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How Much Will China Save? Projecting China's National Savings Through 2040*

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This paper projects China's national savings through 2040 based on China's national account data, demographic data, and data on rural and urban life-cycle income and consumption. Our baseline projections show that China's national saving in 2040 will be 16 times the current national saving. The annual growth rate of wealth will decline from 16.3 percent in 2012 to 9.5 percent in 2040. Lowering the growth rate of wealth accumulation to the current rate of return to wealth increases consumption through 2040; lowering the growth rate of wealth further may increase consumption more in the short run, but less in the long run.

Keywords: China, consumption, earnings profiles, national saving, wealth accumulation.

JEL classification codes: C82, E21, E27, F13, J11, O53.

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I. Introduction

The Chinese economy has experienced a sustained high rate of growth since the start of its market-oriented economic reforms and opening up to the outside world in 1978. The growth rate of real GDP has been around 10 percent over the past two decades. The high growth has been accompanied by a high gross domestic saving rate. The gross domestic saving rate in China stayed around 35 percent in 1980s, soared to above 45 percent in 2004, and currently stands around 52

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percent.[1] At the same time, the share of the elderly (65 or over) in the population has been increasing, rising from 4.7 percent in 1980 to 9.1 percent in 2011. The aging of the population, which is attributable to China's one-child demographic policy enforced in 1979, will affect the level of aggregate consumption and national saving in China in the future.[2] This paper uses China's national account and demographic data, as well as data on rural and urban respective life-cycle income and consumption to project China's national savings through 2040.

The life-cycle hypothesis is now the standard theory that links an individual's consumption path and his or her expected lifetime income (e.g. Modigliani and Brumberg, 1954; Friedman, 1957), and the crucial point of the theory is the saving decision. The life-cycle hypothesis has provided the theoretical basis for many empirical investigations to study saving behavior. Much of the empirical literature demonstrates that aging populations can adversely affect savings rates. Fry and Mason (1982) and Mason (1981, 1987, 1988) argue that the saving rate depends on the product of the youth-dependency ratio and the growth rate of national income. Age structure affects national saving because people tend to dissave during childhood and old age, whereas those in middle age are more apt to save. Using data from many developed countries, Feldstein (1980), Modigliani and Sterling (1983) and Horioka (1991) find a significant and numerically important relationship between the private saving rate and demographic variables. Elderly dependency rates and youth dependency rates have a negative influence on the private saving rate. Using data from many developing countries, Schmidt-Hebbel, Webb and Corsetti (1992) and Heller and Symansky (1997) also find that aging could significantly affect the private and national saving rates.

Significant contributions have been made in explaining China's high saving rate. Modigliani and Cao (2004) use China's aggregate time-series data (1953–2000) and find that income growth and decline in the young population dependency played a major role in the dramatic increase in China's saving rate, as predicted by the life-cycle hypothesis. Ge *et al*. (2012) find that demographic changes (mainly China's population control policy) contributed significantly to the recent increase in household saving. However, there are few studies predicting China's national savings.

This paper focuses on predicting China's aggregate national savings by using a methodology similar to Auerbach and Kotlikoff (1990) and Auerbach *et al*. (1991), where they use a partial equilibrium framework to predict how the US saving would develop through time. Their methodology can provide a sense of the importance of demographic composition on national saving. We improve their method by: (i) utilizing the producer's price (instead of the consumer's price) to adjust the national account data, as the accuracy of the latter adjustment method depends on an assumption (i.e. labor's share of indirect business taxes was equal to labor's share

1 The World Bank, World Development Indicators Database.

2 The one-child policy was introduced in 1979 to control population growth, which restricted the number of children that a married urban couple could have to one, with exemptions for some minority groups. In addition, China has limited inward immigration, which aggravates the aging problem.

of net national product) which may not always hold; and (ii) applying different life-cycle income and consumption profiles for rural and urban areas (instead of using the same profiles for the whole country) as rural people count for half of the population in China and their profiles are different from urban people's profiles. The present paper answers the following two questions. First, how will the projected demographic changes in the future affect national saving and how much wealth will China accumulate through 2040? Second, how much more would China consume if it lowered the rate of its wealth accumulation from now through to 2040?

The paper proceeds as follows. Section II describes the methodology, Section III presents the data, Section IV discusses our findings and Section V concludes the paper.

II. Methodology

Two main approaches are used to demonstrate how demographics will affect savings in the near future: a general equilibrium simulation model (see Auerbach and Kotlikoff, 1987) and a partial equilibrium simulation methodology (see Auerbach *et al*., 1991). The former approach relies on the empirically estimated preference and production parameters. Compared to the first approach, the second methodology incorporates more information about actual age-specific saving patterns and provides a sense of the importance of demographic composition on national saving. This section discusses our methodologies for processing the data and for predicting the future values of consumption, savings and wealth in China. We have the historical national income data from 1982 to 2011. Our predictions are for the period of 2012–2040, a forecasting horizon of 29 years.

II.1. Consumption at the producer's price

Different approaches can be used to calculate GDP. In the income approach, GDP is the sum of total factor income, including compensation of employees, net taxes on production, depreciation of fixed assets and operating surplus (profits). Compensation to employees is labor income and operating surplus (profits) is capital income, and both are measured at the producer's price. When GDP is calculated by the expenditure approach, its components are household consumption (or private consumption), government consumption, investment and net exports, and all are measured at the consumer's price (final price). The difference between GDP at the producer's price and GDP at the consumer's price is the amount of net production taxes.

We can convert GDP at the consumer's price to GDP at the producer's price using the budget identity given in Equation (1):

$$(1+\tau_t)C_t + (1+\tau_t)G_t - T_t = C_t + G_t, \tag{1}$$

where C_t and G_t stand for household consumption and government consumption at the producer's price in year t, respectively; $(1+\tau_t)C_t$ and $(1+\tau_t)G_t$ denote household consumption and government consumption at the consumer's price

in year t, respectively; T_t is net production tax and $T_t = \tau_t(C_t + G_t)$.[3] We can derive the net production tax rate τ_t through Equation (1) and, then, using τ_t, we can convert $(1+\tau_t)C_t$ and $(1+\tau_t)G_t$ at the consumer's price into C_t and G_t at the producer's price.

II.2. Prediction of labor earnings and consumption

Here we will focus on the description of how to project the future aggregate labor earnings. The prediction of household consumption (C_t) is very similar.[4] We employ the methodology of Auerbach and Kotlikoff (1990), which uses the sex-as well as age-earnings and sex- as well as age-consumption profiles observed in the historical data, to predict future consumption and labor earnings under the assumption that these profiles are time-invariant.

Let E_t stand for the value of aggregate labor earnings in year t ($t = 1982, 1983, \ldots, 2011$) in the 2011 Chinese yuan:

$$E_t = \sum_{a=0}^{100} \sum_{s=m,f} \sum_{j=r,u} \overline{e}_{a,s,j,t} \times N_{a,s,j,t} = \sum_{j=r,u} \overline{e}_{40,m,j,t} \times \sum_{a=0}^{100} \sum_{s=m,f} \overline{R}_{a,s,j} \times N_{a,s,j,t}, \quad (2)$$

where $\bar{e}_{a,s,j,t}$ indicates average labor earnings at age a ($a = 0, 1, 2, \ldots, 100$), sex s ($s = m$ means male and $s = f$ means female), area j ($j = r$ means rural area and $j = u$ means urban area) and time t; $N_{a,s,j,t}$ represents the total population age a, sex s, area j at time t[5] ; $\overline{R}_{a,s,j}$ is the age- and sex-relative earnings profile in area j and is time-invariant (i.e. $\overline{R}_{a,s,j} = \overline{e}_{a,s,j,t}/\overline{e}_{40,m,j,t}$).[6] Therefore, given the value of aggregate labor earnings (E_t) as well as rural and urban aggregate labor earnings, the age- and sex-relative earnings profile in area j ($\overline{R}_{a,s,j}$) and population ($N_{a,s,j,t}$), we can determine $\bar{e}_{40,m,j,t}$ (average earnings of a 40-year-old man) using Equation (2):

$$\overline{e}_{40,m,j,t} = \overline{e}_{40,m,j,1982} \times \left(1 + g_{e,j}\right)^{(t-1982)}, \quad (3)$$

where $g_{e,j}$ is the annual growth rate of an average 40-year-old man's earnings in rural ($j = r$) or urban ($j = u$) areas. Let $t = 2011$ in Equation (3) and we obtain $g_{e,j}$. We assume that $g_{e,j}$ is constant over time.[7] Now we can project future aggregate labor earnings. First, we use a cohort component method to project the population

3 Net taxes on production refers to taxes on production less subsidies on production.

4 In this section, if not specified, 'consumption' is evaluated at the producer's price.

5 $a = 100$ stands for people who are aged 100 or above. According to China's Sixth Population Census (2010), the population at age of 100 or above is 15 811 in urban and 20 123 in rural areas.

6 Kotlikoff and Summers (1981) and Carroll and Summers (1989) remark on the relative stability of the shape of US cross-section age-consumption and age-earnings profiles in the postwar period. Here, we use the same assumption that China's age- as well as sex- consumption and labor earnings profiles are constant through time.

7 For the projection in Section IV, we will allow $g_{e,j}$ to gradually decrease.

by age and sex from 2012 to 2040 in rural and urban areas on the basis of China's Sixth Population Census in 2010. Second, rewrite Equation (2) as:

$$E_t = \sum_{j=r,u} \overline{e}_{40,m,j,2011} \times \left(1 + g_{e,j}\right)^{(t-2011)} \times \sum_{a=0}^{100} \sum_{s=m,f} \overline{R}_{a,s,j} \times N_{a,s,j,t}, \qquad (4)$$

where $t = 2012, 2013, \ldots, 2040$. Given the value of $g_{e,j}$, the age- and sex-relative earning profile in area j ($\overline{R}_{a,s,j}$), and projected population ($N_{a,s,j,t}$), we can obtain the projected value of aggregate labor earnings through 2040 using Equation (4).[8]

In projecting government consumption (G_t), we only consider the total population and not the age distribution of the population. Specifically, we first calculate the growth rate of per capita government consumption (g_g) over the period 1982–2011. Using per capita government consumption in 2011, future total population and g_g (assuming g_g is constant over time), we can obtain future government consumption.[9]

II.3. Prediction of future wealth and calculation of rate of return on wealth

As mentioned earlier, labor earnings and consumption are measured at different prices, and so it is important to render them consistent with each other before doing arithmetical operations that combines them. Auerbach *et al*. (1991) use consumption data directly from the national income and product accounts (NIPA), and adjust labor earnings data by making them equal to the sum of (i) NIPA wages and salaries; (ii) a portion of NIPA proprietor's income; and (iii) a portion of indirect business taxes.[10] Here we will use a different approach to adjust the data to be consistent in measurement.

Combining the expenditure approach, the disposition approach and the income approach to NIPA, we can yield an expression for net national saving (S_t) as $S_t = E_t + rW_{t-1} - C_t - G_t$, where r is return to capital, W_{t-1} is the value of national wealth at the end of year $t-1$, and rW_{t-1} is operating surplus or profits in year t.[11] Using the discretion formulation of savings as the addition to wealth (i.e. $S_t = (W_t - W_{t-1})$), we rewrite net national saving equation as:

8 We will project future household consumption in the same way that we project future labor earnings.

9 For the projection in Section IV, we will allow g_g to gradually decrease.

10 Auerbach et al. (1991) allocated indirect business taxes to labor assuming that labor's share of these quantities was equal to labor's share of net national product, which is gross national product minus depreciation. In the same time, they use net national product minus adjusted labor earnings to obtain adjusted capital income. This kind of adjustment has a shortcoming: the accuracy of this adjustment depends on the assumption (i.e. labor's share of indirect business taxes was equal to labor's share of net national product), which may not always hold.

11 Note that if one were to use the consumption data from NIPA without converting the consumption data reported at consumer's price to being stated in producer's price, the resulting net national saving would be: $S_t = E_t + rW_{t-1} - (1+\tau_t)C_t - (1+\tau_t)G_t = E_t + rW_{t-1} - C_t - G_t - T_t$, which is incorrect. The detailed derivations (for net national saving) are available upon request.

$$W_t = W_{t-1}(1+r) + E_t - C_t - G_t \quad t = 2011,\ 2012,\ \ldots,\ 2040. \qquad (5)$$

Therefore, if we know the value of wealth in 2010, then given the value of E_{2011}, C_{2011} and G_{2011} we can use Equation (5) to calculate W_{2011}. Given the value of W_{2011}, E_{2012}, C_{2012} and G_{2012} we can derive W_{2012}, and so forth obtaining all the values of W_t through to 2040.

Therefore, how do we calculate the value of W_{2010}? The value of W_{2010} depends on the rate of return, r, of course; and it could be obtained by dividing operating surplus (profits) in 2011 by r. Table 1 contains the data for rW_{t-1}, E_t, C_t and G_t for the period of 1982–2011. Therefore, we solve for r iteratively using the data in Table 1; that is, we solve for the value of r that minimizes the difference between the right-hand-side and the left-hand-side of Equation (5). We will adopt the criterion that the r must minimize the difference to less than 1 percent for: (i) 1982–2011, (ii) 1995–2011 and (iii) 2001–2011.[12] We find that only $r = 8$ percent satisfies this criterion for these three periods.

Finally, we calculate China's additional spending over the period 2012–2040 when we lower the annual growth rate of its wealth to a new level, say γ after 2011, which is lower than the growth rate of wealth generated by Equation (5).

III. Description of Data

This section discusses the data used for our projections, including labor earnings and consumption, age- and sex-relative earnings and household consumption profiles, and population by age and sex in the urban and the rural areas. The reliability of official Chinese data is often questioned by researchers and policymakers.[13] It is quite possible that some government officials manipulate the data for political purposes. However, Chow (1993, p. 810) argues that Chinese statistics, by and large, are internally consistent and accurate enough for empirical work. The Chinese Government has promised to improve the quality of data and to adjust historical statistical data (including GDP) when new survey data are obtained, or when the methods of organizing data change (China National Bureau of Statistics or the NBS, 2003). For example, after China's First Economic Census in 2005 (which investigate the data of the year 2004), the NBS revised all the statistical data from 1993 to 2004 (Xu, 2006). The GDP data for 12 provinces were adjusted downward, and many others adjusted upward. Holz (2014) finds that the supposed evidence for GDP data falsification is not compelling, that the NBS has much institutional scope for falsifying GDP data, and that certain manipulations of nominal and real data would be virtually undetectable.

12 It will be shown later (see Figure 6) that 1995 was the beginning of sustained high growth in wealth accumulation, and that wealth accumulation accelerated after 2001.

13 Holz (2004) found that the relationship between the GDP component household consumption and the underlying data varies from year to year, which suggests that time-series comparisons of Chinese GDP may be invalid.

Table 1 China aggregate data (billion yuan, at the 2011 constant price)

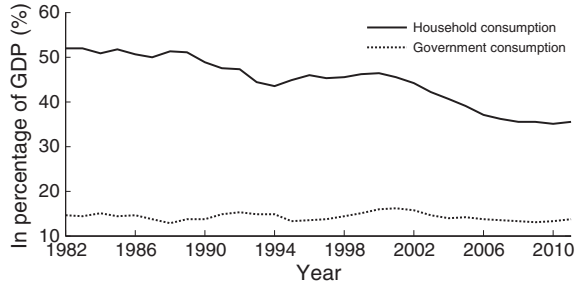
Year	*Household consumption at producer's price*	*Government consumption at producer's price*	*Labor earnings (compensation to employees)*	*Operating surplus (profits)*
	C_t	G_t	E_t	rW_{t-1}
1982	1205.71	337.22	1424.46	655.35
1983	1302.21	360.83	1554.91	713.38
1984	1458.33	430.37	1807.78	830.83
1985	1669.97	462.76	1968.22	942.07
1986	1766.17	506.22	2067.34	954.24
1987	1887.29	517.10	2250.53	1076.32
1988	2018.37	505.71	2378.51	1139.36
1989	1909.19	509.46	2275.14	1053.24
1990	1978.35	552.55	2560.32	1072.64
1991	2169.76	679.67	2784.06	1208.46
1992	2463.90	796.63	3077.85	1467.49
1993	2661.49	889.94	3585.88	1695.77
1994	2870.69	972.22	3872.64	1770.68
1995	3224.48	952.29	4335.19	1808.62
1996	3574.95	1048.99	4560.96	2062.03
1997	3698.86	1123.95	4980.60	2174.38
1998	3902.39	1229.42	5407.77	2306.47
1999	4186.21	1369.74	5762.71	2503.40
2000	4506.32	1539.11	6245.94	2811.07
2001	4771.34	1688.83	6768.53	3117.58
2002	5105.41	1805.19	7504.24	3591.53
2003	5325.70	1850.90	8277.50	4332.48
2004	5908.10	2023.23	9893.68	5030.18
2005	6387.60	2311.24	11 432.68	5657.09
2006	7039.38	2602.48	12 935.62	6819.57
2007	7622.17	2840.57	14 436.47	7973.31
2008	8080.42	3021.16	17 967.55	8027.12
2009	9040.25	3342.25	20 921.95	7426.35
2010	9744.28	3693.69	23 490.12	9620.58
2011	10620.20	4096.00	26 540.00	10 729.73

Source: Calculated by author based on Hsueh and Li (1999), China National Bureau of Statistics, *Data of Gross Domestic Product of China* 1952–2004 (2007) and *China Statistical Yearbook* (2006–2012) and Bai & Qian (2010).

III.1. Labor earnings and consumption

We take China's nominal GDP by expenditure approach for the period of 1982–2011 from the China National Bureau of Statistics (*China Statistical Yearbook*, 2012). Figure 1 shows the percentage of household consumption and government consumption in GDP at the consumer's price. The fraction of household consumption in GDP decreases over time. It was around 50 percent in the 1980s, fell gradually to approximately 45 percent in the 1990s, and continued to decrease to 35 percent in 2011. The share of government consumption in GDP is around 14

Figure 1 Household and government consumption: 1982–2011.



Source: China National Bureau of Statistics (2012)

percent. In all, total consumption drops from 65 percent of GDP in 1980 to 49 percent of GDP in 2011.

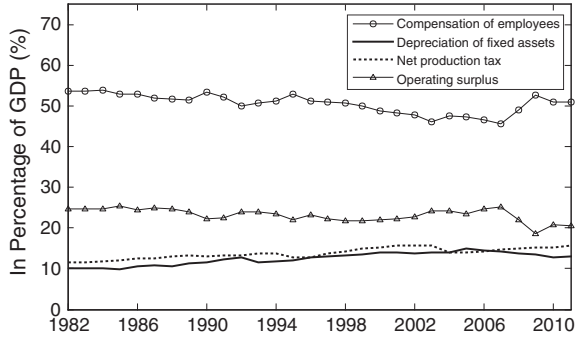
The China National Bureau of Statistics (NBS) uses the income approach to calculate the GDP for each province but it does not provide the GDP calculated by the income approach at the national level. We add up the regional data to obtain data at the aggregate economy level.[14] For 1982–1995, we obtain the components of gross regional product for each province calculated using the income approach from Hsueh and Li (1999), and for 1996–2011 from the NBS.[15] Figure 2 shows the share of each component over the years. Compensation of employees was well above 50 percent of GDP until 1998, then started to decrease, fell to only 45 percent in 2007, the lowest, and bounced back to 51 percent in 2011.[16] Fixed asset depreciation increased over time, rising from 10 percent of GDP in 1982 to 15

14 We recalculated the data and found that, for the period of 1982 to 2011, the average gap between the GDP obtained by adding up local GDPs and the GDP obtained by expenditure approach is only around 2 percent.

15 (1) The China National Bureau of Statistics (1997) published GDP by income approach at provincial level from 1978. We double-checked the data from Hsueh and Li (1999) and NBS (1997); they are the same. (2) Hsueh and Li (1999) do not report data for Tibet (1982–1984) and Hainan (1982–1989). We obtain the gross regional product for Tibet (1982–1984) and Hainan (1982–-1989) from various issues of the *China Statistical Yearbook* and assume that the share of the four components in 1982–1984 (1982–1989) is the same as those of in 1985 (1990) for Tibet (Hainan). (3) The NBS did not publish GDP by income approach for 2008. We calculate the four GDP components (income approach) in 2008 by assuming each component's share of GDP equals the average share of GDP in the years 2007 and 2009. (4) From 2004, the NBS changed statistical methods. According to Bai and Qian (2010), we adjusted the compensation of employees and operating surplus or profits (labor share and capital share) data to make them consistent with the data before 2004.

16 Perhaps it is surprising that, since 2007, the labor share of output (compensation to employees) increased, while the capital share of output (operating surplus) decreased. The reasons are as follows. In 2007, the government issued the *Labor Contract Law*, requiring that employers not underpay workers. In addition, as Chinese economic development proceeds, the growth rate of rural migrant workers keeps decreasing. Thus, the wage rate has increased significantly. Based on NBS (2014), the growth rate of total wages for the urban employees was 10 percent from 1995 to 2006, but it increased to 20 percent from 2007 to 2011.

Figure 2 GDP by income approach: 1982–2011.



Source: Hsueh and Li (1999) and China National Bureau of Statistics (2006–2012, 2007).
Note: From 2004, the NBS changed the statistical methods. According to Bai and Qian (2010), we adjusted the compensation of employees and operating surplus or profits (labor share and capital share) data to make them consistent with the data before 2004.

percent of GDP in 2005, the highest, and fell to 13 percent in 2011. Net production tax increased slightly, from 12 percent in 1982 to 15.6 percent in 2011.[17] Operating surplus (profits) was 25 percent in 1982, kept decreasing to near 20 percent in 2000, then began to increase and reached 25 percent in 2007, the highest level, and fell to 20 percent in 2011.

Combining the consumption data at the consumer's price from GDP by expenditure approach with net production tax data from GDP by income approach, we obtain consumption data at the producer's price using Equation (1). Table 1 displays aggregate consumption and labor earnings over the period of 1982–2011 in 2011 prices (computed using CPI and 2011 prices).

III.2. Age- and sex-relative earnings and household consumption profiles

We use the data from the Urban Household Survey (UHS, 2007) and the Rural Household Survey (RHS, 2007) to calculate the labor earnings profile and household consumption profile by age and by sex in urban and rural areas.[18] We use a kernel-weighted local polynomial regression of labor earnings and household consumption on age to obtain the smoothed data. The 2007 urban household survey data are from all provinces in China, while the rural household survey data are from seven provinces, Beijing, Shanxi, Liaoning, Fujian, Hunan, Yunnan and Gansu, covering the eastern, middle and western regions. The 2007 data is the

17 In China, the ratio of net production tax to GDP is almost twice as high as that in the USA. This ratio is only around 7 percent over the past 30 years in the USA.

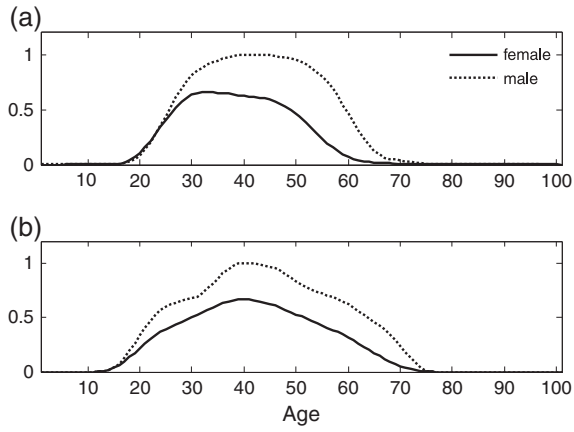
18 Since the profile is a relative value (ratio), it does not matter that consumption is evaluated at the consumer's price or producer's price.

newest data we could obtain. We also have the 2004 data, and using the 2004 data we obtain similar results.

Figure 3a calibrates urban labor earnings profiles of men and women by dividing them by the average urban earnings of a 40-year old man (i.e. the figure displays the age- and sex-relative earnings profile in urban areas, $\overline{R}_{a,s,u}$). The profile shows that before the age of 17, a man basically does not earn anything. Starting from 17, a man's earnings increase gradually to peak at approximately 40 years old. A woman tends to work 1 or 2 years earlier than a man, and reaches her highest earnings at approximately 30 years old. A male's lifetime labor earnings are nearly twice that of a woman's. Figure 3b calibrates rural labor earnings profiles of men and women by dividing them by the average rural earnings of a 40-year old man (i.e. the panel displays the age- and sex-relative earnings profile in rural, $\overline{R}_{a,s,r}$). The interesting difference in the earnings profiles of urban and rural areas is that the former is 'plateau-shaped' while the latter is 'peak-shaped'. Upon reaching the maximum income, urban people continue to earn nearly that amount for the next 15 years. For rural people, their earnings, 15 years after the peak (age 55) would be 70 percent of their peak earning.

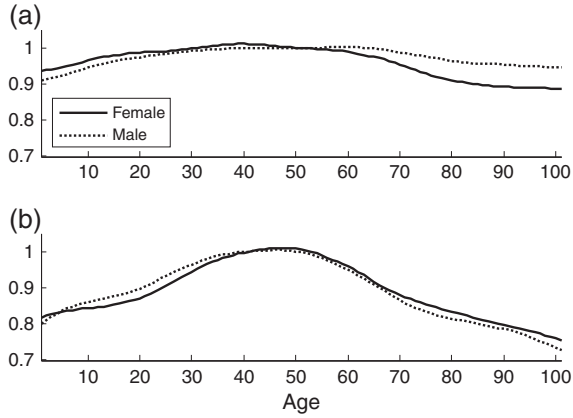
Panel A of Figure 4 calibrates the urban household consumption profile of men and women by dividing them by the average urban household consumption of a 40-year old man. Both the profiles are very smooth over the lifetime, which is in line with life-cycle model hypothesis. It is notable that while a 40-year-old woman's earnings equal only 60 percent of a 40-year-old man's earnings, women have almost the same level of consumption as men. Panel B of Figure 4 calibrates

Figure 3 $\overline{R}_{a,s,j}$ profile for urban and rural labor earnings: (a) urban and (b) rural.



Source: China National Bureau of Statistics, *China Urban Household Survey* (2007), *China Rural Household Survey* (2007) and own calculations.
Note: Recall that $\overline{R}_{a,s,j} = \overline{e}_{a,s,j,t}/\overline{e}_{40,m,j,t}$, age- and sex-relative earnings profile, where $j = r$ means rural area and $j = u$ means urban area.

Figure 4 $\overline{R}_{a,s,j}$ profile for urban and rural household consumption.



Source: China National Bureau of Statistics, *China Urban Household Survey* (2007) and *China Rural Household Survey* (2007), own calculations. Note: Recall that $\overline{R}_{a,s,j} = \overline{c}_{a,s,j,t}/\overline{c}_{40,m,j,t}$, the age- and sex-relative household consumption profile, where $j = r$ means rural area and $j = u$ means urban area.

the rural household consumption profile of men and women by dividing them by the average rural household consumption of a 40-year old man. Compared with urban people, rural people consume less during childhood and old age than in middle age.

Because the latest labor earnings and household consumption data by age and sex in rural and urban areas we can obtain is for the year of 2007, we will follow Auerbach and Kotlikoff's (1990) assumption that the normalized profiles (age- and sex-relative earnings and household consumption profiles) remain unchanged over time.

III.3. Population by age and sex in urban and rural areas

We obtain data on population by age and sex in rural and urban areas from the NBS.[19] We use China's Sixth Population Census, conducted in 2010, to project the population by age and sex in rural and urban areas for each year from 2012 to 2040 by:

1 Assuming that the urban total fertility rate is 1.1 births per woman in 2010, increases to 1.4 births per woman in 2020, and then does not change any more;

19 Data for 2006–2011 were from the NBS *China Population and Employment Statistics Yearbook* (2007–2012); data for 1989–2005 were from the NBS *China Population Statistics Yearbook* (1990–2006); data for the year 1982 were from the NBS *1982 Population Census of China*; data for 1983–1988 were calculated based on total urban and rural population in 1983–1989 and the age- and sex-specific population growth rate between 1982 and 1989.

the rural total fertility rate is 1.45 births per woman in 2010, increases to 1.8 births per woman in 2020, and then does not change anymore.[20]

2 Accepting the projections of future mortality rate by age and sex published by the Ministry of Labor and Social Security.

3 Assuming that the sex ratio at birth is 120 boys to 100 girls in urban areas and 122 boys to 100 girls in rural areas.

4 Assuming that the infancy mortality rate is 4.1‰ in urban areas and remains unchanged afterwards; the infancy mortality rate is 10‰ in rural area, decreases to 5‰ in 2020, and then does not change anymore.

5 Assuming that the number of people moving from rural to urban areas is 12 million each year before 2015, 10 million each year in 2016–2020, 6 million each year in 2021–2030 and 4 million each year in 2031–2040.[21]

The projected total population rises from 1.34 billion to 1.36 billion in 2021, the peak, and then decreases gradually to 1.25 billion in 2040. Figure 5 presents the evolution of the demographic structure over 2010–2040. The proportion of young people (age 0 to 17) in the population will decrease from 21 percent in 2010 to 12 percent in 2040, while the proportion of aged people (above 65) will climb from 9 percent in 2010 to 26 percent in 2040.

III.4. Trends in labor earnings, household consumption and government consumption

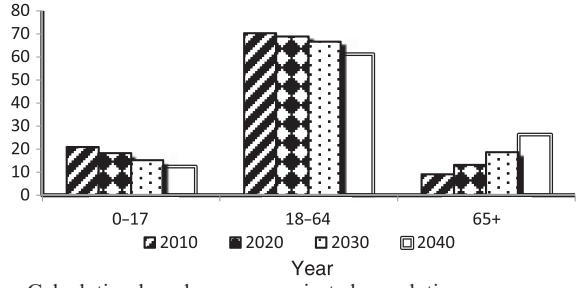
The first four columns of Table 2 show the average household consumption and labor earnings of 40-year-old men in urban and rural areas. In urban areas, a man's consumption of 2202 yuan and labor earnings of 5922 yuan produced a consumption–earnings ratio of 37 percent in 1982. This ratio climbed to reach a maximum of 42 percent in 1988 before declining to reach a minimum of 19 percent in 2011, the last year in our dataset. In rural areas, a man's consumption of 1023 yuan and labor earnings of 3819 yuan produced a consumption–earnings ratio of 27 percent. This ratio climbed to reach a maximum of 29 percent in 1985 before declining to reach a minimum of 15 percent in 2011. The last column of Table 2 presents per capita government consumption, which increased steadily from 331 yuan in 1982 to 3040 yuan in 2011, while the ratio of per capita government consumption to compound labor earnings was 7.7 percent in 1982, rose to 10.3 percent in 2001, the highest level, and then declined to 6.6 percent in 2011.[22] Adding compound household consumption and government

20 We did a sensitivity analysis under a higher fertility rate: if the urban total fertility rate increases to 1.8 births per woman in 2020, and rural total fertility rate increases to 2.1 births per woman in 2020, the national wealth will decrease by 2.7 percent in 2040 compared to the baseline results.

21 The projected population data shows that the urbanization rate is 60 percent in 2020, 65 percent in 2030 and 70 percent in 2040. Considering that the *hukou* system reform will increase the speed of urbanization, we did a sensitivity analysis by allowing a higher urbanization rate (i.e. 62 percent in 2020, to 68 percent in 2030 and 74 percent in 2040) and the results are similar.

22 Compound labor earnings are the weighted average of rural labor earnings and urban labor earnings. Compound household consumption is the weighted average of rural household consumption and urban household consumption.

Figure 5 Demographic structure (2010, 2020, 2030 and 2040).



Source: Calculation based on own projected population.
Note: The figure shows the percentage of the three different age groups (0–17, 18–64 and 65 +) in the total population in the years of 2010, 2020, 2030 and 2040.

consumption together, the total consumption of the 40-year man in China ranged from 24 to 41 percent of compound labor earnings over the period of 1982–2011. As the average growth rate of labor earnings (8.68 percent) was greater than the growth rates of the combined household and government consumption (7 percent) for the 40-year man, the savings rate increased over the years.

For the projection in the next section, we will assume that the average growth rates of urban and rural labor earnings, urban and rural household consumption, and per capita government consumption of a 40-year-old man in the period of 1982–2011 (which are 8.74, 7.11, 6.14, 4.92 and 8.08 percent, respectively) will decrease gradually to 49 percent of the average value of 1982–2011 in 2040.[23]

III.5. The accumulation of wealth

Earlier, we had found that $r = 8$ percent allows the data in Table 1 to meet the equality specified in Equation (5), the wealth accumulation equation. The timing of the fluctuations in the growth rate of wealth displayed in Figure 6 shows that the business cycle has large effects on the rate of wealth accumulation, causing it to range from −7.5 percent in 1989 (a year of depressed economic activities but a year of turbulent political activities) to 20 percent in 2003 (a year of extraordinary export boom), and from − 7.4 percent in 2009 (a year of global financial crisis) to 29 percent in 2010 (a year after China announced a four-trillion yuan investment plan). We smoothed the growth rate series to look at the underlying movement by using a centered-MA3 procedure. The smoothed series reveals that China had sustained high rates (of at least approximately 10 percent) from 1995 onward and that the growth rate showed a high trend after 2002 when new political leaders

23 China's average real GDP growth rate is 10.24 percent in 1982–2011, and if the real GDP growth rate decreases to 5 percent in 2040, the latter is 49 percent of the former. We also made projections under the assumption that growth rates decrease gradually to 39 percent of the average value of 1982–2011 in 2040. (China's average real GDP growth rate is 10.24 percent in 1982–2011, and if it decreases to 4 percent in 2040, the latter is 39 percent of the former.)

Table 2 Per capita household consumption, labor earnings, and government consumption (billion yuan, at the 2011 constant price)

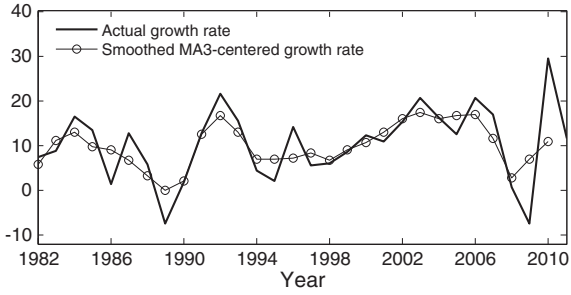
Year	Urban		Rural		Per capita government consumption
	Household consumption of a 40-year-old man	Labor earnings of a 40-year-old man	Household consumption of a 40-year-old man	Labor earnings of a 40-year-old man	
1982	2202.05	5922.24	1023.02	3819.22	331.73
1983	2257.16	6299.40	1107.04	4037.05	350.29
1984	2368.58	7099.43	1236.84	4522.02	412.40
1985	2724.41	7517.84	1364.62	4759.24	437.18
1986	2892.14	7663.35	1382.55	4824.03	470.88
1987	3062.04	8184.63	1424.19	5030.11	473.10
1988	3376.76	8035.00	1427.45	5281.52	455.49
1989	3190.64	7648.93	1300.90	4833.56	452.03
1990	3367.93	8521.47	1281.10	5282.40	483.28
1991	3730.97	9724.63	1333.95	5355.57	586.81
1992	4302.46	11 259.11	1426.90	5455.53	679.89
1993	4759.53	13 286.78	1427.42	5981.91	750.89
1994	5084.89	14 142.86	1487.82	6225.05	811.20
1995	5630.40	14 910.40	1625.86	6940.49	786.23
1996	5757.12	14 470.34	1878.04	7372.38	857.09
1997	5771.90	14 775.23	1889.84	7984.42	909.15
1998	6020.81	15 668.76	1882.77	8380.99	985.42
1999	6345.51	16 544.88	1927.95	8495.46	1088.95
2000	6688.06	17 658.97	1994.99	8823.34	1214.35
2001	6867.78	18 663.20	2075.09	9165.72	1323.26
2002	7164.41	21 400.93	2165.09	9129.82	1405.33
2003	7409.23	23 588.34	2118.93	9466.97	1432.29
2004	8056.58	27 621.59	2285.63	10 978.94	1556.47
2005	8388.33	31 612.17	2532.72	12 756.94	1767.60
2006	9031.76	35 505.84	2738.58	13 694.53	1979.85
2007	9560.89	39 060.43	2887.28	14 636.84	2149.84
2008	9892.71	47 368.98	3064.41	18 146.16	2274.94
2009	10 892.92	54 621.03	3313.59	20 229.44	2504.50
2010	11 419.48	58 661.17	3558.50	23 035.34	2754.62
2011	12 133.78	64 062.84	3985.07	26 664.60	3040.04
Average	6011.71	21 050.03	1971.60	9376.99	1157.50

Source: Calculated by author based on Hsueh and Li (1999), China National Bureau of Statistics, *Data of Gross Domestic Product of China* 1952–2004 (2007), *China Statistical Yearbook* (2006–2012), *China population and employment statistics yearbook* (2007–2012), *China Population Statistics Yearbook* (1990–2006), *1982 Population Census of China* (1982).

took office.[24] The outcome was that the amount of wealth at the end of 2011 was 16 times larger than in 1982.

24 The average annual growth rate of wealth was 10.32 percent for the 1982–2011 period; and 8.7, 11.5 and 13.3 percent, respectively, for the sub-periods of 1982–1994, 1995–2011 and 2001–2011.

Figure 6 Growth rate of wealth: Actual and smoothed (%).



Source: Own calculation based on data from Table 1.

IV. Projection Results

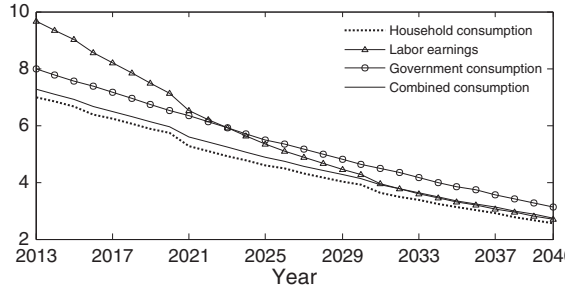
IV.1. Projected national saving

The results from using our projection methodologies are displayed in Figure 7. We see that the growth rate of labor income declines from 9.6 percent in 2012–2013 to 2.7 percent in 2039–2040, with the average over the period being 5.4 percent. The growth rate of combined household and government consumption falls from 7.2 percent in the beginning of the period to 2.7 percent at the end of the period to yield an average 2012–2040 growth rate of 4.7 percent. Because we had assumed that the growth rates of the labor earnings, household consumption and government consumption for a 40-year old Chinese man would proportionally decrease on the basis of the average 1982–2011 growth rates for these items, the fact that the difference of average growth rate between aggregate earnings and combined consumption becomes smaller reflects the differences in demography between the 1982–2011 period and the 2012–2040 period.

Using the projected wealth data, we can obtain national saving from 2012 to 2040. National saving is 26 trillion yuan in 2012, 180 trillion yuan in 2030, and keeps increasing to 417 trillion yuan in 2040, which is 16-fold of that in 2012.[25] (The growth rate of national saving is 14 percent in 2012, 9 percent in 2030 and 8.4 percent in 2040). Based on data from Table 1, we can see that national saving in 2011 is 42-fold that in 1982, and the average growth rate over the period of 1982–2011 is 14 percent. Apparently, the growth rate of national saving slows down. There are two reasons behind this. First, urban people have a higher consumption–earnings ratio than rural people (see Subsection III.4). With urbanization, the proportion of urban people increases, the nationwide

25 If growth rates of earnings and consumption of the 40-year-old man decrease gradually to 39 percent of the average value of 1982–2011 in 2040: (i) the average growth rate of labor income during 2012–2040 will be 4.9 percent; (ii) the average growth rate of consumption during 2012–2040 will be 4.3 percent; and (iii) national savings in 2040 will be 15-fold that in 2012.

Figure 7 Growth rates of projected *C*, *G* and *E*: 2013–2040 (%).



consumption–earnings ratio increases, and the growth rate of national saving decreases. Second, people tend to save in middle age and dissave during old age. With population aging, the proportion of aged people increases and the growth rate of national saving decreases.

IV.2. Consumption under different rates of wealth accumulation

The above baseline projections of earnings and consumption show a great increase in China's wealth, which (at the 2011 price) rises from 183 trillion yuan in 2012 to 4756 trillion yuan in 2040, a 25-fold increase.[26] This huge increase occurs despite the fact that aging of the population, which also leads inevitably to a falling rate in wealth accumulation (from 16.3 percent in 2012 to 10.9 percent in 2030, and then to 9.5 percent in 2040).

To understand how the consumption path would change under different rates of wealth accumulation after 2011, we write the following equations:

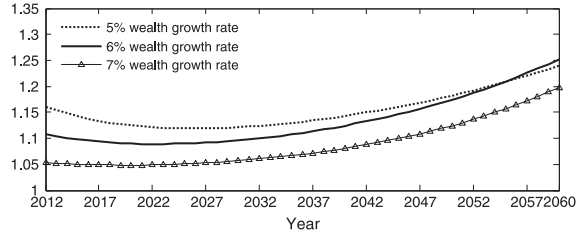
$$\begin{aligned} CG_{\gamma,t} &= W_{\gamma,t-1}(1+r) + E_t - W_{\gamma,t} \\ &= W_{2011}(1+\gamma)^{t-2012}(r-\gamma) + E_t \\ &\text{for } t = 2012,\ 2013,\ \ldots,\ 2040, \end{aligned} \tag{6}$$

where $CG_{\gamma,t}$ is total consumption (household consumption plus government consumption) calculated based on the growth rate wealth sequence γ, $W_{\gamma 2011} = W_{2011}$[27] and the target value of $W_{\gamma t}$ in each future year is generated from $W_{\gamma t} = W_{\gamma t-1}(1+\gamma)$. Clearly, γ has to be less than the baseline wealth growth rate for consumption to increase. If the growth rate of wealth γ increases, $W_{2011}\ (1+\gamma)^{t-2012}\ (r-\gamma)$ may either increase or decrease.

26 If growth rates of earnings and consumption of the 40-year-old man decrease gradually to 39 percent of the average value of 1982–2011 in 2040, China's wealth in 2040 will be 25-fold that in 2012.

27 The value of W_{2011} is obtained by substituting the 2011 values for E_t, C_t and G_t and the 2010 value of W_t into Equation (5).

Figure 8 Ratio of total consumption induced by slower wealth accumulation to total consumption under 8 percent wealth growth rate($r > \gamma$).



Source: The three curves are calculated based on the following formula: (total consumption under a lower wealth growth rate)/(total consumption under 8 percent wealth growth rate).

We now project total consumption at alternative values of γ: 5, 6, 7 and 8 percent (recall that $r = 8$ percent). The ratios of total consumption induced by a slower wealth accumulation to total consumption under the wealth growth rate 8 percent are shown in Figure 8. Consumption under 5 percent wealth growth rate is larger than that under 6 percent wealth growth rate in the short run, but smaller after 2055.[28]

However, if $r < \gamma$, a lower wealth growth rate will guarantee higher consumption. We project total consumption for three values of γ: 8, 9 and 10 percent.[29] In Figure 9 consumption under 8 and 9 percent wealth growth rate is larger than that in the baseline (baseline wealth growth rates are all above 9 percent, e.g. 16.3 percent in 2012 to 10.9 percent in 2030, and then to 9.5 percent in 2040). However, if the wealth growth rate is 10 percent, consumption will be smaller than that on the baseline in the future.

How much more would China consume if lowered the rate of its wealth accumulation from now through to 2040? When the wealth growth rate is reduced to 5, 7 or 9 percent, the amount of extra consumption in each case is very large, being 152, 138 and 90 percent above the baseline in 2040, respectively.

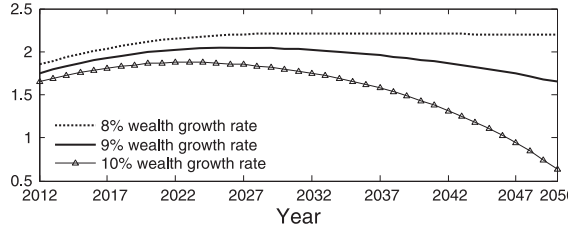
Figure 10 shows the changes in the wealth stock behind the different consumption paths. Compared to the 25-fold increase in wealth between 2012 and 2040 under the baseline projections, wealth increases threefold, fivefold and tenfold, respectively, when $\gamma = 5$ percent, $\gamma = 7$ percent and $\gamma = 9$ percent.

V. Concluding Remarks

Extending the methodology used by Auerbach and Kotlikoff (1990) and Auerbach *et al*. (1991), this paper has predicted China's aggregate national saving

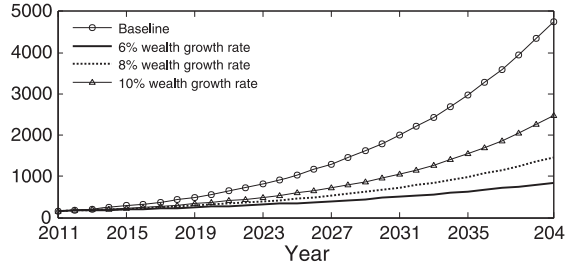
28 In order to show the intersection of the curves, we made projections through to 2060.
29 The average wealth growth rate in 1983–2011 was 10 percent.

Figure 9 Ratio of total consumption induced by slower wealth accumulation to baseline total consumption ($r < \gamma$).



Source: The three curves are calculated based on the following formula: (total consumption under a lower wealth growth rate)/(total consumption in the baseline).

Figure 10 China's wealth, 2011–2040 (in trillion of the 2011 yuan).



through 2040 based on China's national account data, demographic data, and rural and urban respective life-cycle income and consumption data.

There are two extensions in the methodology. First, we utilize the producer's price (instead of the consumer's price) to adjust the national account data. We show that directly use the consumption data from the NIPA (i.e. without conversion) will underestimate national savings. Second, we apply different life-cycle income and consumption profiles (instead of using the same profiles for the whole country) for rural and urban area. We have shown that urban and rural people share different life-cycle income and consumption profiles.

Our baseline results show that future demographic factors will reduce the gap of the average growth rate between aggregate earnings and combined consumption during the period 2012–2040. With the population decreasing and aging, the growth rate of aggregate earnings and combined consumption will decrease, with the former declining more than the latter. Moreover, national saving in 2040 will be 16-fold that in 2012, and wealth accumulation in 2040 will be 26-fold that in 2012. The projected annual growth rate of national saving is decreasing from 14 percent in 2012 to 8.4 percent in 2040. The projected annual growth rate of wealth is decreasing from 16.3 percent in 2012 to 9.5 percent in 2040. Compared to the

41-fold increase in national saving between 1982 and 2011, the growth rate of national saving slows during 2012–2040 due to urbanization and population aging.

The high saving rate in China has been identified by some observers to be the cause of China's chronic trade surpluses; it is now common to hear calls for China to rebalance its growth path by saving and investing less and increasing consumption. Our analysis shows that lowering the growth rate of wealth accumulation to the current rate of return to wealth will increase consumption through 2040; lowering the growth rate of wealth further may increase consumption more in the short period, but less in the long run.

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