IIASA
Science for
Global Insight
International Institute for Applied Systems Analysis
Schlossplatz 1 • A-2361 Laxenburg • Austria
Telephone: (+43 2236) 807 342 • Fax: (+43 2236) 71313
E-mail: publications@iiasa.ac.at • Internet: www.iiasa.ac.at

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The Future Population of China: Prospects to 2045 by Place of Residence and by Level of Education

Gui-Ying CAO *cao@iiasa.ac.at*

Approved by

Wolfgang Lutz (lutz@iiasa.ac.at)
Leader, POP Project

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Contents

Abstract

Using methods of multi-state population projection, the population of China up to 2045 was studied by simultaneous interacting states of educational categories and urban/rural residence in three alternative future paths. The results anticipate that in 2045, more than 60% of the population will have secondary education, while this was the case for only 8% of the population in1964. This study not only produces educational projections, it also provides regular population projections by age, sex, and urban/rural place of residence. In the coming decades, China will reach its peak in total population, working population, and aging population in different times under low, medium and high scenarios. According to results of this study, an important question will face Chinese policy makers in the context of sustainable socioeconomic and environmental development: How should the anticipated socioeconomic developments in the coming decades be figured into the demographic trade-off between rapid fertility decline in the near term and rapid population aging in the long term?

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About the Authors

Dr. Gui-Ying Cao is a Research Scholar with the Population Project at IIASA.

The Future Population of China: Prospects to 2045 by Place of Residence and by Level of Education

Gui-Ying CAO

1 Introduction

While demographic processes and structures rest on a biological base, changes in fertility, mortality and migration are to a large degree socially determined. Economics, social processes and environmental issues have far-reaching demographic consequences, affecting population size, age structure, and family formation. Education is of overwhelming social, economic, and cultural importance. During the process of demographic transition, the strong negative correlation between higher education and lower fertility is especially pronounced.

This report studies population trends and the role of present and future educational trends in shaping the future population of China in the context of IIASA's multi-state demographic projection model. The development of China's population in association with social, economic, and environmental changes has drawn much attention from international scholars and policy makers. In the advent of economic reform, including educational and social welfare reform, many new trends have arisen and consequently, the effects of the economic reform have strongly influenced demographic components such as fertility, mortality and rural-to-urban migration.

A number of projections for China's future population have been produced by demographers at the UN and other international institutions, as well as in China. The projection presented here is different from other forecasts. One very important feature of this study is that it explicitly includes educational status of the population in its projection. The multi-state population projection method not only considers fertility, mortality, and migration as the driving forces of demographic change, but also assumes education by age, sex, and region as a dimension in population projection. To our knowledge this is the first time that the educational composition by age, sex, and region has systematically been used for the demographic method of cohort-component projection in China.

Another feature of this study is that it independently projects the urban and rural population (the national population projection of China consists of aggregated results of urban and rural projections). Demographers have devoted little attention to fertility trends and variations in China, e.g. its localities. The urban-rural projections produced by other institutions are based only on assumed future proportions of urban population, which are then applied to the projected national population by age and sex. In China, place of residence, particularly urban/rural divided, is an important issue for many social and economic considerations, and it strongly correlates with demographic changes (Lutz *et al.* 1999). Under the central planned economy, Chinese cities were

closed off to farmers by the “invisible walls” of the household registration system (Chan 1997). Levels of socioeconomic development have differed largely between rural and urban regions. The result of these “invisible walls” is that China has become a highly segmented society, divided by the geographical division of urban and rural sectors. So far, the urban household registration system, which determines where one can live and work, has prevented a tidal wave of rural migrants, who cannot be fully absorbed in the urban areas. Especially socioeconomic differences between rural and urban regions have increased during the economic reform.

It is appropriate for China’s population projection to use net migration as a parameter in the multi-state model. Since the 1980s, a large rural-to-urban migratory movement has challenged the powerful household registration system, and brought on agricultural and urban industrial economic reforms. Rural-to-urban migration in China has become a hot issue for policy makers and scientists. It not only changes the economic structure and social stability, it also strongly correlates with demographic distribution, age structure and demographic transition. It is not an easy task to collect the date of migration because there is no exact definition of migration, and almost every source has different information and estimates. We have calculated and adjusted the information and date of migration by age, sex, and education in order to meet the requirements of the multi-state model for population projection. From this point of view, our study can be considered as a pioneer study.

Using recently available data, we attempt to study the following questions:

1) To what extent do educational levels have an impact on future population growth?
2) Do educational differentials make a difference in projected population growth?
3) How is the age structure influenced by educational and regional differences?
4) To what extent do educational differentials affect the distribution of population in the future?
5) What is the likely educational composition of the population in the future?

In addition to this introduction, this report consists of four sections. Section 2 describes the salient demographic features affected by rural and urban regions, as well as by educational differentials in contemporary China. The analysis focuses on the development of education, fertility, rural-to-urban migration, aging, and sex ratio. Section 3 briefly describes the data and sources used, and explains the base-line input used, such as modified fertility, estimated migration by education and age, and estimates of the elderly population by educational categories. Nine sets of scenario assumptions for the future course of fertility, mortality, migration and education by rural/urban regions over the next 50 years are presented. Section 4 analyses the projection results and shows the population size, age structure, educational composition, rural and urban distribution of the population at both the national and rural/urban levels. Section 5 concludes the discussion. The policy implications lay emphasis on the obtained results of the population projection concerning shifts in Chinese family policy, integrated policy approach, and migration policy, which may be used by planners and policy makers for sustainable development planning in China.

2 Salient Demographic Features in Contemporary China

China is the most advanced developing country in the population transition process, where fertility rates declined from 4.2 births per woman in 1974 to below replacement level, 1.85, in 1995. The factors fostering the fertility transition in China have been attributed to the government's population policies and family planning programs. On the other hand, a broad spectrum of causes is related to socioeconomic development beyond the government's population policies and family planning programs. The fertility transition has been recently influenced by the rapid socioeconomic changes resulting from the new economic reform. In urban regions, the economic reform may have increased the potential benefits of having fewer children in families. In rural areas, however, the substitution of the household responsibility system of production for the commune system has increased productivity and household income, but has weakened the government's ability to regulate fertility.

It is interesting to ask why fertility patterns and trends differ in urban and rural China in spite of a uniform intensification of population policies throughout the nation. These differences have resulted from differences in socioeconomic conditions. It seems likely that most of the factors tend to facilitate the government's effort to make information, supplies, and services accessible to the urban population (Cheng and Maxim 1992). Among the socioeconomic factors, education is an actual or potential determinant of fertility reduction. Studies have shown that education affects several aspects of fertility in China. First, educational development has had a substantial effect on the age at which women marry because they stay in school longer and because education widens their employment opportunities in the labor market. Second, higher educational levels have substantially raised the investment costs of children, especially for parents who wish to ensure good career prospects for their children. Finally, education promotes a rational view of family formation and the acceptance of contraception for either spacing or limiting the number of children.

In the following, we briefly view educational changes in China over the past decades, and address fertility, migration, aging, and sex ratio by comparing rural and urban regions.

2.1 Development of education

Education begins with kindergarten (ages 3-6) and continues with primary (ages 6-12) and secondary (ages 12-18), which includes junior and senior secondary schools, specialized secondary schools, vocational secondary schools, and technical training schools. Higher education, which includes universities and colleges as well as college for postgraduates, requires 4-5 years for a B.A. degree, 7-8 years for a Masters degree, and 10-11 years for a Ph.D.

In China, education is considered to be "a project of vital and lasting importance, calling for a good educational foundation" (*People's Daily*, May 15, 1987). For decades the educational policy has been to "enable everyone who receives an education to develop morally, intellectually and physically" (Liu 1989). One of the most remarkable changes seen in China today is in education at all levels (see Table 1). The percentage of no schooling has declined from 51.8% in 1964 to 16% in 1995. The most profound change is at the middle school level, where attendance has risen from only 8.32% in 1964 to 39.29% in 1995 – almost 5 times as many as in 1964.

Table 1. Population, aged 6 and over, by educational level in 1964, 1982, 1990, and 1995. Based on State Statistical Bureau (1986b, 1993a, 1998); Population Institute (1985); Office of Population Survey (1997); Yao and Hua (1995).

	1964		1982		1990		1995	
	(in millions)	%	(in millions)	%	(in millions)	%	(in millions)	%
No schooling[a,b]	258.05	51.80	283.68	31.88	182.25	18.77	179.38	16.02
Primary school	192.00	39.30	355.35	39.94	420.21	43.25	475.26	42.45
Middle school	41.46	8.32	244.73	27.50	353.27	36.36	439.97	39.29
College and above	2.88	0.58	6.04	0.68	15.76	1.62	25.06	2.24
Total	494.39		889.80		971.49		1119.67	

[a] No schooling includes the illiterate and semi-literate.
[b] No schooling in 1990 covers only population aged 15 and over.

The educational system in China is under the authority and guidance of the Ministry of Education of the central government. At the provincial level, education is administered by the educational bureau of the provincial government. For more than four decades, government expenditure on education has increased significantly. In 1953, the percentage of the educational share of the total government expenditure was 8.8%; in 1994 it had increased to 16.91% (State Statistical Bureau 1995). Associated with the economic reform in the mid-1980s, the central government advocated parts of the university to be financed by various institutions under the supervision of the Ministry of Education or the authority of education at the provincial level. The objective of this policy is to expand higher education to suit the needs of economic development. The government policies have focused on two aspects concerning the increased fundamental education of the population.

2.1.1 Eradicating illiteracy and popularizing nine years of educating the population

In the 1950s, there was a widespread movement to eradicate illiteracy in order to raise the listening and writing abilities of Chinese citizens. Around 70% of the total population were without formal schooling after World War II (1937-1945) and the civil war (1945-1949). In the 1960s, the implementation of an obligatory nine-year education policy began. This policy called for six years in primary school and three years in junior secondary school. The realization of this policy has been consistent in urban regions. However, in rural regions, it did not develop in the planned way in terms of financial assistance. Eventually, in 1986, the State Council set up and issued a “law of obligatory nine-year education of citizens” in order to meet the Chinese “four modernizations” (industry, agriculture, science and technology). Under this law, all persons are obliged to complete nine years of education, and the authorities at all levels must make this possible for everyone voluntarily. Since then, concrete action supporting nine years of education was taken everywhere in the rural regions. As a result, China has reached near universal enrolment in primary school-age children, and has rapidly increased the number of students in secondary schools. In 1997, the percentage of children enrolled in primary schools was 98.9%, while in 1952 it was only 49.2%. The percentage of graduates of primary school entering junior secondary school was 44.2% in 1957, and increased to 93.7% in 1997 (State Statistical Bureau 1998). However, it is necessary to

mention that in spite of the rapid expansion in education, illiteracy in rural China is still high.

2.1.2 Encouraging and improving women in education

When observing the changes in education, one of the most crucial phenomena to be considered is the participation of women in education. An important aspect of the state policies has always been to encourage women to enroll in schools at various levels. In China, a woman's education is one of the important indicators of a woman's social status, because a woman's employment and domestic status prospects depend heavily on the training and educational schemes through which she can acquire the relevant skills. The Chinese government has made deliberate efforts to improve women's status by ensuring equal opportunities in education. Therefore, the past four decades have witnessed a remarkable improvement in female education, which is not only a manifestation of the general improvement in the standing of females, but also an indication of the universal increase in female opportunities to receive education.

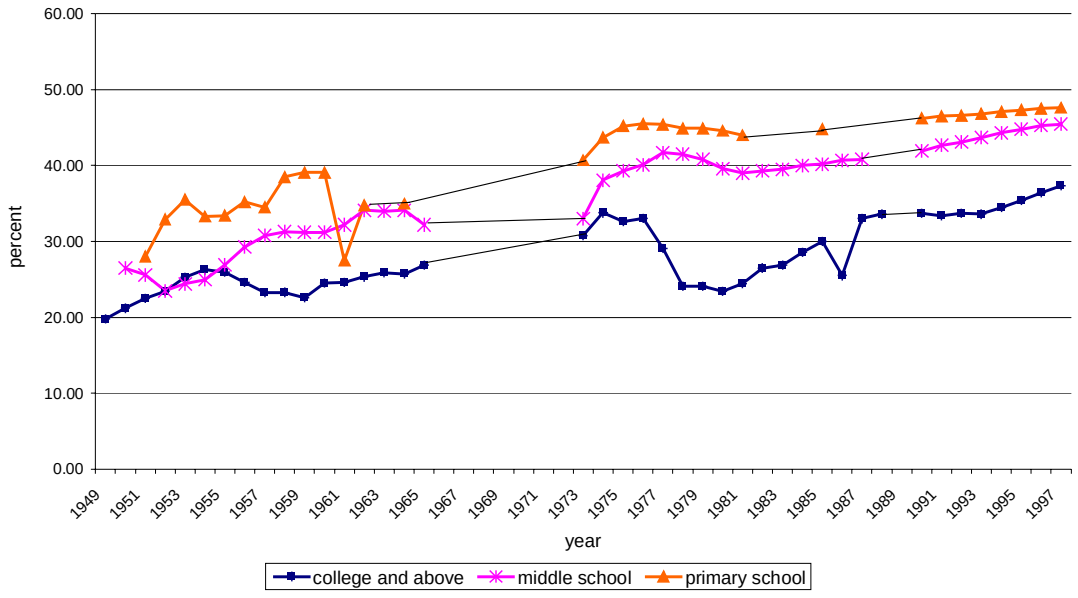


Figure 1. Development of women's education. Data for the years 1966-1972 and 1989 are not available. Data from China All Women's Federation (1991); Chinese Ministry of Education (1984, 1998); State Statistical Bureau (1993b, 1996, 1998).

Figure 1 and Table 2 show a dramatic rise and changes in the proportion of women's share of total students at all levels of education. In 1997, among all students, 37.32% were women in higher education, 45.46% in middle schools, and 47.63% in primary schools. In 1952, only 23.39% were women in universities, 23.50% in middle schools, and 32.9% in primary schools. This indicates a decline in the gender gap in education. Of course, this by no means excludes gender differences in education. In fact, when

comparing the proportion of females enrolled with those of males, gender differences in all levels of education still exist, especially in rural China.

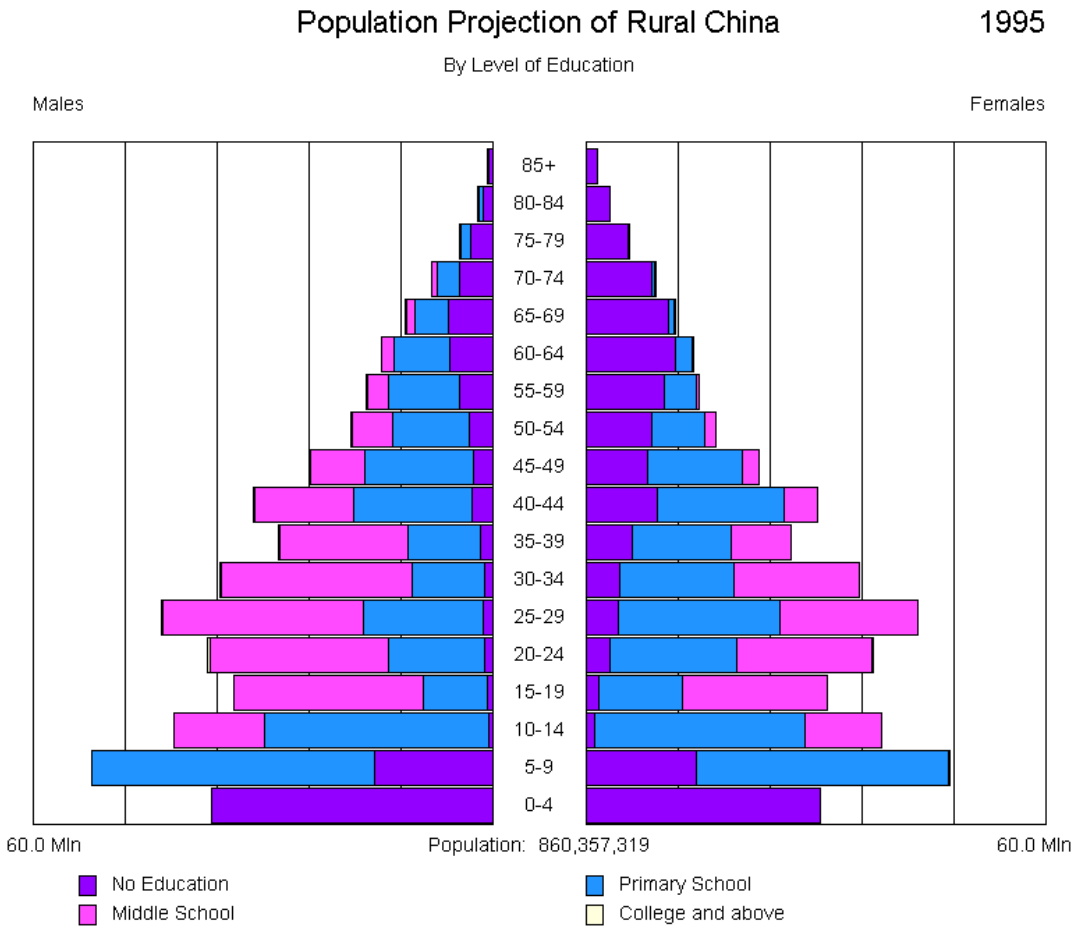
Table 2. Percentage of women of total students at stated educational level, 1949-1997. Data for the years 1966-1972 and 1989 are not available. Data from China All Women's Federation (1991); Chinese Ministry of Education (1984, 1998); State Statistical Bureau (1993b, 1996, 1998).

Year	College and above	Middle school	Primary school	Year	College and above	Middle school	Primary school
1949	19.77			1974	33.76	38.10	43.70
1950	21.20	26.50		1975	32.59	39.30	45.20
1951	22.53	25.60	28.00	1976	33.02	40.10	45.50
1952	23.39	23.50	32.90	1977	29.04	41.70	45.40
1953	25.28	24.40	35.50	1978	24.11	41.50	44.90
1954	26.27	25.00	33.30	1979	24.09	40.80	44.90
1955	25.90	26.90	33.40	1980	23.44	39.60	44.60
1956	24.60	29.30	35.20	1981	24.42	39.00	44.00
1957	23.25	30.80	34.50	1982	26.50	39.30	
1958	23.30	31.30	38.50	1983	26.90	39.50	
1959	22.58	31.20	39.10	1984	28.60	40.00	
1960	24.50	31.20	39.10	1985	30.00	40.20	44.80
1961	24.65	32.20	27.50	1986	25.50	40.70	
1962	25.34	34.10	34.80	1987	33.00	40.80	
1963	25.84	34.00		1988	33.40		
1964	25.73	34.10	35.00	1989			
1965	26.88	32.20		1990	33.70	41.90	46.20
1966				1991	33.40	42.70	46.50
1967				1992	33.70	43.10	46.60
1968				1993	33.60	43.70	46.80
1969				1994	34.50	44.30	47.10
1970				1995	35.40	44.80	47.30
1971				1996	36.40	45.30	47.50
1972				1997	37.32	45.46	47.63
1973	30.77	33.00	40.70				

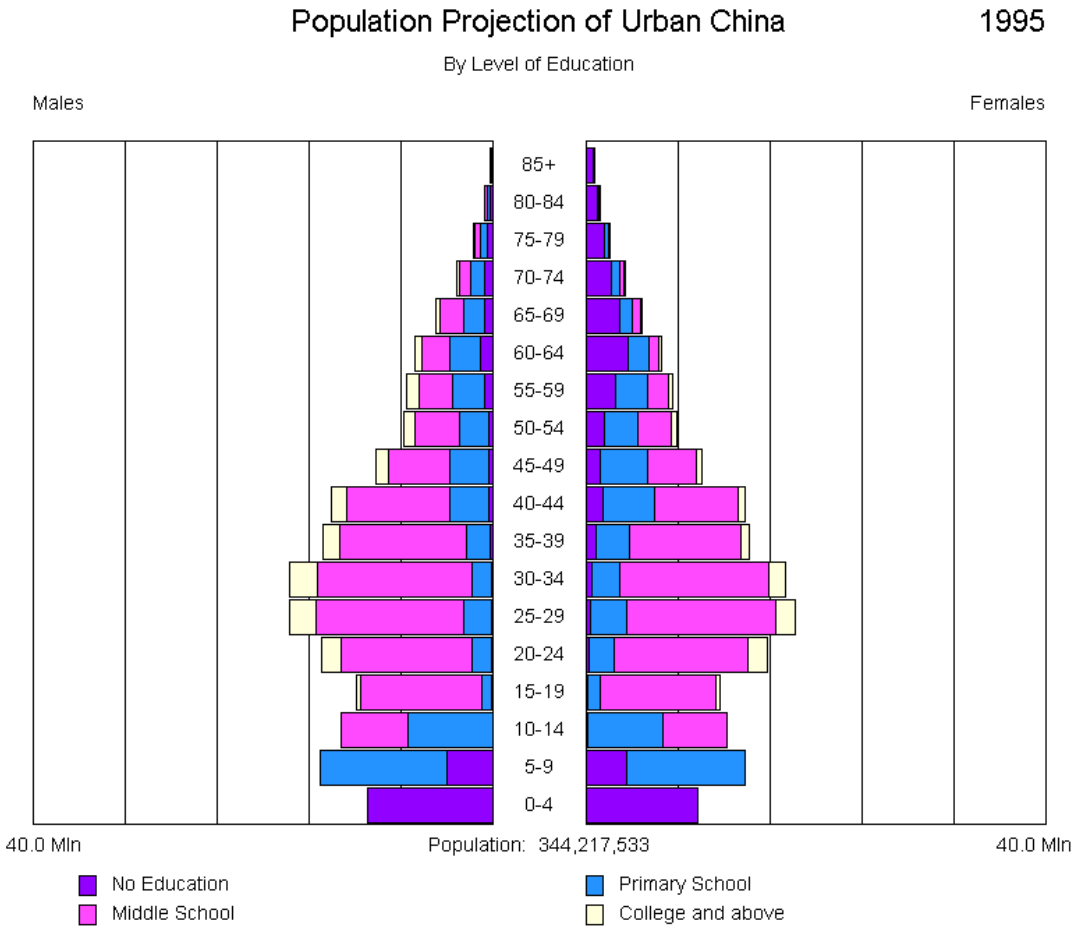
Another important aspect of education in China is that it is regionally unbalanced; particularly, the disparities are very large between rural and urban regions. On the one hand, the development of education is unequal, because "the primary functional sub-systems of a society, the economic, the polity, the integrative sub-system, and latent pattern-maintenance sub-system, each constitutes part of the situation for each of the other" (Parsons and Smelser 1964:51). On the other hand, education is an important active participant in the socioeconomic process. Therefore, educational systems have differential impacts on various aspects of development and social change.

The educational distributions by age and rural/urban regions, calculated from the *National 1% Population Sample Survey 1995* (Office of Population Survey 1997) show

that there are great disparities between rural and urban China (see population pyramids below).



Generally, the educational success in both rural and urban China is likely to continue as young generations move up the age pyramid. But the level of education at all degrees is much higher for the urban than for the rural population. Obviously, there was a much larger proportion of the urban population in the middle school level in each age group. Also, the rural/urban disparities by gender are pronounced. The rural population with low educational levels has the highest gender difference. The level of no schooling among ages 15 and above was higher for females than for males. Intake in middle schools for females aged 30 and above was about half that of males. Observations from the rural and urban pyramids indicate that rural males and females should be targeted for educational and development services. Furthermore, cultural barriers to women's education in rural China have to be ameliorated somewhat through programs specifically addressed in this issue.



2.2 Fertility differentials by rural and urban region

The differences in total fertility rate (TFR) between urban and rural populations over the past decades can be seen in Figure 2. Urban fertility rates were even lower during the early 1950s, before the government initiated birth control policies. The government's first family planning campaign took place in the mid-1950s, when the government began to manufacture contraceptives and relax restrictions on induced abortion. The urban fertility transition began as early as 1954, when the TFR was 5.72. It then fell to 5.67 in 1955, to 5.33 in 1956, and to 5.25 in 1958. Urban TFR was very low (2.98) in 1961, at half of the 1957 level, as a consequence of starvation between 1959-1961. Urban fertility as a proportion of rural fertility dropped greatly in the 1960s: from 76% in 1962 to 53% in 1969. This disparity demonstrates the relatively early timing of the urban fertility transition. In 1963 the baby boom took place. Since then, urban China has experienced unprecedented fertility declines. By the middle of the 1970s, the urban fertility rate had already reached the replacement level. By this time, the government had given full attention to and taken concrete action for family planning by encouraging late marriages and fewer births. The rapid urban fertility decline during the 1970s coincided not only with the intensification of the family planning program, but also with the development of education and other socioeconomic factors and processes.

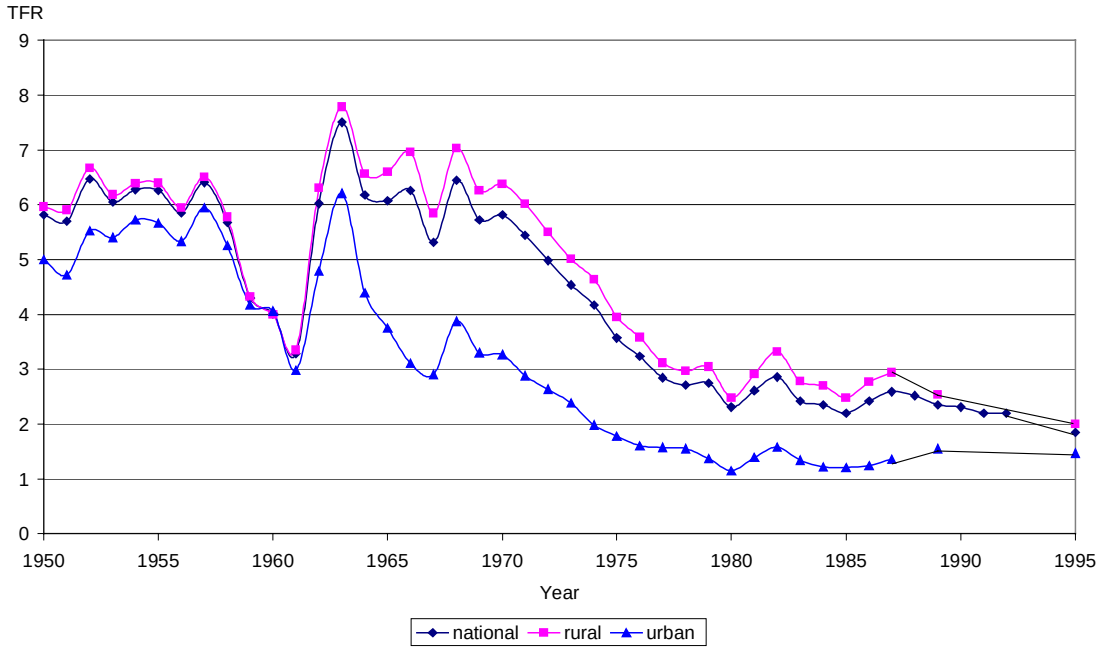


Figure 2. Differences in TFR between urban and rural populations, 1950-1995. Data based on: for 1950-1979, State Family Planning Commission (1982); for 1980-1988, State Family Planning Commission (1988); for 1989 and 1990, State Statistical Bureau (1993a); for 1991 and 1992, State Family Planning Commission (1992); for 1995, Office of Population Survey (1997).

Fertility changes in China have been categorized as “induced” and “natural” (Wang 1991). The former reflects government intervention hastening fertility decline; the latter reflects a fertility transition accompanied by socioeconomic development, such as increased family income, improvement of education, and promotion of social welfare services. Experiences of rural fertility transition have been considered as an induced decline. In contrast with urban fertility declines, in 1961 the rural fertility rate fell to 3.35 due to starvation. By 1962 the rural fertility rate was 6.30; this was not the case in urban regions until 1963. Between 1963-1970, a big baby boom took place. The rural population began its fertility transition at a rate of 7.03 in 1968, then fell to 6.26 in 1969, to 6.38 in 1970. The TFR in rural China has rapidly declined since full-scale implementation of family planning policies began throughout China in 1971. Although the specific requirements of greater population control were not strictly adhered to during the 1970s, the TFR fell from 6.01 in 1971 to 3.05 in 1979. Eventually, the TFR of rural China dropped to 2.48 in 1981 when the State Council put forward the strict family policy: only one child per couple. By 1995, the TFR of rural China reached 2.0. Fertility change in rural China has indicated that successful implementation of the birth planning program has played an important role in contributing to lower levels of rural fertility.

2.3 Fertility differentials by educational level

Over the years, various associations have been examined between education and fertility in underlying policy issues, theory, methodology, and empirical evidence. Empirical studies around the world show negative statistical associations between education and fertility in demographic change. Cochrane (1979, quoted in Eloundou-Enyegue 1999:289) says: "education does not affect fertility directly, but acts through many variables such as the biological supply of children, the demand for children by husbands and wives, and the regulation of fertility." Moreover, some researchers have extended the analysis to examine the specific benefits responsible for the effects of schooling on fertility.

Here, rather than to theoretically and methodologically discuss the effects of education on fertility, we empirically look at more insights of education-fertility interactions based on the 1990 population census (State Statistical Bureau 1993a).

Table 3. Age-specific fertility rates (per 1,000) for females by educational level, rural/urban regions, and for all of China in 1990. Calculations based on State Statistical Bureau (1993a).

Age group	Total	No schooling	Primary school	Middle school	College and above
Rural					
TFR	**2.58**	**3.00**	**2.59**	**2.43**	**1.59**
15-19	25.92	50.43	30.61	14.50	1.11
20-24	218.69	255.42	227.03	199.71	73.77
25-29	173.06	186.25	172.48	168.74	179.17
30-34	65.68	68.54	60.33	72.57	41.69
35-39	23.17	27.29	19.99	24.92	18.81
40-44	7.04	9.46	5.59	5.01	3.65
45-49	2.01	2.24	1.78	1.54	0.53
Urban					
TFR	**1.59**	**2.55**	**2.08**	**1.48**	**1.31**
15-19	10.14	48.00	28.21	6.59	0.14
20-24	143.08	232.45	196.98	139.64	44.36
25-29	117.72	152.42	132.05	110.30	170.20
30-34	34.16	54.47	44.59	28.86	34.30
35-39	10.67	17.36	11.36	8.90	10.03
40-44	2.10	4.44	2.08	1.43	1.70
45-49	0.71	1.15	0.68	0.53	0.34
All China					
TFR	**2.29**	**2.96**	**2.52**	**1.99**	**1.32**
15-19	21.99	50.30	30.40	11.39	0.18
20-24	198.81	253.96	223.93	176.21	46.88
25-29	155.55	183.37	167.37	142.65	170.66
30-34	55.74	67.04	57.68	48.24	34.58
35-39	19.56	26.16	18.25	14.87	10.37
40-44	5.67	8.88	4.79	2.81	1.77
45-49	1.63	2.09	1.46	0.89	0.35

As can be seen in Table 3, fertility has declined as a result of better education. In each age group there is an inverse relationship between age-specific fertility and educational levels. A higher educational level is associated with lower TFR. In China as a whole, the most dramatic change in fertility has occurred among women with middle school and college education. The TFR of women with no schooling is more than twice that of women with college education, and 1.5 times higher than those with middle school education. Thus, education appears to be an active factor influencing fertility rate beyond the national family planning guidelines.

The Chinese experience has shown that education affects women's fertility through the path of delaying marriage and thereby delaying a woman's entrance into her reproductive life. The age at first marriage is highly and positively correlated to education. According to the women's marriage survey in 1987 (Sha 1994:72), the average age at first marriage was 25.89 for college level, 23.05 for middle school, 21.08 for primary school, and 20.14 for women with no schooling. Women with a middle school or higher education are more likely to marry later, and hence give birth to fewer children than their less educated counterparts. Thus, the educated women use their human capital resources in the labor market while they reduce their time allocation for familial roles such as bearing and rearing children.

Furthermore, when comparing the fertility rates of urban and rural women at all educational levels, women in rural areas have a higher fertility rate than their city-dwelling counterparts. The rural-urban fertility differentials at the same educational level suggest that the fertility decline is a result of multiple interactions of socio-economic factors, not only of education alone.

2.4 Son preference and the unusually high sex ratio of infants

China has had a traditional culture of male preference for thousands of years. Males play the major role in carrying on the family line, labor participation and old-age security, therefore, parents tend to value sons over daughters. Although this traditional culture has been gradually weakening with the social changes in China, since the 1980s, the sex ratio of males to females at birth has been increasing steadily. Some people still wish to have at least one son in their small families, therefore, fertility behavior is different for women with and without sons. Son-preference is common in many parts of China, especially in rural areas, where the levels of socioeconomic development are relatively low. The effects of sex preference on fertility behavior are reflected in the selection of the sex of children through medical technologies.

Since the 1980s, the sex ratio at birth has been rising steadily (see Table 4). In China as a whole, the sex ratio rose from 107.63 in 1982 (the third census) to 111.75 in 1990 (the fourth census). In 1995, the high sex ratio of infants became more serious: it was as high as 116.57, and increased by 4.82 compared to 111.75 in 1990. The unusual high sex ratio of infants in recent years has attracted much attention from demographers and the government departments concerned.

As an explanation to the high infant sex ratio in China – although there is no common conclusion – the more concentrated suggestions are: 1) sex selection through medical technologies (selective abortion before the birth); and 2) under-reporting of female births or false reporting of early deaths of girls as stillborns. Some demographers

believe that selective abortion before birth and under-reporting on female infants may be the main reasons.

Chinese demographers have found that there is a strong relationship between the sex ratio of infants and the sex composition of children (Hao 1997). A woman, whose first child is a boy, is more likely to want a one-child certificate than a woman, whose first child is a girl; at all parities, women with few or no sons are less likely to be using contraceptives than those with many sons. Also, the probability of having a second birth for women with one daughter is higher than for those with one son; and the probability of a third birth for women with two daughters is significantly higher than for those with one son and one daughter. Moreover, as Table 4 indicates, place of residence also affects the infant sex ratio; the rural infant sex ratio is higher than the urban one. However, there are further questions ahead for Chinese demographers: How does the son-preference influence the fertility behavior of the population in general? How large has the influence been? Will the son-preference hamper further fertility decline?

Table 4. The sex ratio of infants. Calculations based on Office of Population Survey (1997); Office of Census (1991); Population Institute (1985); State Statistical Bureau (1986a, 1986b, 1993a, 1996); Yao (1995).

Year	Male	Female	Sex Ratio
All China			
1953	9,716,971	9,264,877	104.88
1964	14,509,500	13,974,327	103.83
1982	10,787,028	10,022,319	107.63
1990	12,254,905	10,965,946	111.75
1995	9,274,600	7,956,200	116.57
Rural			
1990	9,846,920	8,787,090	112.06
1995	7,018,600	5,960,700	117.75
Town[a]			
1990	731,060	649,130	112.62
1995	707,500	612,000	115.60
City[a]			
1990	1,701,050	1,558,370	109.16
1995	1,548,400	1,383,600	111.91

[a] See Section 3.1.1 for definition of town and city.

2.5 Fast growing rural-to-urban migration

Since the mid-1980s, rural-to-urban migration has been an important factor in demographic change. One of the major consequences of the economic reforms in China has been a rise in population mobility. Rural-to-urban migration is a dynamic force in the transition from a planned to a market-oriented economy.

Although there are numerous methodological problems in the classification of rural migration, generally, the so-called floating rural laborers, who are moving across provinces, are estimated at around 56 million (Jia and Meng 1996). Of these, 70%-80% are working in cities and other urban areas (Cai 1995). Thus, rural migrant labor is estimated at approximately 45 million. Beijing, Shanghai, and Guangdong each host about 10 million migrants (Yang 1997).

There are deep socioeconomic reasons for the fast growing rural-to-urban migration. The quantities of rural-to-urban migration are largely determined by continuing population growth; dramatic changes in the structure of agricultural production; a rapidly growing urban economy and agglomerates; implementation of the family responsibility system and a dual household registration system.

Prior to 1978, the distribution of the population resulted from the implementation of a traditional economic development strategy, which placed its first priority on heavy industry. This strategy created barriers for migration in two ways. 1) Industrial growth by heavy industry created few employment opportunities to absorb surplus rural laborers. 2) A planned labor force allocation had made interregional and inter-sectoral migration impossible. In addition, a household registration ("hukou") system was introduced to prevent rural laborers from moving into cities. The hukou system is analogous to an internal passport system, or at least to a "green card" system. This system created different opportunities and constraints for holders of the urban hukou or rural hukou status. Under such a system, the rural population could not change their residential status and occupational identity as they liked. As a result, despite the change of composition in national output value when agricultural production dropped from 57.7% in 1952 to 32.8% in 1978, employment structure did not change accordingly. The agricultural labor force only decreased from 83.5% in 1952 to 70.5% in 1978. Corresponding to this was a rise in the urbanization level: 17.9% in 1978 versus 12.5% in 1952. Since migration was strictly controlled, it was difficult for farmers to change their jobs and residential status. Hence, a large amount of surplus labor accumulated in the rural areas, associated with the technological development of agriculture. China now faces stronger pressure for rural labor force transference and land annexation. According to estimates by the Population Institute of the Chinese Academy of Social Sciences, the proportion of rural labor surplus of total rural labor is 31.53% for all of China (Cai 1995). Because the differences between provinces is very substantial, the direction of migration and of the labor movement appears to be from central and west to east, and from rural to urban areas.

With the transition from a planned to a market-oriented economy, the household registration system in urban China tends to be a dual-track system, the so-called "planned" track and "outside-of-planned" track. In the planned track, rural-to-urban migration is still constrained by a highly controlled household registration system. Only hukou migration (i.e. migration with permanent residency rights) is considered as planned migration. The scale of migration through the changing of permanent residence has not advanced enough to correct the distorted population distribution, so that migration "without plan" has become a necessity. Migration without residency rights, the so-called "floating" population, is outside of the state plans. They are not supposed to stay in the destination permanently. However, a large outside-of-planned track migration actually plays a substantial role in the urban economy and the urbanization process. They demand low-wage rural labor in China's urban areas. Many construction companies already hire their unskilled workers directly from rural areas. The booming

towns and cities also offer numerous opportunities for rural laborers to start a small private business.

It is necessary to address three points. 1) A large rural-to-urban migration outside of the state plans is often not reflected in the official statistics. 2) Most migrants come from the floating population; at a low degree they are expected to become permanent citizens. Their place of destination is not fixed, and their duration of stay is temporary. 3) The duality of migration is an outcome of the different levels of socioeconomic development in cities and in the countryside, including labor market segmentation based on the hukou system. These points are preconditions to understanding Chinese rural-to-urban migration.

2.6 Fast population aging

Chinese population aging appeared in the population age distribution in the mid-1970s. Since the 1980s it has steadily increased along with the significant fertility decline and a stable increase in life expectancy. In the 1990s it has become more serious (see Table 5).

Table 5. Age distribution (in %) of the total population by rural, urban, and all China, 1953-1995. Data based on: for 1953-1982, Institute of Population (1985); for 1990, Office of Census (1991); for 1995, Office of Population Survey (1997).

Age group	1953	1964	1982	1990	1995
All China					
0-14	36.28	40.69	33.59	27.62	26.73
15-19	56.40	53.18	58.77	63.81	63.10
60 and over	7.32	6.13	7.64	8.57	10.17
Median age	22.70	20.20	22.90	25.30	27.70
Rural					
0-14			35.40	29.59	28.72
15-19			56.80	61.69	61.29
60 and over			7.80	8.72	9.99
Town[a]					
0-14			28.31	23.70	23.50
15-19			65.29	69.10	66.95
60 and over			6.40	7.20	9.54
City[a]					
0-14			26.00	21.88	21.09
15-19			66.60	69.50	67.90
60 and over			7.40	8.62	11.01

[a] See Section 3.1.1 for definition of town and city.

Between 1964-1995, the median age declined by 7.5 years. The proportion age 60 and older increased by 2.4% from 1982 to 1990, and reached 10.7% in 1995. The proportion age 0-4 decreased by 7.1% between 1964 and 1982, and by 6.86% from 1982 to 1995. It is obvious that the speed of population aging has become quicker since

the 1980s. In the geographical aspect, the speed of population aging in cities is faster than in the country. From 1982 to 1995, the proportion age 60 and older in cities increased by 3.61%, whereas in rural areas it rose by 2.19%.

Population aging is a global phenomenon. However, when comparing the more developed countries (MDC) with the less developed countries (LDC), the type of aging is different, when the entire age distribution is considered. "MDCs are 'aging from the middle,' whereas LDCs are 'aging from the bottom.'… In MDCs, aging is reducing the size of the labor force, as the proportion of 15-59 year olds in the population declines. In LDCs, aging is increasing the size of the labor force: the proportion in the middle age group remains constant and population is redistributed, ... from the under-15 group, where labor force participation is very low, to the over-60 age group, where labor force participation is substantial, especially in low-income countries" (MacKellar 1997:5). When we consider the size of the labor force, Chinese population aging fits the LDC pattern. Since the 1960s, the size of the labor force in China has maintained a stable and sustained development: it reached 590 million in 1982, and increased to 723 million in 1990, then rose to 760 million in 1995. Currently, China is in the golden period of labor resource.

The aging of the Chinese population has developed its own characteristics when compared to other LDCs as well as to MDCs. Aging in China started late and developed fast. It usually takes 50-100 years for industrialized countries to change from a country with a young population to a country with an aged population. But in China, this process took only 30 years. The population aging of MDCs developed gradually following high economic development, while in China aging occurred during a period of low economic development. China now has the largest aged population in the world, and must deal with the social security issues of an aged population. Although at present, the proportion of the aged population and the old-age dependency ratio in China are more favorable than in the MDCs, they will deteriorate rapidly and soon surpass the levels of western industrialized countries, as well as the former socialist countries of central and eastern Europe, causing similar problems. And with a much lower level of income in China, the solution of the problem becomes even more difficult.

3 Base Data and Scenario Assumption for the Next 50 Years

The tools of a multi-state population projection allow the projection of a population by several characteristics, such as age, sex, education and place of residence. In particular, educational levels have been introduced into the model as one of the assumed main sources of population heterogeneity. Thus, specific sets of assumptions are applied to educational groups linked with fertility, mortality and migration patterns.

3.1 Base data

As required by the multi-state population projection by educational level, the base data is divided into age, sex, educational level, rural and urban region. The base data for the Chinese projection is derived from four major sources:

1) *National 1% Population Sample Survey 1995* (Office of Population Survey 1997), conducted by the State Statistical Bureau of China. This large-scale survey on national strength and condition after the 1990 population census, provided a reliable

basis for the data of the starting year: population by age, sex, educational level, as well as by rural and urban region, fertility and mortality by age and region, registered rural-to-urban migration.

2) *National Population Census 1990* (State Statistical Bureau 1993a) served as a reference for estimating the fertility rate by education and by rural/urban region for women aged 15-49.

3) *Survey Data on the Chinese Support System for the Elderly* (National Research Center on Aging 1992) allowed us to construct the population aged 60-80 by educational level.

4) *Sampling Survey, Data on Chinese Migration in 74 Cities and Towns in 1986* (Institute of Population Studies 1988). This was a key project of the Chinese Academy of Social Sciences and the P50 Program of the United Nations Population Fund (UNFPA, New York). It provided detailed information about educational levels of migrants by sex and age. It is available to estimate the educational structure of migration.

In the *National 1% Population Sample Survey 1995* (Office of Population Survey 1997), the data on urban and rural population, levels of education, and migration are based on the following concepts.

3.1.1 Urban and rural population

Urban population includes all people living in cities and towns with permanent residency rights. **City population** refers to people with permanent residency rights living in the districts of cities that are sub-divided into districts, or living in the street communities of cities that are not sub-divided into districts. **Town population** refers to people with permanent residency rights living in neighborhood communities under the jurisdiction of cities that are not sub-divided into districts, or living in neighborhood communities of towns directly under country jurisdiction. **Rural population** refers to all people not living in cities and towns, who are without permanent residency rights of a city or town, and are living in rural areas.

3.1.2 Concept of level of education

No schooling refers to those who are illiterate or semi-literate. **Primary school** refers to those who have completed the final grade at the first level of education. Normally, this takes six years in China. **Middle school** refers to those who have completed the final grade at a senior secondary school and a junior secondary school, or a vocational secondary school, or a technical training school. **College and above** refers to those who have completed the final degree at a university or college, as well as a college for post-graduates, including universities and colleges for adults.

3.1.3 Concept of migration

Migration refers to those who have left a rural region, where they were registered as residents, and have lived or worked continuously for more than one-half year in cities or towns without permanent residency rights of the city or town, but have been registered as temporary residents.

3.2 A brief explanation of the base-line input data

3.2.1 Modified fertility in 1995

The TFR calculated directly according to the 1% survey in 1995 was 1.46 (Office of Population Survey 1997). Does such a low figure reflect the current level of fertility in China? The TFR in 1989 was 2.25, according to China's 1990 population census (State Statistical Bureau 1993a). In 1991 it was 1.65, according to the sample survey of 380,000 people conducted by the Family Planning Committee (1991). The adjusted TFR was 2.20 (Zeng 1996). The State Statistical Bureau (SSB) obviously believed that the TFR is lower (1.46). The main reason for such low fertility was the under-reporting of the data on births and fertility. This has happened in different population sample surveys in recent years (Zhang *et al.* 1997). To make an accurate evaluation of China's fertility level in the mid-1990s, the SSB adjusted the TFR of 1995. The adjustment was based on the total birth rate of the 1995 survey (Office of Population Survey 1997), which was 17.12 per thousand. This figure was obtained by adjusting sample errors and enumeration errors, and reflected more accurately the actual status of births. According to this figure, the adjusted TFR of 1995 was 1.85 for the whole country. According to the proportional relationship between the surveyed TFR of all China, and the TFR of cities, towns, and rural areas, the adjustment on the TFR for cities was 1.43, for towns 1.58, and for rural areas 2.

The base-year fertility data by education used in the multi-state projection was estimated in three steps. First, in light of the adjustment on TFR by the SSB in 1995, we adjusted the age-specific fertility rate (see Table 6a). Second, we estimated the fertility differentials by education, based on the fertility level of all educational categories, according to the 1990 population census (see Table 6b). Finally, we calculated the age-specific fertility rate by education according to the results of the first and second steps.

Table 6a. Estimated TFR by region in 1995, as adjusted by the State Statistical Bureau (Department of Population and Employment). Source: Zhang *et al.* (1997).

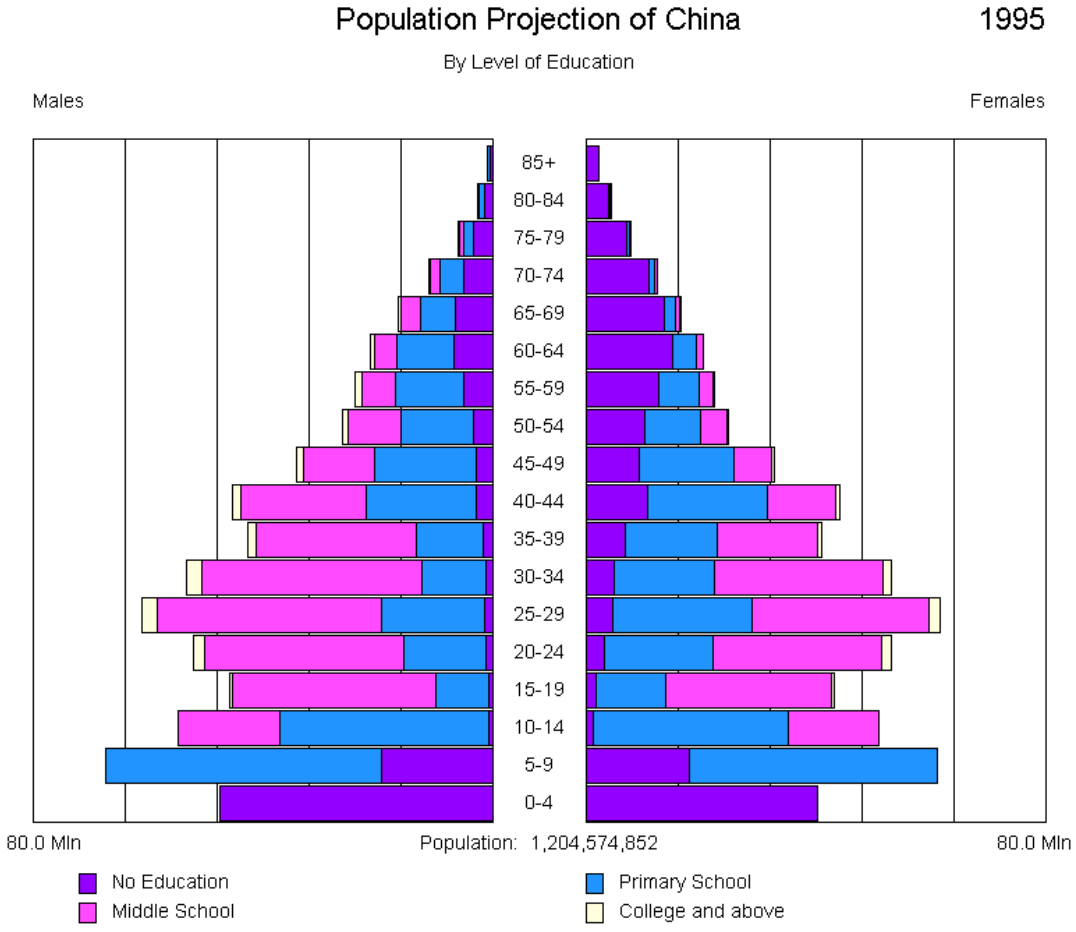
Region	TFR	Modified TFR	Differential TFR
All China	1.46	1.85	0.39
City	1.13	1.43	0.30
Town	1.25	1.58	0.33
Rural	1.58	2.00	0.42

Table 6b. Estimated age-specific fertility rates (ASFR) and TFR by region in 1995. Calculations are based on Office of Population Survey (1997).

Age group	ASFR and TFR	Ratio ASFR/TFR	Estimated ASFR and TFR
Rural			
15-19	0.07	0.04	0.08
20-24	0.85	0.54	1.08
25-29	0.47	0.30	0.60
30-34	0.15	0.09	0.19
35-39	0.03	0.02	0.04
40-44	0.01	0.01	0.01
45-49	0.00	0.00	0.01
Total	1.58	1.00	2.00
Town			
15-19	0.03	0.02	0.04
20-24	0.66	0.53	0.84
25-29	0.43	0.34	0.54
30-34	0.10	0.08	0.13
35-39	0.02	0.02	0.03
40-44	0.01	0.00	0.01
45-49	0.00	0.00	0.00
Total	1.25	1.00	1.58
City			
15-19	0.02	0.02	0.03
20-24	0.54	0.49	0.70
25-29	0.43	0.39	0.56
30-34	0.10	0.09	0.13
35-39	0.02	0.02	0.02
40-44	0.00	0.00	0.00
45-49	0.00	0.00	0.00
Total	1.13	1.00	1.43
All China			
15-19	0.05	0.04	0.07
20-24	0.77	0.53	0.98
25-29	0.46	0.32	0.58
30-34	0.13	0.09	0.17
35-39	0.03	0.02	0.04
40-44	0.01	0.01	0.01
45-49	0.00	0.00	0.00
Total	1.46	1.00	1.85

3.2.2 The age group 5-9 in 1995

Through the population pyramid below, we can see that the size of the cohort aged 5-9 is much larger than either the 10-14 or 0-4 group. There are two basic causes for this. First, the "echo effect" of the baby boom from 1963 to the early 1970s. The age 5-9 cohort was born between 1985 and 1990; they are children of the large baby boom generation. In 1983, more than 29 million young Chinese born during the baby boom would marry and have their children. This baby boom created great pressure on Chinese population control in terms of first marriage and births in most of the 1980s. Second, the effect of the New Marriage Law in 1981, which lowered the legal age of marriage from 23 to 20 (for women). Accordingly, the mean age at first marriage has declined, and a dramatic increase in the number of married people was expected as the baby boom generation reached the legal age of marriage. For example, 18% of the women were married by age 23 or younger in 1980. This increased to 30.8% in 1982, and to 28.3% in 1983. The impact of the fluctuation resulting from the change of the legal marriage age has been gradually eliminated since the late 1980s.



Source: Office of Population Survey (1997)

3.2.3 Estimated rural-to-urban migration by education and age

Analyzing data for rural-to-urban migration is not an easy task. There is no exact definition for rural-to-urban migration in different estimates. The data of total net migration has been calculated according to the 1% population survey in 1995 (Office of Population Survey 1997). However, because of a lack of accurate data on rural to urban by level of education, the age, sex and educational structures have been estimated, based on the survey data of the Institute of Population Studies (1988) since it provides the educational level of migration for males and females, as well as for age groups.

3.2.4 Estimated population age 60 and above by education

Survey data on the Chinese support system for the elderly (National Research Center on Aging 1992) gives the proportion of the population in each educational category for ages 60-100. The proportion of each educational level is applied to the same age group in 1995 for the projection.

3.2.5 Data on mortality not estimated by education

Unfortunately, due to a lack of accurate data on mortality by level of education, the same base-year data on mortality levels is used for all educational levels in the multi-state projection.

3.3 Sets of scenario assumptions for future projection

The usual way to produce scenario assumptions, which combine the alternative three basic demographic components fertility, mortality and migration, is to operate through one of these three factors. In our multi-state population projection, education combines with fertility, mortality and migration in a scenario approach. Also, the place of residence (rural or urban) is considered as a variant.

The scenarios for education are obtained from that principle. Fertility is low among women with higher education, in a period when educational levels are increasing. Women with higher education tend to take the lead in reducing their fertility, and a fertility gap appears (Yousif *et al.* 1996). The weight of each educational category is hypothesized to change by increasing the educational transition rate among different educational levels, which link with the low, central and high demographic assumptions, so that the impact of education on future population size and population structure will be tested.

The following scenario matrix (Table 7) and tables of summarized assumptions (Tables 8-14) present nine sets of scenarios for rural and urban Chinese population projection over 50 years. The national population projection is aggregated from the results of the rural and urban projections. Each scenario combines low, central, and high assumptions on fertility, mortality, migration, and education. Each scenario assumption (low, central, and high) combines with another three scenarios: no convergence, education converged, education and region converged. The base year parameters of each area remain the same in all nine scenarios.

The low scenario implies that fertility and mortality will decline with the increase in higher education by the end of the projection period. The TFR is expected to continue to

drop to 1.7 in rural areas, 1.29 in urban regions, 1.56 at the national level. The assumptions of low mortality, which lead to an increase in life expectancy at birth, range between 1.79 to 2.10 years (per decade) for rural men and women, and at about 1.65 years for both sexes in urban China. Consistent with declining fertility and mortality rates, we assume that the highest transition rates achieved by the end of the projection period in rural regions will be 100 for males and females with no schooling to primary school. For those with primary to middle school education, they will be 90 for males and 85 for females. Those with middle school to college and above levels, they will be between 8 to 10. These assumptions show that the middle school level is rising quickly in rural areas. For urban regions, the highest transition rates are 100 from primary to middle school, and 35 from middle school to college level and above for both males and females. In both rural and urban regions, we assume that there are no illiterate or semi-literate. The scenario of net rural-to-urban migration is expected to increase at a very low level, since it is still under the strict control of the urban household registration system.

In ***the central scenario,*** fertility by different educational category will remain constant until the end of the projection period, at the same level as the base year 1995 in rural and urban regions. At the national level, TFR is aggregated to be between 1.75 and 1.86. In rural China, life expectancy will increase by 6.73 years for men and 6.74 years for women by the end of the projection period. A moderate rise in net migration is expected. The transition rates for men in rural China are at the same level as the low scenario assumption for no schooling to primary and primary to middle school. The transition rate for middle school to college and above is assumed lower than in the low scenario. For rural females, the transition rates are lower than for males for middle school and college and above, i.e., 75 for primary to middle school, 4 for middle school to college and above. For urban China, we assume that the gender gap disappears in all levels, and that the transition rates are the same as in the low educational scenario, except for transition rates for middle school to college and above, which are lower than in the low educational scenario.

The high scenario considers high assumptions for fertility, mortality and net migration, and low assumptions for education. We assume that TFR will increase to slightly over replacement level, between 2.12 to 2.32 (aggregated) at the national level. The high scenario for fertility assumes that the policy of family planning will be more relaxed, especially to a great extent in cities. Under the assumption of slow-declining mortality, the life expectancy rises 1.6 years for men and 1.84 years for women per decade in rural regions, and 1.35 years for both males and females in urban regions. With the high assumption for migration, we expect that total net migration will be largely expanded under a gradual relaxation of the urban household registration system. The low education hypothesizes that there are no improvements in various levels of education, and educational levels remain constant as of the starting year 1995.

No convergence refers to fertility differentials by educational levels, and by rural/urban residency which is held constant at the base year 1995.

Education converged means that the fertility differentials by education will decline; a convergence of fertility levels across educational categories takes place, but the distinction of fertility between rural and urban is not declining.

Education and region converged implies a convergence of fertility levels in educational categories and in rural/urban regions; fertility differentials by education and rural/urban residency are declining.

Table 7. Scenario matrix.

	Low Scenario[a]	Central Scenario[b]	High Scenario[c]
No convergence	L1	C1	H1
Education converged	L2	C2	H2
Education and region converged	L3	C3	H3

[a] Low fertility, low mortality, high education, low migration
[b] Central, fertility, central mortality, central education, central migration
[c] High fertility, high mortality, low education, high migration

Table 8. Base year parameters and low scenario assumptions for rural China in 2045.

	Base year 1995	Scenario L1	Scenario L2	Scenario L3
TFR				
Total population	2.00	1.70	1.70	1.50
No schooling	2.33	2.00	1.75	1.50
Primary school	2.01	1.80	1.73	1.50
Middle school	1.91	1.70	1.71	1.50
College and above	1.22	1.20	1.49	1.50
Life expectancy (in years)				
Male	67.61	76.54	76.54	76.54
Female	71.86	82.34	82.34	82.34
Educational transition from no schooling to primary school (in percentage)				
Male	95.31	100.00	100.00	100.00
Female	89.95	100.00	100.00	100.00
Educational transition from primary school to middle school (in percentage)				
Male	72.04	90.00	90.00	90.00
Female	61.20	85.00	85.00	85.00
Educational transition from middle school to college and above (in percentage)				
Male	0.93	10.00	10.00	10.00
Female	0.69	8.00	8.00	8.00
Migration (in millions)				
Total	-6.31	-11.06	-11.06	-11.06
No schooling	-0.67	-1.17	-1.17	-1.17
Primary school	-1.34	-2.35	-2.35	-2.35
Middle school	-3.61	-6.33	-6.33	-6.33
College and above	-0.69	-1.22	-1.22	-1.22

Table 9. Base year parameters and central scenario assumptions for rural China in 2045.

	Base year 1995	Scenario C1	Scenario C2	Scenario C3
TFR				
Total population	2.00	1.92	1.91	1.82
No schooling	2.33	2.33	1.91	1.82
Primary school	2.01	2.01	1.91	1.82
Middle school	1.91	1.91	1.91	1.82
College and above	1.22	1.22	1.91	1.82
Life expectancy (in years)				
Male	67.61	75.68	75.68	75.68
Female	71.86	81.07	81.07	81.07
Educational transition from no schooling to primary school (in percentage)				
Male	95.31	100.00	100.00	100.00
Female	89.95	100.00	100.00	100.00
Educational transition from primary school to middle school (in percentage)				
Male	72.04	90.00	90.00	90.00
Female	61.20	75.00	75.00	75.00
Educational transition from middle school to college and above (in percentage)				
Male	0.93	5.00	5.00	5.00
Female	0.69	4.00	4.00	4.00
Migration (in millions)				
Total	-6.31	-30.81	-30.81	-30.81
No schooling	-0.67	-3.25	-3.25	-3.25
Primary school	-1.34	-6.55	-6.55	-6.55
Middle school	-3.61	-17.62	-17.62	-17.62
College and above	-0.69	-3.39	-3.39	-3.39

Table 10. Base year parameters and high scenario assumptions for rural China in 2045.

	Base year 1995	Scenario H1	Scenario H2	Scenario H3
TFR				
Total population	2.00	2.38	2.29	2.29
No schooling	2.33	2.73	2.29	2.29
Primary school	2.01	2.40	2.29	2.29
Middle school	1.91	2.33	2.29	2.29
College and above	1.22	1.66	2.29	2.29
Life expectancy (in years)				
Male	67.61	74.49	74.49	74.49
Female	71.86	79.08	79.08	79.08
Educational transition from no schooling to primary school (in percentage)				
Male	95.31	95.31	95.31	95.31
Female	89.95	89.95	89.95	89.95
Educational transition from primary school to middle school (in percentage)				
Male	72.04	72.04	72.04	72.04
Female	61.20	61.20	61.20	61.20
Educational transition from middle school to college and above (in percentage)				
Male	0.93	0.93	0.93	0.93
Female	0.69	0.69	0.69	0.69
Migration (in millions)				
Total	-6.31	-50.18	-50.18	-50.18
No schooling	-0.67	-5.30	-5.30	-5.30
Primary school	-1.34	-10.66	-10.66	-10.66
Middle school	-3.61	-28.70	-28.70	-28.70
College and above	-0.69	-5.52	-5.52	-5.52

Table 11. Base year parameters and low scenario assumptions for urban China in 2045.

	Base year 1995	Scenario L1	Scenario L2	Scenario L3
TFR				
Total population	1.48	1.29	1.29	1.50
No schooling	2.32	2.00	1.32	1.50
Primary school	1.92	1.70	1.31	1.50
Middle school	1.42	1.32	1.29	1.50
College and above	1.21	1.20	1.29	1.50
Life expectancy (in years)				
Male	71.17	79.39	79.39	79.39
Female	76.15	84.39	84.39	84.39
Educational transition from no schooling to primary school (in percentage)				
Male	98.40	100.00	100.00	100.00
Female	97.69	100.00	100.00	100.00
Educational transition from primary school to middle school (in percentage)				
Male	100.00	100.00	100.00	100.00
Female	100.00	100.00	100.00	100.00
Educational transition from middle school to college and above (in percentage)				
Male	12.63	35.00	35.00	35.00
Female	11.34	35.00	35.00	35.00
Migration (in millions)				
Total	6.31	11.07	11.07	11.07
No schooling	0.67	1.17	1.17	1.17
Primary school	1.34	2.35	2.35	2.35
Middle school	3.61	6.33	6.33	6.33
College and above	0.69	1.22	1.22	1.22

Table 12. Base year parameters and central scenario assumptions for urban China in 2045.

	Base year 1995	Scenario C1	Scenario C2	Scenario C3
TFR				
Total population	1.48	1.38	1.42	1.82
No schooling	2.32	2.32	1.42	1.82
Primary school	1.92	1.92	1.42	1.82
Middle school	1.42	1.42	1.42	1.82
College and above	1.21	1.21	1.42	1.82
Life expectancy (in years)				
Male	71.17	77.90	77.90	77.90
Female	76.15	82.89	82.89	82.89
Educational transition from no schooling to primary school (in percentage)				
Male	98.40	100.00	100.00	100.00
Female	97.69	100.00	100.00	100.00
Educational transition from primary school to middle school (in percentage)				
Male	100.00	100.00	100.00	100.00
Female	100.00	100.00	100.00	100.00
Educational transition from middle school to college and above (in percentage)				
Male	12.63	25.00	25.00	25.00
Female	11.34	25.00	25.00	25.00
Migration (in millions)				
Total	6.31	30.81	30.81	30.81
No schooling	0.67	3.25	3.25	3.25
Primary school	1.34	6.55	6.55	6.55
Middle school	3.61	17.62	17.62	17.62
College and above	0.69	3.39	3.39	3.39

Table 13. Base year parameters and high scenario assumptions for urban China in 2045.

	Base year 1995	Scenario H1	Scenario H2	Scenario H3
TFR				
Total population	1.48	1.75	1.75	2.29
No schooling	2.32	2.72	1.75	2.29
Primary school	1.92	2.38	1.75	2.29
Middle school	1.42	1.75	1.75	2.29
College and above	1.21	1.65	1.75	2.29
Life expectancy (in years)				
Male	71.17	76.10	76.10	76.10
Female	76.15	81.10	81.10	81.10
Educational transition from no schooling to primary school (in percentage)				
Male	98.40	98.40	98.40	98.40
Female	97.69	97.69	97.69	97.69
Educational transition from primary school to middle school (in percentage)				
Male	100.00	100.00	100.00	100.00
Female	100.00	100.00	100.00	100.00
Educational transition from middle school to college and above (in percentage)				
Male	12.63	12.63	12.63	12.63
Female	11.34	11.34	11.34	11.34
Migration (in millions)				
Total	6.31	50.18	50.18	50.18
No schooling	0.67	5.30	5.30	5.30
Primary school	1.34	10.66	10.66	10.66
Middle school	3.61	28.70	28.70	28.70
College and above	0.69	5.52	5.52	5.52

Table 14a. TFR under low, central, and high scenarios for all China in 2045.

Scenarios	Low fertility	Central fertility	High fertility
Assumptions			
No convergence	1.56	1.75	2.32
Education converged	1.50	1.86	2.12
Education and region converged	1.50	1.82	2.29

Table 14b. Estimated TFR by education in 1995 for all China. Calculations are based on Office of Population Survey (1997).

	Total	No schooling	Primary school	Middle school	College and above
TFR	1.85	2.32	1.98	1.68	1.21

4 Analyses of the Projection Results

Tables 15-21 show the main results of the multi-state projection for China up to 2045. There are nine sets of projections, in which three scenarios (low, central, and high assumptions for fertility, mortality, migration, and education) are combined with no convergence, education converged, and education and region converged. In addition to the nine sets, the ***constant migration*** scenario is used to more clearly define the differentials by education in future population development.

4.1 Population size

Based on a total population of 1.2 billion in 1995, Table 15 indicates that the Chinese population will certainly increase. According to the low, central, and high scenarios, the Chinese population for 2045 will be 1.37-1.38 billion (low), 1.48-1.49 billion (central), and 1.55-1.59 billion (high). Even under the extreme scenario of low fertility, the population is expected to grow by about 143-173 million.

Although the population will continue to increase over the next five decades, it will grow at different speeds in different years and in rural and urban regions. In the low scenario, population growth reaches its peak during 2020-2025. In the central scenario, it peaks between 2030-2035, after which the population begins to show negative growth. In the high scenario, growth will peak in 2045. The population in both rural and urban regions will increase particularly rapidly during the next 20 to 35 years. Due to the age structure of the population in the base year, the number of women of reproductive age (15-49) will increase until between 2010 to 2015. The total number of reproductive women will be around 300-350 million, according to the central and high assumptions. The period from 1995 to 2015 is a crucial time for China's future population growth. However, the speed of population growth is different between rural and urban China, since migration is an active factor in the projection. More migrants entering the cities bring a higher increase in urban population size, as shown by all scenarios. If we keep migration constant, as in C1 and H1 of Table 15, in central and

high scenarios combined with no educational and regional convergence, the increased rate of urban population size is lower than 13.94% for the central scenario, and 29.58% for the high scenario.

Table 15. Population size (in millions) under low, central, and high scenarios in 2045.

			Low Scenario		Central Scenario		High Scenario	
		Base year population 1995	Population	Rate of increase (%)	Population	Rate of increase (%)	Population	Rate of increase (%)
No	Rural	860.36	919.83	6.91	977.01	13.56	990.51	15.13
Convergence	Urban	344.22	457.38	32.88	505.02	46.72	577.12	67.66
	China	1204.57	1377.21	14.33	1482.03	23.03	1567.63	30.14
					C1: constant migration		H1: constant migration	
	Rural	860.36			1024.62	19.09	1091.98	26.92
	Urban	344.22			457.09	32.79	475.31	38.08
	China	1204.57			1481.71	23.01	1567.29	30.11
Education	Rural	860.36	916.70	6.55	970.58	12.81	969.42	12.68
Converged	Urban	344.22	456.52	32.63	506.13	47.04	576.32	67.43
	China	1204.57	1373.23	14.00	1476.71	22.59	1545.74	28.32
Education	Rural	860.36	874.39	1.63	952.72	10.74	969.41	12.68
and region	Urban	344.22	472.69	37.32	539.14	56.63	620.91	80.38
Converged	China	1204.57	1347.08	11.83	1491.86	23.85	1590.32	32.02

4.2 Age structure

Tables 16 and 17 present the age structure under the multi-state projection. By 2045 the proportion of the 0-14 age group in the total population will decline to about 14%-14.8% in the low scenario, more than 16% in the central scenario, and about 19%-20% in the high assumption, compared to 26.73% in total population in 1995. Meanwhile, the proportion of the age group 60 and over in the total population will increase from 10.17% in 1995 to about 31% in the low scenario, about 29% in the central scenario, and about 26% in the high scenario. This means that the proportion aged 60 and over will double or even triple in size over the next decades. This will be a period of very rapid aging, as a result of the baby boomers (born between the mid-1960s and early 1970s) reaching their advanced years. As a result, there will be no growth in the working-age population after 2025 in the low scenario, and between 2030-2035 in the central scenario. Thereafter follows a decline in the working age population.

The results of the projection show differences in the aging process in rural and urban regions. When considering the level and speed of aging, either the proportion of elderly or the speed of aging in urban areas is higher than in rural areas in all scenarios, while according to the data of the base year, the proportion aged 60 and over was almost at the same level in rural and urban regions. However, if we compare the no convergence scenario with the education and region converged scenario, in which a convergence of fertility around the middle school level across the different educational categories and in rural/urban regions takes place, the increase in aging in urban regions will be slightly slower, and the proportion of elderly will decrease more than 2%. The difference

between rural and urban areas becomes smaller under the education and region converged scenario.

Table 16. Population (in millions), and proportion of 0-14 age group in the total population in 2045 (in %).

		Base Year 1995		Low Scenario		Central Scenario		High Scenario	
		Population	Total	Population	Total	Population	Total	Population	Total
No	Rural	247.12	28.72	154.06	16.75	181.24	18.55	224.95	22.71
Convergence	Urban	74.91	21.76	49.89	10.91	57.65	11.42	79.04	13.70
	China	322.03	26.73	203.95	14.81	238.89	16.12	303.99	19.39
						C1: constant migration		H1: constant migration	
	Rural					185.99	18.15	236.90	21.69
	Urban					53.81	11.77	69.42	14.61
	China					239.80	16.18	306.32	19.54
Education	Rural	247.12	28.72	153.10	16.70	178.23	18.36	213.39	22.01
Converged	Urban	74.91	21.76	49.61	10.87	58.48	11.55	78.68	13.65
	China	322.03	26.73	202.71	14.76	236.71	16.03	292.07	18.90
Education	Rural	247.12	28.72	130.31	14.90	167.66	17.60	213.39	22.01
And region	Urban	74.91	21.76	58.56	12.39	77.67	14.41	106.42	17.14
Converged	China	322.03	26.73	188.87	14.02	245.33	16.44	319.81	20.11

Table 17. Population (in millions), and proportion of ages 60 and over in the total population in 2045 (in %).

		Base year 1995		Low Scenario		Central Scenario		High Scenario	
		Population	Total	Population	Total	Population	Total	Population	Total
No	Rural	85.97	9.99	265.12	28.82	263.44	26.96	242.29	24.46
Convergence	Urban	36.49	10.60	160.54	35.10	163.10	32.30	164.13	28.44
	China	122.47	10.17	425.66	30.91	426.54	28.78	406.42	25.93
						C1: constant migration		H1: constant migration	
	Rural					272.13	26.56	260.07	23.82
	Urban					153.60	33.60	145.42	30.59
	China					425.73	28.73	405.48	25.87
Education	Rural	85.97	9.99	265.12	28.92	263.42	27.14	242.51	25.02
Converged	Urban	36.49	10.60	160.54	35.16	163.10	32.22	164.13	28.48
	China	122.47	10.17	425.66	31.00	426.52	28.88	406.64	26.31
Education	Rural	85.97	9.99	265.12	30.32	263.62	27.67	242.52	25.02
And region	Urban	36.49	10.60	160.54	33.96	163.10	30.25	164.13	26.43
Converged	China	122.47	10.17	425.66	31.60	426.72	28.60	406.65	25.57

4.3 Educational composition

Tables 18-20 provide a picture of the total population of China by educational level in the end year of projection. The results for all scenarios show a rapid decline in the percentage of the population with no schooling in rural and urban areas. In rural regions, the proportion with no schooling decreases from 27.17% in 1995 to 8%-13% until 2045 in all scenarios. This change implies that China can substantially reduce the illiterate or semi-literate population. For China as whole, the total population with no schooling will decrease from 18.36% in the base year to between 7.5% and 11.5% in 2045.

Another important result from the multi-state projection is that the middle school level will increase considerably over the next decades. In all scenarios, by 2045, the percentage of urban area population attending middle schools is between 68%-71%, i.e., about 17%-21% higher than in the base year. As a result, in all of China, the total population attaining a middle school education will reach 55%-66% by 2045, while it was only 41.06% in the base year.

It is interesting to note that in the low to high scenarios, the size of both the rural and the urban population under the education converged scenario is smaller than under the no convergence scenario, although the assumptions for total fertility in these two scenarios are almost same (except H3=2.29 is slightly higher than H1=2.38 in rural regions). Even in the assumption on TFR for urban China, C2 is higher than C1, but the size of the population is still smaller. This situation is evident when we consider fertility differentials by educational level. In the education converged scenario, we assume fertility converging to the middle school level across educational categories, which are 1.7, 1.91, 2.29 for rural, and 1.29, 1.42, 1.75 for urban China. The differentials of fertility by education disappear. The size of the population under the education converged scenario points out that slow growth is associated with a general increase in the level of education.

Table 18. Population distribution (in %) by education under low, central, and high scenarios in rural China in 2045.

		Base year 1995	Low Scenario	Central Scenario	High Scenario
No	no schooling	27.17	8.80	9.81	13.42
Convergence	primary school	42.72	33.28	25.64	39.44
	middle school	29.87	56.53	64.00	47.09
	college and above	0.25	1.39	0.55	0.05
				C1: constant migration	H1: constant migration
	no schooling			9.81	12.93
	primary school			25.48	38.44
	middle school			64.07	48.40
	college and above			0.64	0.23
Education	no schooling	27.17	8.78	9.74	12.76
converged	primary school	42.72	33.31	25.63	28.64
	middle school	29.87	56.53	64.06	58.51
	college and above	0.25	1.38	0.57	0.09
Education	no schooling	27.17	8.05	9.45	12.76
and region	primary school	42.72	33.70	25.49	28.64
converged	middle school	29.87	56.91	64.59	58.51
	college and above	0.25	1.34	0.47	0.09

Table 19. Population distribution (in %) by education under low, central, and high scenarios in urban China in 2045.

		Base year 1995	Low Scenario	Central Scenario	High Scenario
No	no schooling	15.93	5.85	6.33	7.56
convergence	primary school	26.97	11.22	11.81	12.73
	middle school	50.50	70.60	69.84	70.03
	college and above	6.61	12.33	12.02	9.68
				C1: constant migration	H1: constant migration
	no schooling			6.17	7.93
	primary school			11.29	11.84
	middle school			70.28	70.19
	college and above			12.26	10.04
Education	no schooling	15.90	5.84	6.40	7.55
converged	primary school	26.97	11.21	11.85	12.72
	middle school	50.50	70.62	69.75	70.04
	college and above	6.61	12.33	12.00	9.69
Education	no schooling	15.93	6.51	7.72	9.29
and region	primary school	26.97	11.62	12.61	13.62
converged	middle school	50.50	69.68	68.04	67.87
	college and above	6.61	12.19	11.63	9.23

Table 20. Population distribution (in %) by education under low, central, and high scenarios for all of China in 2045.

		Base year 1995	Low Scenario	Central Scenario	High Scenario
No	no schooling	18.36	7.82	8.66	11.11
convergence	primary school	37.96	25.95	21.06	30.17
	middle school	41.06	61.21	65.94	55.29
	college and above	2.62	5.02	4.35	3.44
				C1: constant migration	H1: constant migration
	no schooling			8.69	11.27
	primary school			21.10	30.37
	middle school			65.90	55.22
	college and above			4.31	3.14
Education	no schooling	18.36	7.81	8.63	10.90
converged	primary school	37.96	25.96	21.04	22.96
	middle school	41.06	61.20	65.96	62.63
	college and above	2.62	5.03	4.37	3.51
Education	no schooling	18.36	7.51	8.84	11.46
and region	primary school	37.96	25.95	20.96	23.01
converged	middle school	41.06	61.39	65.80	62.02
	college and above	2.62	5.15	4.40	3.51

4.4 Rural-urban distribution

Table 21 presents the rural and urban population distribution in 2045, resulting from our projection. By 2045, the proportion of total urban population will reach different levels based on the different scenarios. When we look across all scenarios, we see two things:

1) An increase in the proportion of the urban population is largely caused by the number of rural-to-urban migrants. The scenario is combined with greater migration to show a higher proportion of urban population. For example, in the high scenario, the urban proportion reaches 39%, while the low scenario shows 35%.

2) The proportion of the total urban population is influenced by fertility differentials at the educational and regional levels. In scenarios combined with education and region converged, in which a convergence of fertility across educational categories and in rural/urban regions takes place, and fertility differentials by education and rural/urban disappear, the proportion of the urban population is higher.

As mentioned previously, migration analysis is arguably the most complex demographic variable for our population projection. In projecting the proportion of urban population over the next decades, three important dimensions should be taken into account.

1) The methodological measurement in the classification of rural-to-urban migration. Our assumption for migration lies in the definition of a migrant: one who has left a rural region of registered residence, and has lived or worked continuously for more than one-half year in a city or town without permanent residency rights for that city or town, but has been registered as a temporary resident. The short-term “floating” population is excluded. The base year data on migration is relatively small. Therefore, we believe that the proportion of total urban population over the next decades will be higher than our assumption concludes, since a large rural migratory

movement outside of the planned migration track will play a substantial role in the urban economy and in the urbanization process.

2) To what degree will the central government relax the urban household registration system, and to what extent will the government keep the policy of avoiding excessive population concentrations in cities in the near future? The World Bank (1995) has estimated that by 2050, the government policy of avoiding excessive population concentrations in cities will keep the share of urban employment in China at around 50% of the total labor force. This is significantly below the 70%-80% reached in countries such as Japan and Korea.

3) How many rural-urban migrants, including the floating population, will be absorbed as permanent residents in cities during the economic development? The rural-to-urban migratory movement to big cities such as Shanghai, Beijing, and Guangzhou, has shown that there is a need to coordinate the growth of the regional economy and the constraint of migratory cost under market-economic conditions. On the one hand, large cities begin to absorb selected rural-to-urban migrants as their permanent inhabitants. On the other, most floating population do not settle down in cities, but rather continue their urbanization process after returning to their original residence.

Table 21. Total urban population (in %) in total population in 2045.

	Base year 1995	Low Scenario	Central Scenario	High Scenario
No convergence	28.58	33.21	34.08	36.81
			C1: constant migration	H1: constant migration
			31.00	30.00
Education converged	28.58	33.24	34.27	37.29
Education and region converged	28.58	35.09	36.14	39.04

5 Conclusion: Population and Sustainable Development in the Context of Policy, Education, and Economy in China

China's population trends have challenged the ability of the government and the land to provide sufficient food and housing. The ongoing population change has affected prospects for sustainable socioeconomic and environmental development. Over the next decades, the following trends pertaining to the sustainable development of population, economy and environment might be assumed: 1) An ever increasing population will result in three peaks: total population, aging, and working-age population. 2) An ever decreasing consummation of resources per capita, especially land, will result from a large population (Yuan *et al.* 1997). 3) The economy will take off with a dramatic reform of the economic structure. The GDP and GDP per capita will increase smoothly with a stable economic structure, a slow reduction in agriculture, and a steady increase in third industry. 4) The degradation of natural ecosystems will continue. The coming century will support the largest number of people with the most destroyed ecosystems

(Yuan *et al.* 1997). All of these trends may seriously restrain China's prospects for sustainable development.

When considering future population and sustainable development, Chinese scholars and policy makers are faced with numerous questions: 1) Will the current low fertility level be sustained, or will there be a rebound? 2) How can low fertility levels be stabilized after fertility has reached below or near replacement level? 3) When will the government adjust the current population policy? 4) What are the implications of very low fertility for the economy and society? 5) How should the anticipated socioeconomic development in coming decades be figured into the demographic trade-off between rapid fertility decline in the near term, and rapid population aging in the long term? In the context of global sustainable development, population is usually seen as an important independent force, since the number of people strongly affects the demand for food, shelter, health and infrastructure. Moreover, any sudden relaxation of the population policy, in a country with many poor and backward rural areas, without adequate preparation could result in a new baby boom (Zeng 1996). Therefore, China should select a way of smoothly stabilizing the population as well as a policy for long-term population trends.

Education will be an essential part of population and sustainable development planning in the coming decades. It is not only the Chinese experience that fertility decline has been interacting with education. This can clearly be seen in the results of multi-state projections. A slow-growing population is associated with an increase in educational attainment. Education differentials will affect the age structure as well as the rural/urban distribution of population over the next five decades.

Fertility changes in China have frequently been categorized as "induced" and "natural." The rural fertility transition has been considered an induced decline and the urban fertility transition a natural decline. A strategic policy shifting should lead to a narrowing of the gap between the government's goals to limit the fast growing population and the peasantry's demand for more children in the near future. The mandatory education program in rural China could lower fertility. This calls for a successful switch of focus of the Chinese family planning programs from executive methods to an "integrated approach" which involves enhancement of education, better status for women, and social welfare.

A rapid increase in aging and fast growing rural-to-urban migration will co-exist in China in the future. The results of the multi-state projection show that an increase in the proportion of urban population is largely caused by the extent of rural-to-urban migration. Both the proportion of elderly and the speed of aging in urban areas is higher than in rural areas. Thus, from the perspective of securing a more favorable ratio of working-age persons to retirement-age persons, more rural-to-urban migration might contribute to a smoother change in the population age structure in the cities.

According to the results of our projection, the future educational composition of the population will increase considerably in the middle school level over the next decades. This will be a significant benefit to sustainable population, socioeconomic, and environmental development. The changing of the educational composition of the population will coincide with the changing of the economic structure, with a slow reduction in agriculture and a steady increase in the service sector. In this sense, the combination of education and population projections significantly contributes to understanding sustainable development options for China.

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