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Future Population Trends in China: 2005-2050

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Abstract

Using China's 2000 census data, this paper conducts population projection under different fertility scenarios to gauge the likely trends in China's future population change. The range of fertility assumptions captures the uncertainty of current fertility estimates as well as the likely trends under the family planning policy and economic development. Only one mortality scenario is applied and net international migration is assumed to be null in the population projection. Future life tables are generated by Brass logit techniques with initial 2000 life tables and assumed annual life expectancy at birth following the United Nations medium improvement model.

China is experiencing unprecedented demographic transition together with the radical social and economic transformation. Demographically speaking China is now a developed country. However, China's future population growth is substantial, a solely result of the population momentum built into the age structure by past fertility and mortality. 10 percent or 135 million increase is expected in the next 25 years under the medium fertility scenario. China would reach a maximum population of 1443 million in 2030, followed by a long-term population decline.

Two major changes of the future population age structure of China are continuing demographic dividend and rapid population ageing. China's demographic window of opportunity opened at 1990 and will close at 2033. Having a work force of around one billion has many advantages if we consider only the dependency ratio in the population or the labour supply for the development. However, China will be also experiencing a rapid population ageing after 2015. One fifth to one quarter of the Chinese population would be older people at age 65 or over after 2035. The year of 2029 would be a turning point in China's age structure transition, when for the first time in Chinese history the elderly population would exceed the child population.

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1. Introduction

Population data are needed in virtually all the fields of social life and societal development. Data on size and structure of a population, for example, play a crucial role in formulating development policies and implementing social programs. Timely and accurate population data are obtained by monitoring population changes, while designing development strategies and evaluating development goals are largely based on estimation and projection of future population trends. Chinese experience shows that total population estimates from more recent projections are usually lower than those from previous projections, but higher than those published by National Bureau of Statistics of China. Thus regular conduct of population projection is necessary for a country or area, so that changing population situation is incorporated and results are produced to be more likely the realities.

The major objective of this paper is to produce a population projection of China up to the mid-century. A great demographic transition is taking place in China while Chinese economy is expected to be growing still rapidly in the next one or two decades. China's demographic trends have important implications for future economic development. Fertility is far below replacement in China while population momentum is expected to be substantial. However, China's family planning policy can make a difference in future fertility level. This paper conducts population projection under different fertility scenarios to gauge the likely trends in China's future population change. We give in the next section a description of the data and methodology in the population projection, followed by presentation and analysis of the results and their implications.

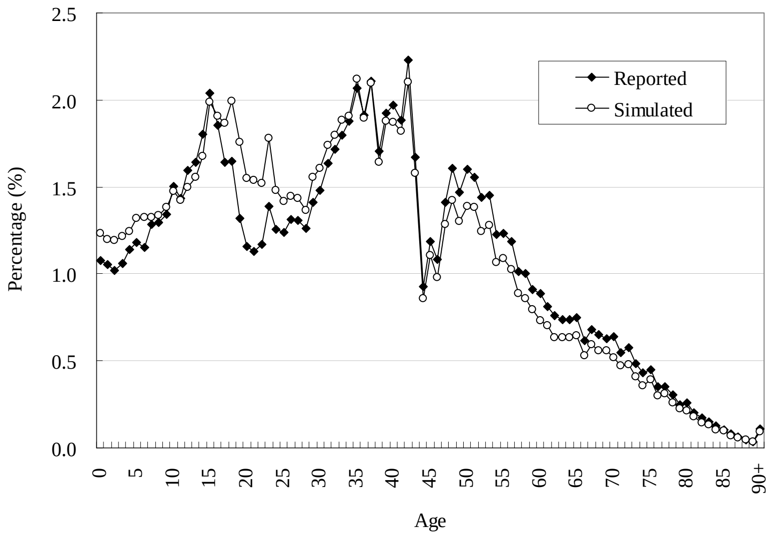
2. Data and assumptions in the population projection

2.1 Data prepared for the population projection

Despite the fact that population data from 2005 One-percent Population Sample Survey are available (NBS 2007), the input data of this projection are drawn from the 2000 Population Census (NBS 2002). Scholars (Yu 2002; Zhang and Cui 2003; Zhang and Zhao 2006; Zhai and Chen 2007; Cui 2008) argue that there are some problems, to varying extent, in data quality of births and population under age 10 in the 2000 census and 2005 survey, however, no studies are available on assessment and adjustment of the 2005 survey data. 2000 census data have been evaluated and adjustment in a recent study on China's fertility (Zhai and Chen, 2007), in which China's education statistics (student enrolments in primary schools) was used to estimated the age-sex patterns of under-reporting in the 2000 census. The education statistics so far available does not enable such adjustment on the 2005 survey data. Using education data, roughly 30 million people are estimated to be missing from the 2000 census population under age 10 (Zhang and Cui 2003; Zhai and Chen 2007). Adjustment has been made to bring back the missing population and a new distribution of population by age and sex is established, which is used as the base year population for this population projection. Despite the uncertainty with the levels of fertility and mortality derived from the 2000 census, we assume that age pattern of fertility and age-sex pattern of mortality from the 2000 census are accurate and utilized in this population projection[1].

We conduct a two-stage population projection. In the first stage, we make simulation of the population from 2000 to 2005 using particular fertility levels so that the produced total population estimates meet the published numbers from NBS. The population projection after 2005 in the second stage is conducted using different fertility scenarios. Figure 1 compares the age distribution of population from the 2005 survey with that derived from the simulation from 2000 to 2005. The simulated age structure in 2005 has higher proportions in population under age 30 and lower proportions in population over 45.

Figure 1 Comparison of the simulated age structure in 2005 with the 2005 survey reported age structure



Source： Simulation results and NBS(2007).

2.2 Assumptions on future vital rates

Fertility, mortality and migration are the three components causing population change in a defined area or country. Assumptions about the future changes in the three components are crucial to population projection. Table 1 shows three different fertility assumptions adopted in the population projection from 2005 to 2050, representing low, medium and high fertility scenarios respectively.

[1] It's reasonable to assume that births and deaths are under-reported to a similar extent across all ages, and age patterns of fertility and mortality are relatively reliable from the census.

Table 1 Fertility assumptions in the population projection

	2005-2015	2015-2050
Low	A linear decline in total fertility rate from 1.67 in 2005 to 1.5 in 2015	Constant at 1.50
Medium	A linear increase in total fertility rate from 1.67 in 2005 to 1.8 in 2015	Constant at 1.80
High	A linear increase in total fertility rate from 1.67 in 2005 to 2.1 in 2015	Constant at 2.10

The range of fertility levels in the three scenarios captures the various estimates of China's fertility at the start of this century. Most scholars have had consensus on that fertility in China has dropped to below replacement level, but disagreed with how low China's fertility has achieved. Estimates range from a total fertility rate (TFR)[2] of 1.5 or lower to 2.0 or higher (Guo 2004; Ma 2005). However, there are additional considerations adopting the range of the fertility assumptions in this population projection. An TFR of 1.5 children per woman is currently observed in the developed countries, and China would be approaching to this level in the context of current family planning policy and rapid economic development. The medium level of 1.8 children per woman represents the government-targeted fertility level in the long run when the current fertility policy would be gradually changed to a two-child policy (The Project Group on National Population Development Strategies 2007). In fact, China's central fertility policy has been increasingly localized and diversified at provincial and lower level (Guo et al. 2003). Currently there is a two-child policy applied to couples whose both sides are only child, and in rare cases to couples whose either side is only child. Birth spacing policies are also relaxed or abolished in many provinces, and restrictions on timing of marriage and births are largely removed from policies. The medium fertility assumption is often considered to be the most likely future scenario. Finally the high fertility scenario of 2.1 represents the replacement level of fertility, a level that will produce a stationary population in the long run[3].

[2] TFR is calculated as a summation of age-specific fertility rates, implying the average number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years conforming to the age-specific fertility rates of a given year. This rate is sometimes stated as the number of children women are having today.

[3] Replacement fertility refers to a fertility level at which a couple has only enough children to replace themselves. Under the prevailing mortality pattern in China, a TFR of 2.1 is considered to be replacement level (more than 2.0 to allow for childhood mortality).

There is only one mortality scenario in the population projection. NBS published the life table of 2000 census, according to which the average life expectancy of males and females is 69.63 and 73.33 years respectively. Future assumption about changes in life expectancy is made following the United Nations models (medium pace) for mortality improvement (United Nations 2006). Thus China's male and female life expectancy at birth would be respectively increased to 70.71 and 74.53 years in 2005 and to 77.65 and 82.05 years in 2050. Since international migration is too small (largely null) relative to the total population, we usually assume zero net migration in China's population projections as we consider China's population to be virtually a closed one.

3. Method of the population projection

3.1 The cohort-component method

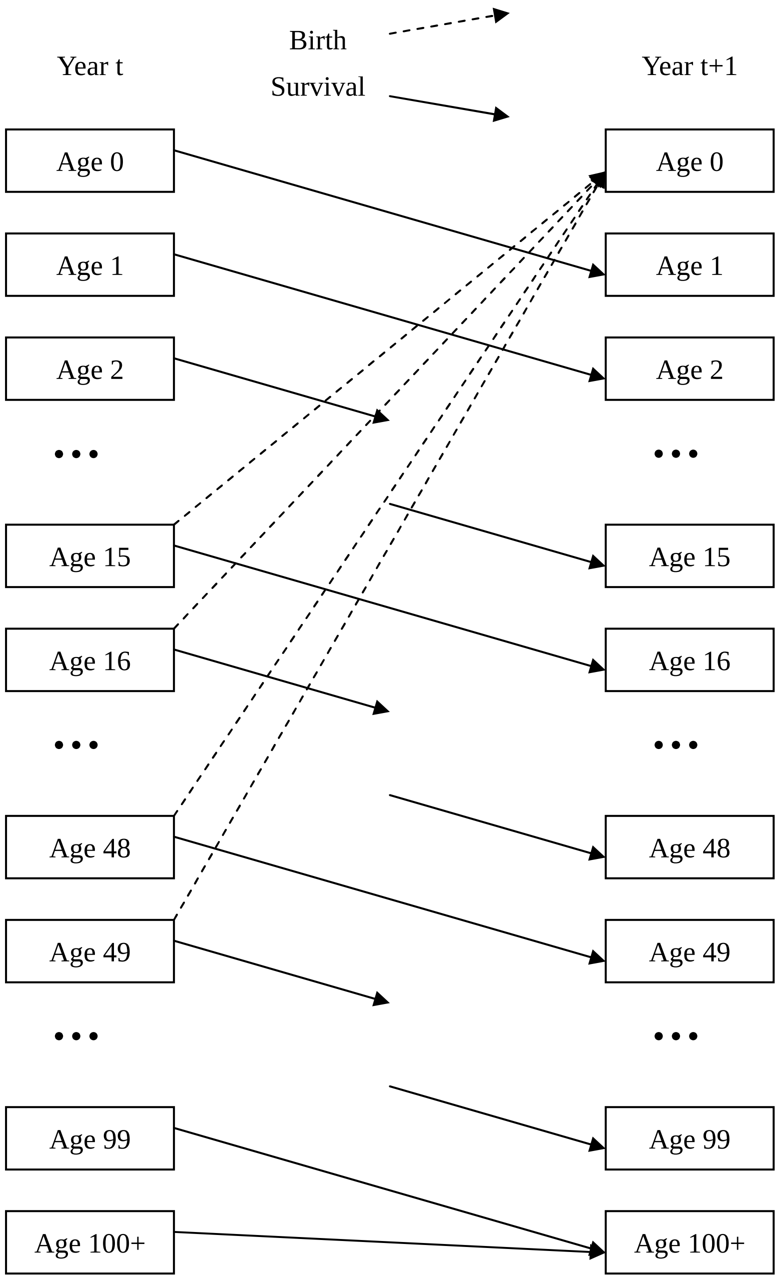
The number of people living in China at a given time will only change when one of the following three events takes place: a birth in China, the death of someone living in China, and a person migrating into or out of China. These components of population change are usually measured by observable rates: the fertility rate, the mortality rate and the migration rate, respectively. A population projection is simply a conduct of calculating future population numbers by applying future rates of fertility, mortality and migration.

Specifically an initial population is grouped into cohorts defined by age and sex, and the projection proceeds by updating the population of each age- and sex-specific group according to assumptions about the three components of population change. Each cohort survives forward to the next age group according to assumed age-specific mortality rates. The cohort-component method of population projection is illustrated in Figure 2 (Hinde 1998; O'Neill et al. 2001; Rowland 2003).

As an example, the number of females in a particular population aged 20 in 2001 is calculated as the number of females aged 19 in 2000 multiplied by the assumed probability of survival for females of that age over the time period 2000-2001. This calculation is made for each age group and for both sexes, and is repeated for each time step as the projection proceeds. Migration can be accounted for by applying age- and sex-specific net migration rates to each cohort as well.

The size of the youngest age group is also affected by the number of births, which is calculated by applying assumed age-specific fertility rates to female cohorts in the reproductive age span (see Figure 2). An assumed sex ratio at birth is used to divide total births into males and females[4].

Figure 2 The cohort-component method of population projection



[4] A normal range of sex ratio at birth (SRB) in history and across the world is 103-107 male births per 100 female births. Usually an assumed SRB of 105 is applied in population projections. However, China has had a rising and highly abnormal SRB over the last 20 years. Estimates stood at 120 since 2000, the world's highest.

A fundamental feature of the method is that the projected size and age structure of the population at any point in the future depends entirely on the size and age structure at the beginning of the period and the age-specific fertility, mortality, and migration rates over the projection period. Uncertainty in projection outcomes arises not from uncertainty in the formal projection model itself, but from uncertainty in the baseline population data and the assumptions of future trends in fertility, mortality and migration (O'Neill et al. 2001).

In a summary way, the cohort-component population projection is conducted by the following three equations:

$$ {}_nP^s_{x+n,t+n} = {}_nP^s_{x,t}\left(\frac{{}_nL^s_{x+n,t}}{{}_nL^s_{x,t}}\right) + {}_nM^s_{x+n,t+n} \qquad (1) $$

$$ {}_nP^s_{0,t+n} = {}_nB^s_t\left(\frac{{}_nL^s_{0,t}}{{}_nl^s_0}\right) + {}_nM^s_{0,t+n} \qquad (2) $$

$$ {}_nB_t = n\sum {}_nF_{x,t} \times {}_nP^f_{x,t} \qquad (3) $$

where P=population, s=sex, M=net migration, B=births, n=interval of age group， t=time (year), F=fertility rate, f=female, l=life table survivors, L=person-years lived by survivors, x=age. Note that total births in Equation (3) need to be split into male and female births using the assumed sex ratio at birth.

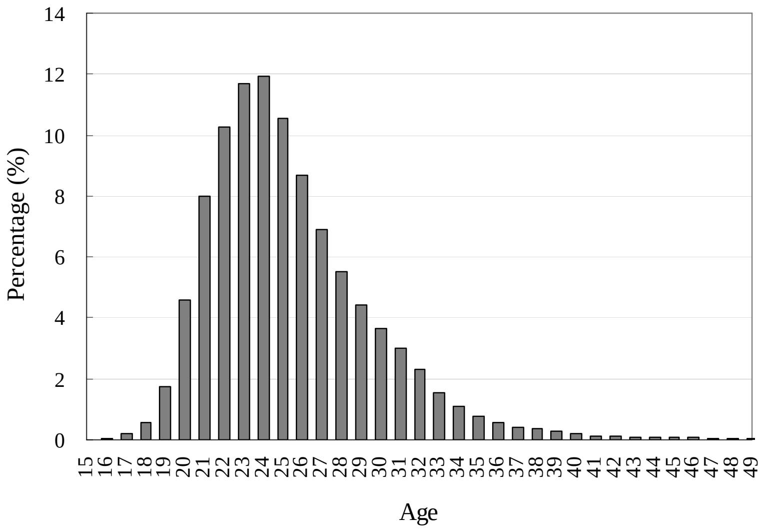
3.2 Age patterns of fertility and mortality

A population projection would be successfully done if the following data have been prepared: a base year population by age and sex, sex-specific life tables for the projection period, age-specific fertility rates for the projection period, and age- and sex-specific net migration for the projection period. In the Chinese case, we disregard the migration component, thus only fertility and mortality are considered. For each of the components, its level and age pattern should be determined for the population projection. Assumptions about their levels for the projection period are already given in last section. An equally important task is to determine the age pattern of fertility and mortality for the projection period. For simplicity, we assume the age patterns are largely held constant[5].

[5] This assumption is reasonable because the post-transitional demographic conditions in China are

Age pattern of fertility applied in the population projection is the percentage distribution of fertility by age, which is obtained by dividing age-specific fertility rates by the TFR (Figure 3). If we keep the age pattern of fertility constant, we can easily calculate age-specific fertility rates applying any assumed TFR in the projection period. The idea is just the same in the case of mortality, but a much more sophisticated approach is adopted in calculating age pattern of mortality, that is life table.

Figure 3 Percentage distribution of fertility by age, China, 2000



Source: NBS (2002).

The central practice of the population projection is that population of each cohort is calculated forward to the next age group the next year according to age-specific survival ratios derived from assumed age-specific mortality rate through calculating a life table[6]. Life tables in the projection period are calculated by Brass logit techniques with an initial life table and the assumed life expectancy at birth in future years.

likely to be of slow and smooth change in levels while virtually no change in age patterns of fertility and mortality.

[6] Life table is a mathematical model that summarises the mortality experience of a population. Specifically the life table describes the mortality experience of a hypothetical group of new born babies throughout their entire lifetime with the assumption that this group is subject to the age-specific mortality rates of the reference period. Life tables are used to calculate survival probabilities and average life expectancies of a population.

Brass (1968; 1971) discovered that a logit transformation of the probabilities of survival to age *x* (*lx* values in life table terms) made the relationship between corresponding probabilities for different life tables approximately linear (United Nations 1983). Specifically the linear relationship

$$\lambda(l_x^*) = \alpha + \beta\lambda(l_x)$$

is approximately true for all values of *x* if $\lambda(l_x)$ is defined specifically as

$$\lambda(l_x) = \text{logit}(l_x) = 0.5\ln\left(\frac{1.0 - l_x}{l_x}\right) \quad ,$$

then the new life table can be produced by $$l_x^* = \frac{1}{1 + e^{\left(2\alpha + \beta\ln\left(\frac{1-l_x}{l_x}\right)\right)}}$$.

In fact, all life tables can be generated from a single life table by changing the pairs of (α, β) values used. Since β determines the shape of the *lx*, changing α without changing β would produce a new life table that has a similar pattern of mortality to the initial pattern while having a different level of mortality (Figures 4-7). When we assume the age pattern of mortality keep the same for the projection period, what we need to do is to set β to be 1 and find an α value that could generate a life expectancy at birth equaling the assumed one, thus producing a life table having the assumed life expectancy at birth. In conducting population projection, survival ratios derived from a life table are used to update each cohort forward year by year.

However, it is a common practice in projecting mortality to use the model life tables[7]. It is very likely that using model life tables and adopting the Brass approach discussed above would produce nearly identical results. However, the Brass approach offers a much greater flexibility both in producing a new life table and in programming the population projection.

[7] Model life tables are constructed for study of age patterns of mortality. They are primarily an aid to the estimation of demographic parameters for countries with limited data. They are needed extensively in preparing population projections. Two types of model life table are available and used widely in population projections: Coale and Demeny (1966) regional model life tables and United Nations (1981) model life tables for developing countries.

Figure 4 Age pattern of male mortality, China, 2000-2050 (*lx*)

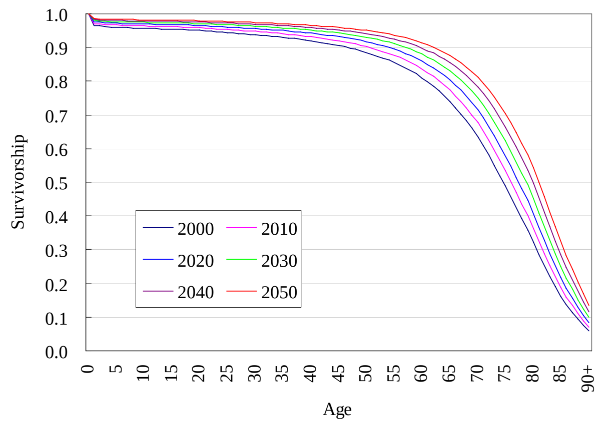


Figure 5 Age pattern of male mortality, China, 2000-2050 (*logit*(*lx*))

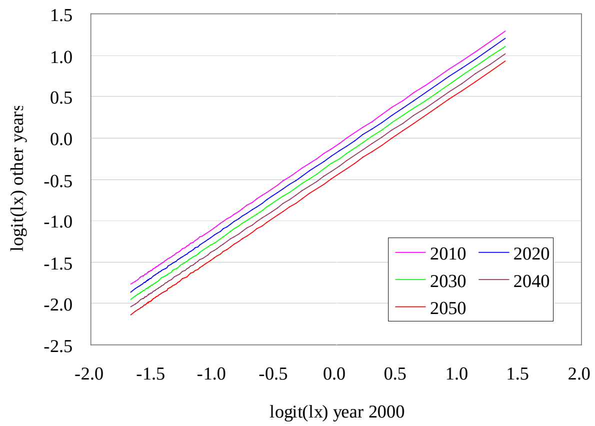


Figure 6 Age pattern of female mortality, China, 2000-2050 (*lx*)

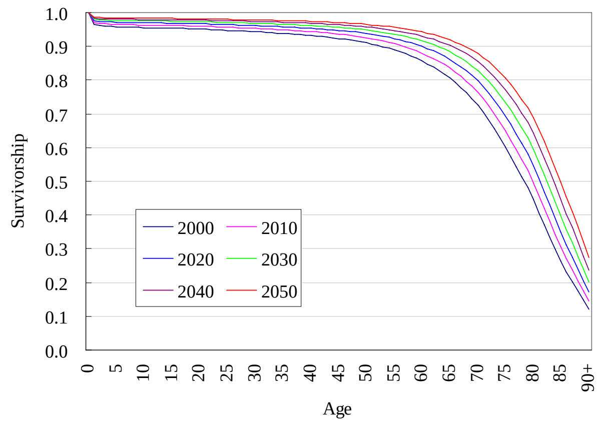
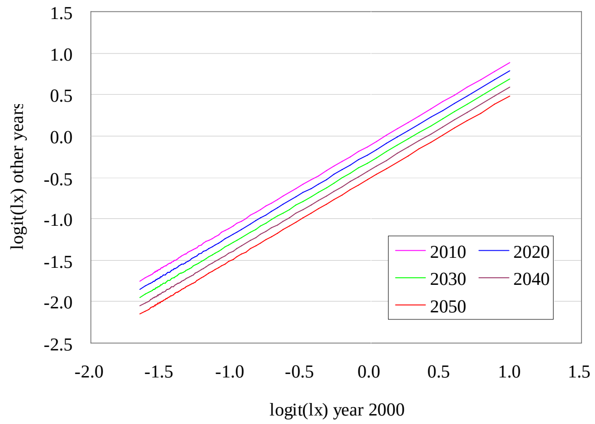


Figure 7 Age pattern of female mortality, China, 2000-2050 (*logit*(*lx*))



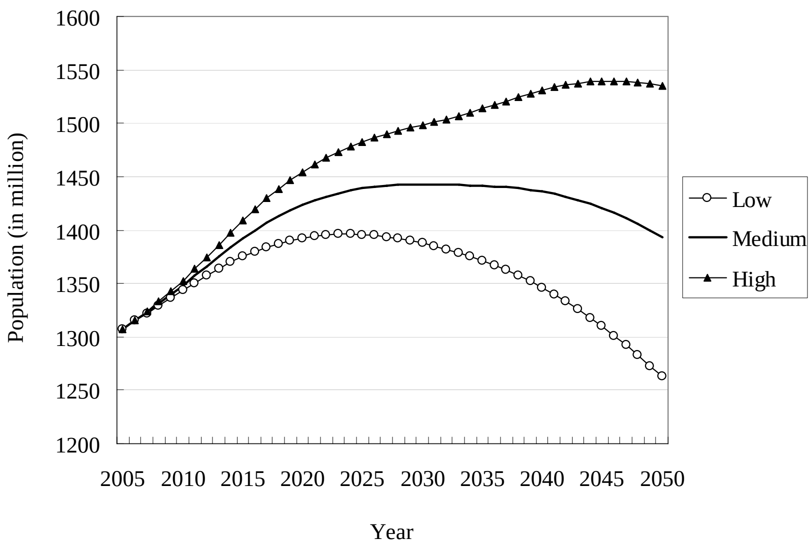
Source: Life tables generated with assumed life expectancy at birth in the projection period.

4. Results from the population projection: trends and implications

4.1 Substantial population growth is expected in the next 25 years, with an increment of 135 million people

The population of China stood at 1307.6 million in 2005 according to NBS estimate based on the 2005 survey. Results from the medium fertility scenario of the population projection show that China's population is expected to increase to 1423 million in 2020, and to a maximum of 1443 in 2030, after which a long-term decline is expected as a result of below-replacement fertility. By 2050, China's population would be reduced to 13.93 million (Figure 8 and Appendix Table 1).

Figure 8 Total population of China, 2005-2050

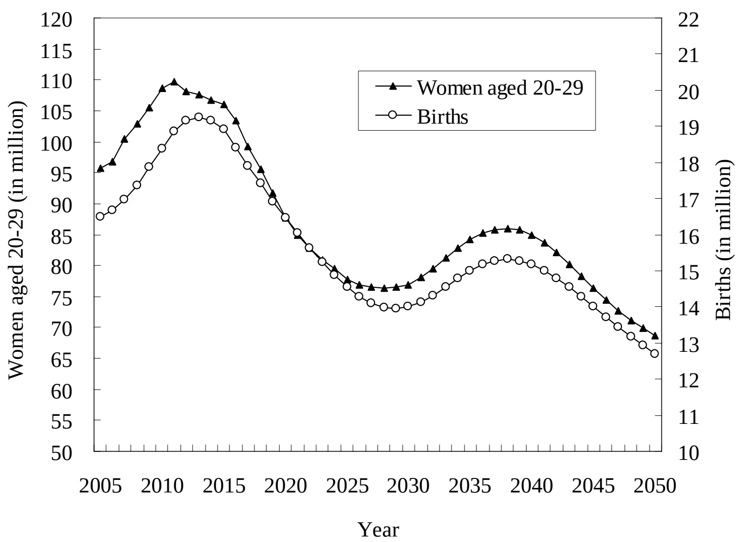


Source: Projection results, see Appendix Table 1.

Increasing differences are observed between results from different fertility scenarios up to 2050. The total population would be 1392 and 1454 million respectively by 2020 under low and high scenarios. An earlier turning point from positive to negative increase is expected in the low scenario, which would occur at 2024 with a maximum population of nearly 1400 million. The population would be increasing to a maximum of 1540 million by 2046 under the high scenario. A population of 1263 and 1535 million is expected respectively under the low and high scenarios by 2050. Despite only a gap of 0.3 birth between different fertility scenarios, huge differences in population size will result in the long run, with the sheer magnitude of 130-140 million between different fertility scenarios.

Even fertility is far below replacement level (TFR=1.5), population momentum built into the age structure would bring about increased number of births in the next 10 years as a result of increasing number of women at childbearing ages. This is what usually called the fourth baby boom in China (Figure 9). Annual number of births would increase from no more than 17 million to 18-20 million, and annual population increment would increase from no more than 8 million to 9-10 million. The baby boom is expected to be reproduced in every 25 years (assuming the average age of childbearing to be 25 years) although to an increasingly lesser extent.

Figure 9 Trends in births and women aged 20-29 (medium scenario), 2005-2050



Source: Projection results, see Appendix Table 2.

Therefore, future population growth in China would be solely a result of population momentum from a relatively young age structure. Unlike many European countries where age structure of populations has turned out negative momentum of population growth, China is still expected to have substantial population increase despite that fertility in China is at a similar level of that in Europe. Projection results show that China's population would grow by 10%, or an increment of 135 million people in the next 25 years. This increment is larger than the current population of Japan, and adds to challenges on China's economic development.

Population of the three broad age groups is expected to experience different path of change. China's child population aged 0-14 tends to be stable at around 260 million up to 2020, after which a declining trend is expected. The working age population aged 15-64 would experience a slow growth to 1000 million by 2016 and level off around 980-990 million up to 2026, then a rapid decline is expected afterwards. However, the elderly population defined to be those of age 65 and over would be growing all way through, from 100 million in 2005, to 200 million in 2026, and 300 million in 2036. The year of 2029 would be a turning point in the demographic history of China, when China's elderly population (233 million) would exceed the child population (232 million) for the first time in history.

4.2 China's demographic dividend is expected to continue in next 30 years

A significant transition in China's population age structure will be taking place, which is presented in the four population age pyramids of 2005, 2020, 2035 and 2050 in Figures 10-13. The 2005 pyramid has distinctively different shape between its lower and upper half. The upper half implies a typical expanding age structure while the lower half exhibits a shrinking population, and this is largely a result of the family planning program implemented since the early 1970s which has dramatically reduced fertility in China hence the population of young age groups. Despite the fact that long-term fertility decline will inevitably lead to population ageing, the top of the 2005 pyramid is still rather narrow, and China's population ageing is in a transition from ageing at the bottom into ageing at the apex.

As the larger cohorts in the middle of the 2005 pyramid move upward, the elderly population will be approaching in size the child population, and by 2020, ageing at the apex would have occurred. The 2035 pyramid has a much greater area in its upper half than that of the lower half, which would be more so in the 2050 pyramid, implying far greater number of the older people than younger people (Figures 12-13). Since fertility decline narrows the lower part of pyramid while further mortality decline expands the upper part, China will be experiencing rapid population ageing as a result of sharp reductions in fertility and mortality in a relatively short time period.

One major feature of age structure transition in China would be a prominent demographic dividend, which is regarded as the economic growth effect from a rising share of the working-age population. Fertility decline leads to a transition from high child dependency ratio into high proportion of labour population, stimulating economic growth through adequate supply of labour force and high saving rate (Bloom and Williamson 1998; Bloom et al. 2000; Bloom et al. 2003; Cai 2004). The demographic dividend resulting from demographic transition has occurred to differing extent in various countries, but most prominently in East Asia countries. Studies show that the demographic dividend has contributed to one-third to one-half of the economic growth miracle in East Asia (Bloom and Williamson 1998; Bloom et al. 2000; Bloom et al. 2003), and one-quarter to one-third of China's rapid economic growth over the last 20 years can be attributed to the demographic dividend (Cai 2004; Wang et al. 2004).

The magnitude of a demographic dividend depends upon the rapidity of decline in fertility and mortality and the time difference between the fertility and mortality decline. Demographically speaking, a demographic dividend started to occur in China since 1990 when the proportion of the working-age population reached 66.7% and total dependency ratio dropped to 50%. The proportion of the working-age population rose to 70.1% in 2000 and stood around 70% until 2020, during which China's total dependency ratio would be 37-45%. Projection from the medium scenario shows that China's working-age population would be declining to 66% and total dependency ratio increasing to 51.6% in 2033, marking the end of the demographic dividend. Thus measuring the demographic dividend by a total dependency ratio of being or below 50%, China would have a demographic dividend for more than 40 years. With a gigantic and low cost work force, China will increasingly become an influential economic power in world and a strong competitor in the international market. Having a work force of this kind of course has many advantages if we consider only the dependency ratio in the population or the labour supply for the development. China will not face the difficulty caused by labour shortage, which is likely to occur in many developed countries. However, given the fact that China has already been troubled by a large number of under-employed peasants in rural areas and an increasing unemployment in urban areas, providing adequate jobs for the growing working-age population will be a daunting task in the next two or three decades at least.

4.3 One quarter of the Chinese population would be aged 65 and over

Another major characteristic of the age structure change in China is the rapid ageing of population, which poses another grave challenge to China's development. Large and rapid increase in both the size and proportion of the elderly population would be expected in the projection of various scenarios. In the projection period, the elderly population will only be affected by mortality change while different fertility scenarios will only make a difference in the proportion of the elderly population through changing the total population. The medium scenario projection shows that China's older people is expected to amount to 173 million by 2020 and 344 million by 2050. The percentage of the older people by 2050 would be 27.4%, 24.7% and 22.4% respectively under the low, medium and high fertility scenarios. One fifth to one quarter of the Chinese population would be aged 65 and over after 2035.

Figure 14 presents development in population ageing in China. A slow pace of ageing is expected before 2015, with the percentage of the older people rising from 7.8% in 2005 to 9.8% in 2015. That is followed by a very rapid ageing during 2015 to 2035 in which the percentage of the older people would more than double, reaching 20% or over; that means the percentage would increase by one point in every two years.

Since the end of the projection period is 2050 while the older people are defined to be those aged 65 and over, fertility change in the projection period will not have any impact on the size of the elderly population. Mortality and migration change will affect the quantity and structure of the elderly population. Because we have only one mortality scenario and international net migration is assumed to be zero, the quantity and trend of the elderly population in different fertility scenarios are exactly the same. A continuous increase in the elderly population is expected throughout the entire projection period. The elderly population is estimated to be 102 million in 2005, which would increase to 173 million in 2020, and a double of that by 2050. The elderly population is expected to exceed 200 million in 2026 and 300 in 2036. The time needed for a 100 million increase in the elderly population is shortest, which is only 10 years, for the elderly population rises from 200 million to 300 million. This period has the fastest growing elderly population just because the largest baby boomers of the 1960s are becoming old, and the ageing pace will slow down as these cohorts are waning out.

Corresponding to the rise of size and proportion of the elderly population, China's child population will decline in both absolute and relative terms. The child population will be reduced from 267 million in 2005 to 232 million in 2029 with the corresponding decline of its percentage from 20.4% to 16.1%. The child population would then level off at 210-220 million with the percentage of 15% after 2030. The year of 2029 would be a turning point in China's age structure transition, at which the elderly population would exceed the child population, and China would become truly an aged society.

Figure 10 China's population age pyramid (medium scenario), 2005

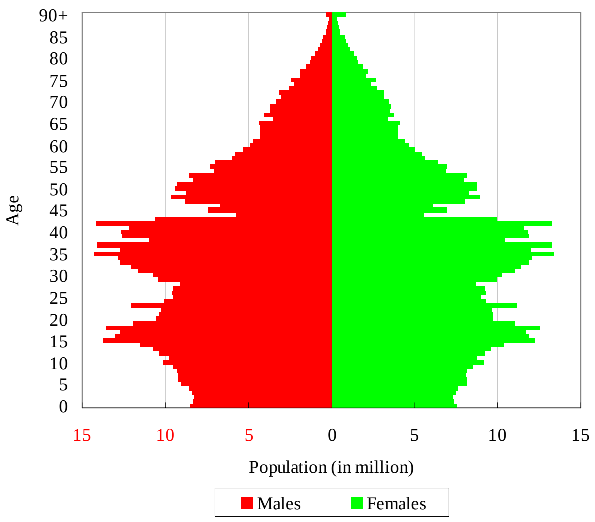


Figure 11 China's population age pyramid (medium scenario), 2020

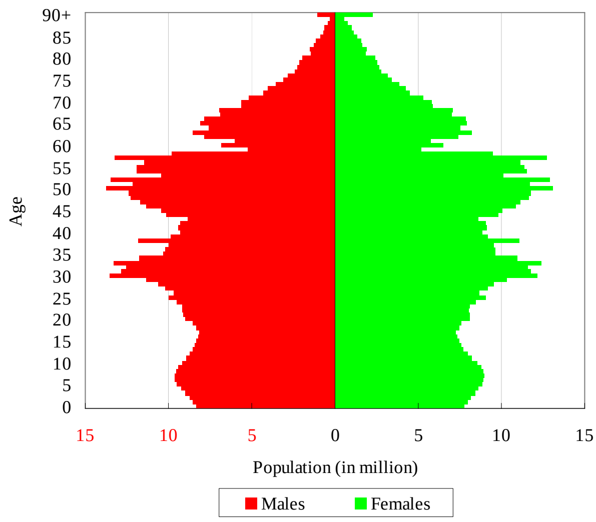


Figure 12 China's population age pyramid (medium scenario), 2035

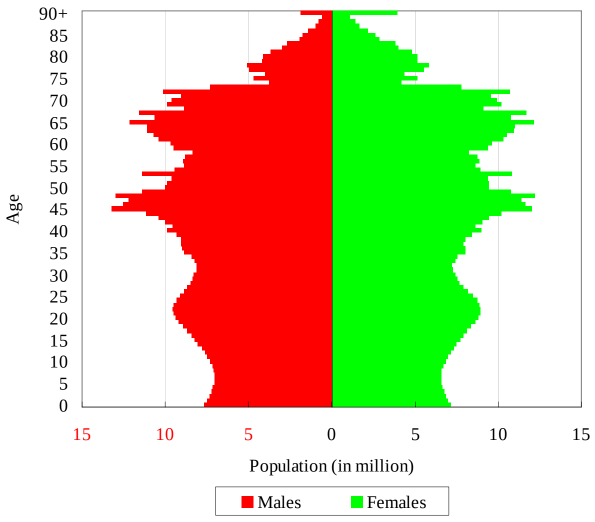
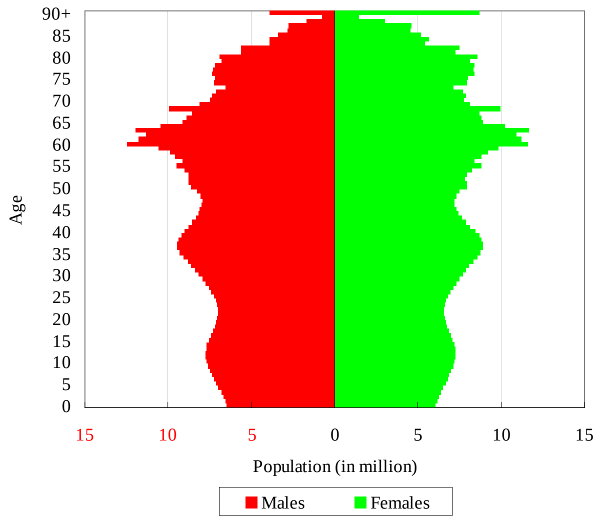
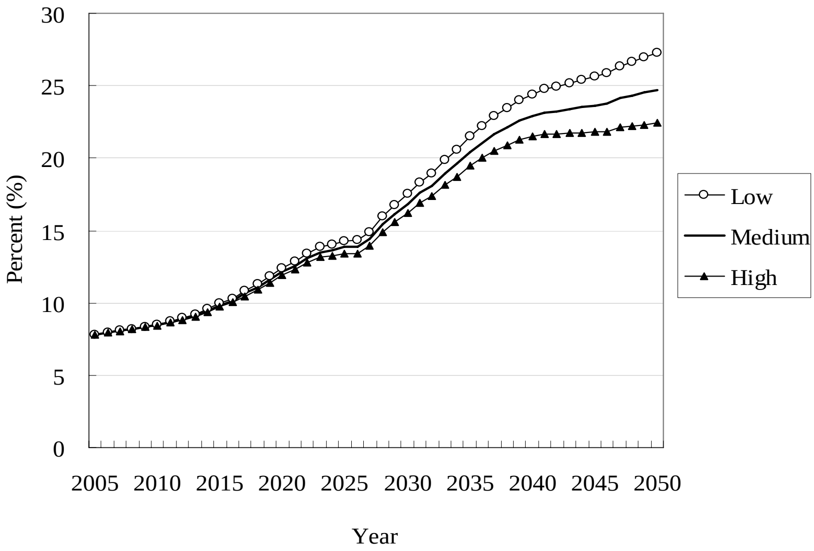


Figure 13 China's population age pyramid (medium scenario), 2050



Source: Projection results, see Appendix Table 3.

Figure 14 Population ageing in China, 2005-2050



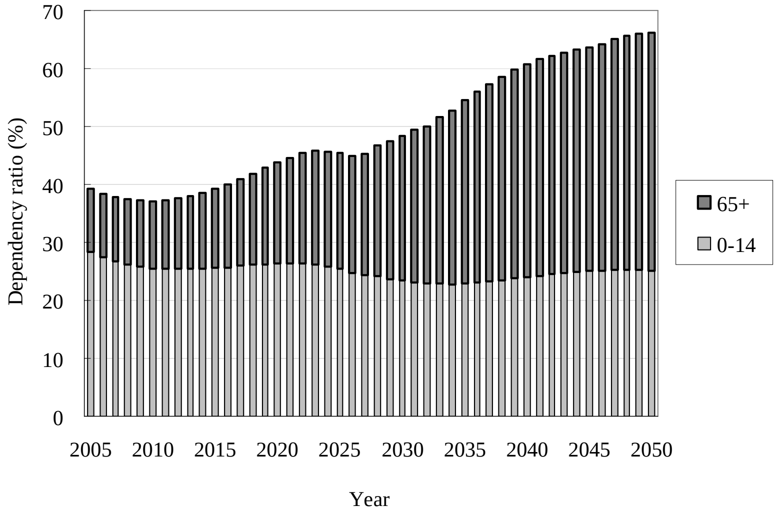
Source: Projection results, see Appendix Tables 1 and 2.

4.4 Rise of total dependency ratio will be driven completely by rise of the old dependency ratio

In demographic terms, the child and elderly populations are regarded as dependent people, and its ratio to the working-age population presents the overall dependency burden in a society. Thus changes in the total dependency ratio and its composition have important social and economic implications. As mentioned earlier, the demographic dividend defined by total dependency ratio is an important change in China's population, and have already had and will continue having great impact on social and economic development in China. Changes in dependency ratios from 2005 to 2050 are presented in Figure 15.

An initial decline followed rapidly by sustained increase is observed in the dependency ratios. The total dependency ratio would stand below 50% by 2034, 2032 and 2028 respectively in the low, medium and high fertility scenarios, which produces the least dependency burden upon the working-age population and has been described to be the demographic dividend. Rise of total dependency ratio will be driven completely by rise of the old dependency ratio after 2015. The total dependency ratio would be below the present level before 2015, which would exceed 50% in 2032, 60% in 2040, and 66% in 2050.

Figure 15 Trends in population dependency ratios in China (medium scenario), 2005-2050



Source: Projection results, see Appendix Table 2.

The initial decline in the total dependency ratio is a result of reduction in the child dependency ratio driven by declining proportion of the child population, while the sheer rise of total dependency ratio afterwards will be driven completely by rise of the old dependency ratio. The old dependency ratio is expected to exceed the child dependency ratio in 2027, 2029 and 2032 respectively in low, medium and high fertility scenarios, marking a transition of support from the child to the elderly population. Projection results show that China's old dependency ratio would double during 2005-2028, from 10.8% in 2005 to 22.6% in medium scenario, 22.8% in low scenario and 22.3% in high scenario. The child dependency ratio would be flattening out after 2015, and rise of old dependency ratio would completely determine the rise of the dependency burden of the working-age population.

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Appendix Table 1 Trends in China's population under different scenarios, 2005-2050 (population in 100 million)

	Total population			Population aged 0-14			Population aged 15-64			Population aged 65+
	Low	Medium	High	Low	Medium	High	Low	Medium	High	
2005	13.08	13.08	13.08	2.67	2.67	2.67	9.39	9.39	9.39	1.02
2006	13.15	13.15	13.16	2.61	2.61	2.61	9.50	9.50	9.50	1.04
2007	13.22	13.23	13.24	2.56	2.57	2.58	9.60	9.60	9.60	1.07
2008	13.29	13.31	13.33	2.52	2.54	2.56	9.68	9.68	9.68	1.09
2009	13.36	13.39	13.42	2.49	2.52	2.55	9.75	9.75	9.75	1.12
2010	13.44	13.48	13.53	2.46	2.51	2.55	9.83	9.83	9.83	1.14
2011	13.51	13.57	13.63	2.45	2.51	2.57	9.88	9.88	9.88	1.18
2012	13.57	13.66	13.75	2.43	2.52	2.61	9.92	9.92	9.92	1.22
2013	13.64	13.75	13.86	2.42	2.53	2.65	9.96	9.96	9.96	1.26
2014	13.70	13.84	13.98	2.41	2.55	2.69	9.98	9.98	9.98	1.31
2015	13.75	13.92	14.09	2.39	2.56	2.73	10.00	10.00	10.00	1.37
2016	13.80	14.00	14.20	2.37	2.57	2.77	10.00	10.00	10.00	1.42
2017	13.84	14.07	14.29	2.36	2.59	2.82	9.98	9.98	9.98	1.50
2018	13.87	14.13	14.39	2.34	2.60	2.86	9.96	9.96	9.96	1.57
2019	13.90	14.18	14.47	2.32	2.61	2.89	9.93	9.93	9.93	1.65
2020	13.92	14.23	14.54	2.30	2.61	2.92	9.90	9.90	9.90	1.73
2021	13.94	14.28	14.61	2.27	2.60	2.94	9.87	9.88	9.88	1.80
2022	13.95	14.31	14.68	2.24	2.59	2.95	9.84	9.85	9.86	1.87
2023	13.96	14.35	14.73	2.20	2.57	2.94	9.82	9.84	9.86	1.93
2024	13.96	14.37	14.78	2.16	2.55	2.93	9.84	9.87	9.90	1.96
2025	13.96	14.39	14.83	2.12	2.51	2.90	9.85	9.89	9.93	1.99
2026	13.95	14.41	14.86	2.07	2.47	2.86	9.88	9.94	10.01	2.00
2027	13.94	14.42	14.90	2.02	2.42	2.81	9.83	9.92	10.00	2.08
2028	13.92	14.42	14.93	1.98	2.37	2.76	9.72	9.83	9.94	2.22
2029	13.90	14.43	14.96	1.93	2.32	2.71	9.64	9.78	9.92	2.33
2030	13.87	14.43	14.98	1.89	2.27	2.66	9.55	9.72	9.89	2.43

2031	13.85	14.43	15.01	1.85	2.23	2.62	9.46	9.66	9.85	2.54
2032	13.82	14.43	15.04	1.82	2.20	2.59	9.39	9.61	9.84	2.61
2033	13.79	14.42	15.07	1.79	2.17	2.56	9.26	9.52	9.77	2.73
2034	13.75	14.42	15.10	1.77	2.15	2.55	9.15	9.44	9.72	2.83
2035	13.71	14.42	15.13	1.74	2.14	2.55	9.02	9.33	9.64	2.95
2036	13.67	14.41	15.17	1.73	2.13	2.56	8.91	9.24	9.58	3.04
2037	13.62	14.40	15.21	1.71	2.13	2.57	8.79	9.15	9.51	3.12
2038	13.57	14.39	15.24	1.70	2.13	2.60	8.69	9.07	9.46	3.19
2039	13.52	14.38	15.27	1.69	2.14	2.63	8.59	9.00	9.40	3.25
2040	13.46	14.36	15.31	1.68	2.14	2.66	8.50	8.93	9.36	3.29
2041	13.40	14.34	15.33	1.66	2.15	2.69	8.41	8.87	9.32	3.32
2042	13.33	14.31	15.36	1.65	2.16	2.73	8.35	8.83	9.31	3.33
2043	13.26	14.28	15.37	1.64	2.17	2.76	8.28	8.78	9.28	3.34
2044	13.18	14.25	15.39	1.63	2.17	2.79	8.20	8.73	9.25	3.35
2045	13.10	14.21	15.39	1.61	2.17	2.81	8.13	8.68	9.23	3.35
2046	13.01	14.16	15.40	1.60	2.17	2.82	8.05	8.63	9.21	3.36
2047	12.92	14.11	15.39	1.58	2.16	2.83	7.94	8.54	9.15	3.41
2048	12.83	14.05	15.38	1.55	2.15	2.83	7.85	8.49	9.13	3.42
2049	12.73	13.99	15.37	1.53	2.13	2.83	7.77	8.43	9.11	3.43
2050	12.63	13.93	15.35	1.50	2.11	2.81	7.68	8.38	9.10	3.44

Appendix Table 2 Trends in China's population under the medium fertility scenario, 2005-2050 (population in million)

	Percentage (%)			Dependency ratio (%)			Population 60+	Population 80+	Women aged 20-29	Births
	0-14	15-64	65+	0-14	65+	Total				
2005	20.40	71.82	7.78	28.40	10.83	39.23	145.26	15.34	95.70	16.49
2006	19.83	72.23	7.94	27.45	10.99	38.44	149.38	16.02	96.74	16.68
2007	19.40	72.53	8.07	26.75	11.12	37.88	154.10	16.82	100.49	16.98
2008	19.07	72.75	8.18	26.21	11.24	37.45	158.92	17.85	102.90	17.38
2009	18.85	72.82	8.33	25.88	11.44	37.32	165.22	18.46	105.47	17.86
2010	18.61	72.91	8.48	25.53	11.63	37.16	172.02	19.69	108.70	18.38
2011	18.50	72.83	8.67	25.40	11.90	37.30	178.32	20.29	109.76	18.85
2012	18.45	72.65	8.90	25.40	12.25	37.64	186.99	21.12	108.15	19.16
2013	18.42	72.44	9.13	25.43	12.60	38.04	194.97	22.26	107.66	19.26
2014	18.40	72.14	9.46	25.50	13.12	38.61	204.33	23.09	106.65	19.16
2015	18.36	71.81	9.83	25.57	13.68	39.26	213.52	24.06	106.03	18.90
2016	18.38	71.47	10.16	25.71	14.21	39.93	221.33	25.09	103.49	18.42
2017	18.39	70.96	10.65	25.92	15.00	40.92	230.40	25.89	99.14	17.91
2018	18.40	70.51	11.09	26.10	15.73	41.83	237.52	26.79	95.53	17.41
2019	18.39	69.99	11.62	26.27	16.61	42.88	240.71	27.07	91.78	16.92

2020	18.33	69.52	12.15	26.37	17.47	43.84	245.18	28.03	87.68	16.47
2021	18.24	69.18	12.58	26.37	18.19	44.55	246.49	28.76	84.96	16.04
2022	18.11	68.79	13.10	26.33	19.04	45.36	256.25	29.38	82.81	15.63
2023	17.94	68.58	13.48	26.16	19.66	45.82	272.06	29.89	80.89	15.23
2024	17.71	68.67	13.62	25.79	19.83	45.62	284.18	30.77	79.47	14.87
2025	17.44	68.72	13.84	25.38	20.13	45.51	296.60	31.73	77.80	14.55
2026	17.12	69.02	13.85	24.81	20.07	44.88	308.73	33.00	76.87	14.29
2027	16.78	68.80	14.42	24.39	20.97	45.36	317.75	34.58	76.46	14.10
2028	16.43	68.18	15.39	24.09	22.58	46.67	331.90	36.19	76.39	13.98
2029	16.08	67.80	16.12	23.72	23.78	47.50	343.27	38.56	76.50	13.95
2030	15.76	67.37	16.87	23.39	25.03	48.42	357.02	41.13	76.89	14.01
2031	15.48	66.93	17.59	23.13	26.28	49.41	367.83	43.36	78.04	14.14
2032	15.25	66.65	18.11	22.88	27.17	50.05	377.97	46.79	79.51	14.32
2033	15.07	65.98	18.96	22.84	28.73	51.57	386.69	49.69	81.19	14.54
2034	14.93	65.45	19.62	22.82	29.98	52.80	394.36	53.22	82.80	14.78
2035	14.85	64.71	20.44	22.94	31.59	54.53	400.08	56.50	84.18	14.99
2036	14.80	64.13	21.07	23.08	32.85	55.92	404.86	58.86	85.22	15.17
2037	14.79	63.56	21.65	23.27	34.06	57.33	406.99	61.82	85.84	15.28
2038	14.82	63.04	22.14	23.50	35.12	58.62	409.67	63.55	86.02	15.32
2039	14.87	62.56	22.57	23.76	36.08	59.84	412.20	63.02	85.70	15.28
2040	14.93	62.19	22.88	24.01	36.80	60.81	414.10	63.32	84.89	15.17
2041	15.01	61.85	23.14	24.27	37.41	61.68	416.49	61.89	83.64	15.01
2042	15.09	61.68	23.23	24.47	37.67	62.13	422.23	65.51	82.06	14.80
2043	15.17	61.46	23.37	24.68	38.02	62.70	424.55	72.58	80.24	14.56
2044	15.24	61.26	23.50	24.87	38.37	63.24	426.82	77.26	78.29	14.29
2045	15.28	61.11	23.61	25.01	38.64	63.65	428.96	81.99	76.32	14.01
2046	15.31	60.93	23.76	25.13	38.99	64.12	433.40	86.43	74.44	13.72
2047	15.31	60.54	24.15	25.29	39.89	65.18	440.45	88.90	72.71	13.44
2048	15.28	60.40	24.32	25.30	40.27	65.57	445.71	94.46	71.16	13.17
2049	15.22	60.27	24.51	25.25	40.66	65.91	451.29	98.20	69.81	12.92
2050	15.13	60.17	24.69	25.15	41.04	66.18	457.63	103.30	68.71	12.70

Appendix Table 3 Age-sex distribution of China's population under the medium fertility scenario, 2005, 2020, 2035 and 2050 (in million)

	2000		2005		2020		2035		2050	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0	9.21	8.31	8.53	7.57	8.36	7.81	7.65	7.15	6.50	6.07
1	9.25	8.20	8.31	7.38	8.53	7.96	7.49	7.00	6.58	6.15
2	9.29	8.10	8.26	7.34	8.75	8.17	7.36	6.88	6.70	6.26
3	9.32	8.21	8.42	7.49	8.99	8.40	7.24	6.77	6.83	6.39
4	9.61	8.55	8.61	7.66	9.24	8.62	7.14	6.67	6.97	6.52

5	10.16	9.16	9.06	8.17	9.47	8.84	7.07	6.61	7.11	6.65
6	9.85	8.78	9.20	8.15	9.59	8.95	7.04	6.58	7.25	6.78
7	10.37	9.25	9.25	8.06	9.63	8.99	7.04	6.58	7.38	6.90
8	10.77	9.65	9.28	8.18	9.57	8.94	7.10	6.63	7.50	7.01
9	11.54	10.40	9.57	8.52	9.40	8.78	7.19	6.72	7.60	7.11
10	13.77	12.30	10.13	9.14	9.18	8.53	7.31	6.84	7.68	7.18
11	13.08	11.93	9.82	8.76	8.95	8.24	7.47	6.98	7.73	7.23
12	12.75	11.70	10.34	9.24	8.73	7.97	7.64	7.15	7.74	7.24
13	13.58	12.56	10.74	9.63	8.56	7.75	7.83	7.33	7.72	7.22
14	11.99	11.07	11.51	10.38	8.44	7.57	8.03	7.51	7.66	7.16
15	10.57	9.75	13.74	12.28	8.37	7.44	8.24	7.71	7.56	7.08
16	10.44	9.76	13.04	11.91	8.22	7.32	8.46	7.92	7.45	6.97
17	10.27	9.71	12.71	11.68	8.19	7.29	8.70	8.13	7.32	6.86
18	12.14	11.23	13.54	12.53	8.35	7.45	8.94	8.36	7.21	6.75
19	10.12	9.30	11.95	11.05	8.54	7.62	9.18	8.59	7.11	6.66
20	9.58	9.01	10.53	9.73	8.99	8.13	9.41	8.81	7.04	6.59
21	9.68	9.31	10.39	9.74	9.12	8.11	9.53	8.92	7.00	6.56
22	9.59	9.24	10.22	9.68	9.17	8.02	9.56	8.95	7.01	6.57
23	9.18	8.75	12.08	11.19	9.20	8.13	9.50	8.90	7.06	6.61
24	10.49	9.98	10.06	9.27	9.48	8.47	9.33	8.74	7.15	6.70
25	10.83	10.29	9.53	8.98	10.03	9.08	9.11	8.49	7.27	6.82
26	11.74	11.12	9.62	9.27	9.71	8.70	8.87	8.20	7.42	6.96
27	12.18	11.42	9.53	9.20	10.22	9.17	8.66	7.93	7.59	7.12
28	12.78	11.97	9.12	8.71	10.61	9.56	8.48	7.70	7.78	7.30
29	12.96	12.13	10.42	9.94	11.36	10.30	8.36	7.52	7.97	7.48
30	14.40	13.51	10.75	10.25	13.55	12.17	8.28	7.39	8.18	7.68
31	12.83	12.11	11.65	11.07	12.85	11.80	8.13	7.27	8.39	7.88
32	14.25	13.35	12.10	11.37	12.51	11.57	8.09	7.24	8.62	8.09
33	11.13	10.52	12.69	11.92	13.32	12.41	8.25	7.39	8.85	8.32
34	12.75	11.98	12.86	12.07	11.75	10.93	8.43	7.56	9.09	8.54
35	12.79	11.91	14.28	13.44	10.34	9.62	8.87	8.06	9.32	8.76
36	12.38	11.68	12.71	12.04	10.20	9.63	9.00	8.05	9.43	8.87
37	14.36	13.39	14.12	13.27	10.03	9.57	9.04	7.95	9.46	8.90
38	10.79	10.04	11.03	10.46	11.84	11.06	9.06	8.06	9.39	8.84
39	5.80	5.56	12.62	11.91	9.85	9.15	9.33	8.40	9.22	8.69
40	7.60	7.02	12.65	11.83	9.32	8.86	9.86	9.00	8.99	8.43
41	6.81	6.19	12.23	11.60	9.40	9.14	9.54	8.61	8.76	8.14
42	8.97	8.08	14.18	13.29	9.30	9.07	10.04	9.08	8.54	7.87
43	9.87	9.04	10.64	9.96	8.89	8.58	10.40	9.45	8.35	7.64
44	8.92	8.36	5.72	5.52	10.14	9.78	11.12	10.18	8.22	7.46
45	9.63	8.89	7.48	6.95	10.45	10.07	13.25	12.02	8.14	7.32
46	9.51	8.92	6.70	6.13	11.30	10.87	12.55	11.64	7.99	7.20
47	8.56	8.10	8.81	8.00	11.70	11.15	12.20	11.40	7.94	7.17
48	8.83	8.32	9.69	8.93	12.25	11.67	12.96	12.21	8.08	7.31

49	7.32	7.02	8.74	8.25	12.38	11.80	11.41	10.75	8.24	7.47
50	7.56	7.08	9.42	8.76	13.71	13.11	10.02	9.45	8.66	7.95
51	7.25	6.59	9.27	8.77	12.17	11.72	9.86	9.44	8.76	7.93
52	6.24	5.78	8.33	7.96	13.47	12.89	9.66	9.36	8.78	7.83
53	6.09	5.59	8.58	8.16	10.47	10.13	11.38	10.80	8.79	7.92
54	5.59	5.21	7.09	6.87	11.93	11.50	9.44	8.92	9.03	8.23
55	5.17	4.82	7.30	6.92	11.91	11.39	8.89	8.61	9.51	8.80
56	5.05	4.61	6.98	6.42	11.45	11.12	8.93	8.86	9.17	8.41
57	4.56	4.22	5.99	5.62	13.20	12.70	8.80	8.76	9.61	8.84
58	4.59	4.23	5.82	5.42	9.84	9.47	8.36	8.26	9.92	9.18
59	4.64	4.24	5.32	5.04	5.25	5.22	9.49	9.38	10.56	9.86
60	4.76	4.34	4.89	4.64	6.81	6.54	9.70	9.62	12.51	11.60
61	3.91	3.62	4.74	4.42	6.04	5.73	10.41	10.32	11.77	11.20
62	4.50	4.07	4.25	4.03	7.86	7.42	10.69	10.53	11.37	10.92
63	4.22	3.87	4.25	4.02	8.53	8.22	11.08	10.96	11.99	11.65
64	4.23	3.97	4.26	4.01	7.60	7.53	11.09	11.01	10.47	10.20
65	3.93	3.83	4.34	4.07	8.07	7.92	12.13	12.13	9.11	8.91
66	3.64	3.55	3.53	3.38	7.82	7.84	10.62	10.76	8.87	8.84
67	3.79	3.62	4.02	3.77	6.90	7.03	11.59	11.72	8.59	8.71
68	3.24	3.23	3.72	3.55	6.96	7.11	8.86	9.11	9.97	9.96
69	2.90	2.86	3.68	3.61	5.62	5.89	9.90	10.22	8.14	8.15
70	3.21	3.25	3.36	3.44	5.62	5.82	9.65	9.97	7.52	7.78
71	2.46	2.55	3.04	3.14	5.21	5.29	9.04	9.57	7.40	7.90
72	2.60	2.73	3.11	3.16	4.31	4.52	10.12	10.72	7.11	7.70
73	2.21	2.37	2.59	2.76	4.03	4.25	7.30	7.83	6.57	7.13
74	1.91	2.13	2.27	2.41	3.53	3.84	3.76	4.22	7.24	7.95
75	1.88	2.15	2.46	2.69	3.11	3.43	4.69	5.15	7.16	7.99
76	1.62	1.93	1.84	2.08	2.87	3.15	3.98	4.38	7.40	8.38
77	1.35	1.66	1.89	2.17	2.43	2.76	4.93	5.50	7.29	8.33
78	1.25	1.57	1.56	1.85	2.29	2.64	5.07	5.87	7.20	8.40
79	1.05	1.37	1.30	1.61	2.13	2.50	4.23	5.15	6.80	8.15
80	0.96	1.34	1.22	1.57	1.99	2.39	4.16	5.14	6.95	8.60
81	0.71	1.02	1.00	1.35	1.48	1.86	3.70	4.80	5.63	7.25
82	0.61	0.93	0.79	1.11	1.52	1.92	2.97	4.03	5.63	7.47
83	0.51	0.79	0.69	1.01	1.27	1.67	2.70	3.79	3.91	5.45
84	0.41	0.67	0.55	0.84	1.11	1.56	1.95	2.90	3.93	5.70
85	0.32	0.57	0.47	0.79	0.90	1.35	1.73	2.63	3.41	5.14
86	0.27	0.49	0.33	0.57	0.71	1.11	1.41	2.18	2.82	4.53
87	0.20	0.38	0.27	0.50	0.63	1.00	1.01	1.67	2.75	4.60
88	0.15	0.29	0.21	0.40	0.45	0.78	0.81	1.40	1.70	3.01
89	0.11	0.23	0.16	0.32	0.33	0.59	0.60	1.11	0.74	1.43
90+	0.09	0.20	0.37	0.83	1.10	2.28	1.87	3.95	3.91	8.72