothing, and Precautionary Saving in Urban China." *Journal of Comparative Economics* 31 (3): 465–485. doi:10.1016/S0147-5967(03)00069-6.
- Meyer, B. D., and J. X. Sullivan. 2003. "Measuring the Well-Being of the Poor Using Income and Consumption (no. W9760)." National Bureau of Economic Research.
- Meyer, B. D., and J. X. Sullivan. 2008. "Changes in the Consumption, Income, and Well-Being of Single Mother Headed Families." *American Economic Review* 98 (5): 2221–2241. doi:10.1257/aer.98.5.2221.
- Modigliani, F., and S. L. Cao. 2004. "The Chinese Saving Puzzle and the Life-Cycle Hypothesis." *Journal of Economic Literature* 42 (1): 145–170. doi:10.1257/002205104773558074.
- Morgan, S. P., G. Zhigang, and S. R. Hayford. 2009. "China's Below-Replacement Fertility: Recent Trends and Future Prospects." *Population and Development Review* 35 (3): 605–629. doi:10.1111/j.1728-4457.2009.00298.x.
- National Bureau of Statistics of China. 2019. *China Statistical Yearbook*. China Statistics Press.
- Park, A. 2008. "Rural-urban Inequality in China." *China Urbanizes: Consequences, Strategies and Policies, East Asia Economic Prospects*, 41–63. World Bank.
- Sicular, T., X. Yue, B. Gustafsson, and L. Shi. 2007. "The Urban–Rural Income Gap and Inequality in China." *Review of Income and Wealth* 53 (1): 93–126. doi:10.1111/j.1475-4991.2007.00219.x.
- Time. 2019. "China's Aging Population Is a Major Threat to Its Future." February.
- United Nations. 2017. *World Population Prospects, The 2017 Revision*. New York: United Nations.
- United Nations. 2018. *World Urbanization Prospects: The 2018 Revision*. Online Edition. <https://population.un.org/wup/>
- Wang, W. 2016. "Population Aging, Family Planning Policy Adjustment and China's Economic Growth." *China Economic Quarterly* 16(1): 67–96. (in Chinese).
- World Bank. 2019. World Development Indicators.
- Zeng, Y., H. Chen, Z. Wang, and K. C. Land. 2015. "Implications of Changes in Households and Living Arrangements for Future Home-Based Care Needs and Costs for Disabled Elders in China." *Journal of Aging and Health* 27 (3): 519–550. doi:10.1177/0898264314552690.