The Impact of Urbanization and Delayed Childbearing on Population Growth and Aging in China

ZENG YI
JAMES W. VAUPEL

URBANIZATION IN CHINA IS LIKELY TO REDUCE future national birth rates and significantly slow population growth because urban residents are apt to continue to have substantially lower fertility rates than rural residents. Delayed childbearing, by reducing period fertility rates, might also slow population growth. Urbanization and delayed childbearing are related because urbanites tend to give birth at older ages and may be more receptive to government efforts to further delay childbearing. In addition to affecting total population size, the resultant reduction in births would increase the proportion of the Chinese population that is above age 65. Because migrants to urban areas tend to be young, this population aging will be more severe in rural than in urban areas. In this article we examine these relationships using a multi-regional population projection model.

According to China's 1982 census, 20.8 percent of the total population lived in urban areas. This was much lower than the world average estimated by the United Nations as 41 percent in 1985 and even lower than the average for other developing countries (excluding China) of about 36 percent in 1985 (United Nations, 1989). With the recent program of economic reform, China is modernizing relatively quickly. Although the process of development in China differs from that in other countries, modernization requires—and entails—massive urbanization. The most recent available data show a sharp increase in the proportion of the population living in urban areas—from the 20.8 percent recorded in 1982 to 36.9 percent in 1987 (State Statistical Bureau, 1988a). This figure has to be interpreted with great caution since in part the change is a statistical artifact, as explained below. Nonetheless, there is no doubt that urbanization in China has been proceeding very rapidly.

Birth rates in China are much higher and childbearing occurs much earlier in rural areas than in towns and cities. In 1981, the total fertility rate for rural areas was 2.9 children per woman, compared with an urban rate of only 1.4 children per woman (China Population Information Centre, 1984). With just over a fifth of the population living in urban areas, this implies a total fertility rate for the entire country of 2.6 children per woman. If the urban share were 40 percent, the same urban–rural fertility differences would imply a national total fertility rate of 2.3 children per woman. This simple calculation suggests that continued urbanization in China could have a major impact on fertility levels.

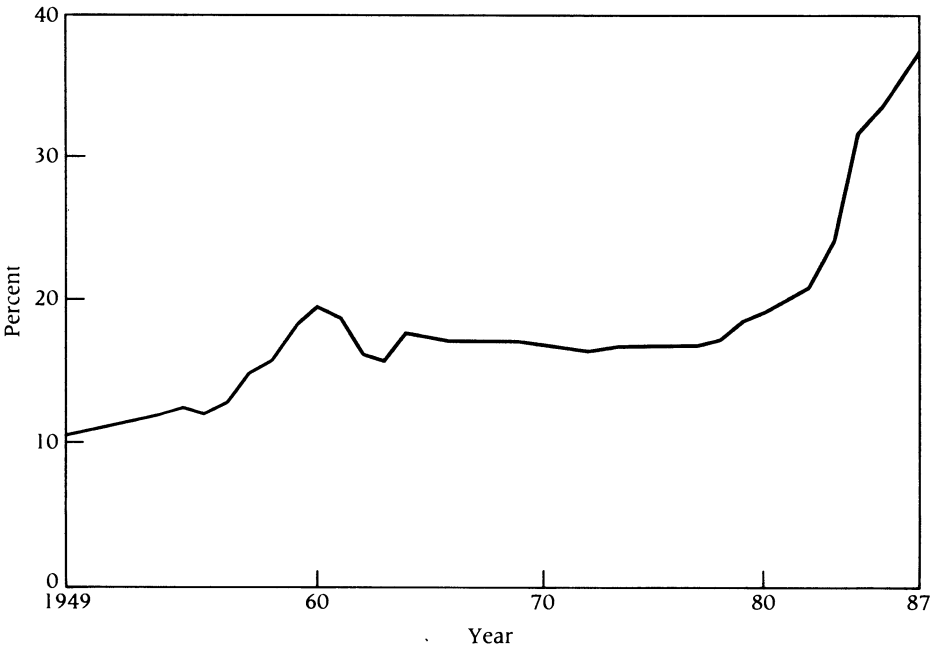
Understanding of the potential impact of urbanization and delayed childbearing on fertility levels, and hence on population growth and population aging, can be deepened by simulation modeling. In this article we present the results of simulations of various scenarios of rural-to-urban migration and increasing age of childbearing. Our main concern is to gain some insights about how urbanization may reduce population growth and accelerate population aging. To provide some background information, we briefly review past, current, and prospective trends in urbanization and in rural–urban differences in fertility levels and timing.

Past, current, and prospective trends

Figure 1 presents the trend from 1949 to 1987 in the proportion of the Chinese population living in urban areas. From 1949 to 1960 the proportion increased considerably, almost doubling from 10.6 percent to 19.7 percent. To facilitate industrial development, the government allowed many people to migrate from rural to urban areas during this period. From 1960 to 1963, however, the urban proportion of the population decreased due to the closing of many short-lived enterprises established during the Great Leap Forward. After 1960 the Chinese government adopted a very restrictive policy concerning rural-to-urban migration. Very few people were allowed to move from rural to urban areas, and some urban residents were mobilized to work in rural areas. The urban proportion of the population remained stable until 1978. From 1979 to 1982, many urban high school graduates who had been sent to the countryside were allowed to move back to their home cities and towns, resulting in a slight increase in the proportion of the population in urban areas (Hu, 1982).

Massive urbanization is now under way (Banister, 1986; Goldstein, 1985; Goldstein and Goldstein, 1985). This movement can be attributed to China's economic reforms and to a new shift in policy to allow rural-to-urban migration. Agricultural production is now managed through household initiative rather than production teams under communal control. Food production has substantially increased. This success has, on the one hand,

FIGURE 1 Percent of the Chinese population living in urban areas, 1949–87



SOURCES: 1949–85: CASS, 1987, p. 409; 1987: SSB, 1988a. (The figure for 1986 is derived by interpolation.)

stimulated the development of various kinds of businesses in urban areas and, on the other hand, reduced the size of the labor force required on farms. The need for surplus rural workers to find new employment and the labor demands of growing urban businesses are the driving forces of contemporary urbanization.

The reported proportion of the population in urban areas jumped from 20.8 percent in mid-1982 to 31.9 percent at the end of 1984 and 36.9 percent in mid-1987. This extraordinarily rapid change, however, can be attributed only partially to actual movement of people from rural to urban areas. A substantial part of the increase is statistical artifact, due to administrative changes in the classification of areas as urban or rural. To promote the development of towns, in 1984 the State Council of China relaxed the criteria for establishing a township. In 1986, the State Council further encouraged cities to incorporate adjacent counties into their administrative boundaries and relaxed the criteria for establishing a city. These two important policy adjustments resulted in a proliferation of the number of towns and cities in China. From 1982 to 1987, the number of towns nearly tripled, from 3,547 to 9,121, and the number of cities increased from 239 to 347. Even more importantly, the administrative boundaries of towns and cities were signif-

icantly enlarged, resulting in the classification of many farmers as urban residents. In nearly half of the 347 cities in 1987 the majority of the population was mainly engaged in agriculture (Ma, 1988; Bai, 1986).

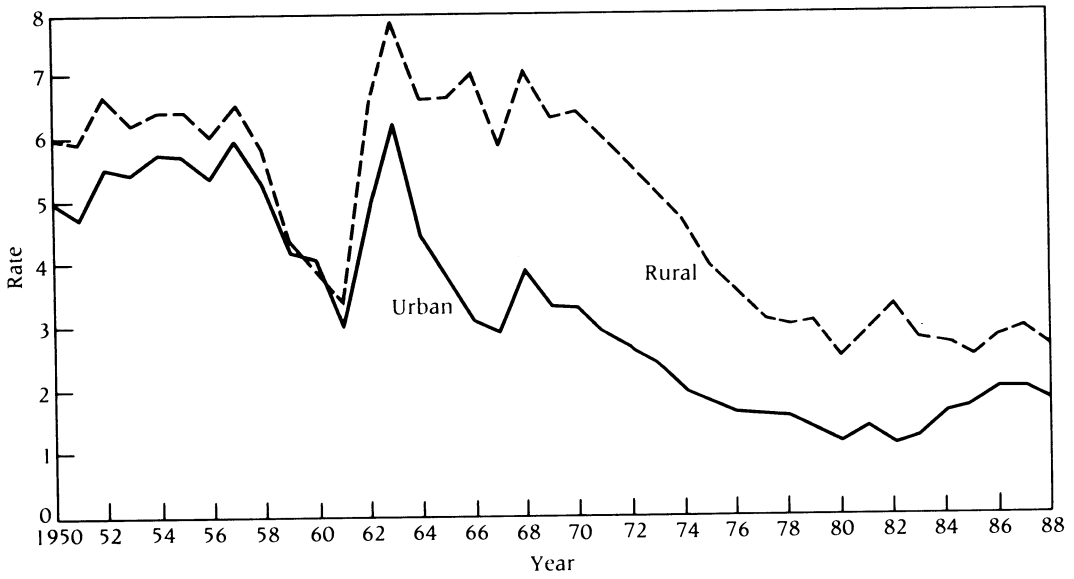
Instead of using the reported urban–rural breakdown of the population, a breakdown based on the distinction between agricultural and nonagricultural workers might more accurately reveal underlying trends in urbanization in China. Nevertheless, we decided not to use this occupational breakdown in our projections because it is problematic to assign occupations to children, the elderly, and others for whom occupation was not reported in the 1982 census and the 1987 One Percent Population Survey,[1] the two sources from which the base population and other demographic data for our projections are derived. More importantly for our exercise, farmers living in urban zones are exposed to urban conditions and are influenced by urban policies; many of these farmers and members of their families are in the process of becoming urbanized. Hence, the reported urban–rural population breakdown has considerable significance even though the figures have to be interpreted with great caution.

No one questions any longer whether urbanization should or will occur. The key issue is how urbanization should be managed. Many analysts and policymakers believe that China should try to avoid the overly rapid growth and high concentration of population in large cities that have produced such serious problems in other developing countries. The official policy today is to restrict the expansion of big cities, to allow the development of medium-sized cities, and to actively promote the growth of towns. Although such a policy might be difficult to implement in most countries, strong and efficient government control in China suggests that it can be made to work reasonably well.[2]

Figure 2 presents the total fertility rates (TFR) for urban and rural areas from 1950 to 1988. These rates represent the average number of children that women who survive to the end of their childbearing years can expect to have at the period age-specific fertility levels. The urban fertility level has been much lower than the rural level since the mid-1960s. The rural TFR was twice as high as the urban rate in 1970 and more than twice as high in 1981. The 1987 One Percent Population Survey indicates that the rural TFR had declined to 2.72 in 1986, compared with 2.9 in 1981. On the other hand, the urban TFR in 1986 had risen to 1.96, in contrast to 1.4 in 1981. The two-per-thousand fertility and contraceptive survey,[3] conducted in 1988, shows roughly the same rural–urban fertility levels in 1986 as given by the 1987 One Percent Population Survey. The 1988 fertility and contraceptive survey indicates further a slight rise of rural TFR in 1987 and a slight decline in rural and urban fertility in 1988.[4]

Mean age of childbearing by birth order in 1981 and 1986 is shown in Table 1. Mean age of mothers at first birth and at higher order births was

FIGURE 2 Total fertility rates in rural and urban areas of China, 1950–88



SOURCES: 1950–81: One-per-thousand fertility survey conducted in 1982 (China Population Information Centre, 1984). 1982–88: Data from the two-per-thousand fertility and contraceptive survey conducted by the State Family Planning Commission (SFPC)in 1988, provided by the Planning and Statistical Department of the SFPC, *China Population Newsletter* 6, no. 2 (April 1989).

substantially lower in rural areas than in urban areas, although the differential narrowed between 1981 and 1986. The mean age of childbearing for all births combined was nonetheless slightly lower in urban areas because many urbanites have only one child, whereas rural residents tend to have a second child and even third and higher order children.

TABLE 1 Mean age of childbearing by birth order and by residence: China, 1981 and 1986

Birth order	Rural		Urban	
	1981	1986	1981	1986
1st	23.8	23.4	26.6	24.3
2nd	26.1	26.7	28.8	27.3
3rd	28.4	28.9	31.3	29.4
4rd	31.0	31.4	*	32.0
5th or higher	36.1	35.8	*	36.0
All births	27.2	26.5	26.9	26.3

* The number of births is too small to calculate a significant value.
SOURCES: 1981: One-per-thousand fertility survey[5] (China Population Information Centre, 1984); 1986: One Percent Population Survey (State Statistical Bureau, 1988a).

The One Percent Population Survey indicated that in 1986 the TFR of women who reported their occupation as agricultural was 2.76, in contrast to 1.24 for those whose occupation was nonagricultural. The mean age of childbearing in the agricultural population was 26.7; in the nonagricultural population it was 26.6. Thus, the increase in the urban TFR and the decrease in urban mean age of childbearing are largely attributable to the incorporation of many agricultural workers into urban areas. Nonetheless, the reported urban TFR in 1986 of 1.96 was substantially lower than the rural TFR of 2.72, and substantial differentials were found between rural and urban areas in mean age of childbearing by parity. The differences are large not only because of great discrepancies in socioeconomic conditions and educational levels, but also because birth control policy is much more restrictive and family planning services are much more effective in urban areas.

Socioeconomic differences between rural and urban areas will almost certainly persist into the next century. Furthermore, as noted earlier, farmers in urban zones tend to be influenced by urban values and policies and can be considered as proto-urbanites. Urban birth control policy may be less restrictive in the next century than it is today and perhaps somewhat less effective given the rapid growth and changing composition of the urban population. Nonetheless, government efforts to control population growth are likely to remain more effective in urban areas than in rural areas. Furthermore, urbanites are likely to continue to desire fewer children than rural residents, especially as economic development progresses. Therefore, it is reasonable to believe that the substantial rural–urban fertility differences will persist into the next century.

The model and the assumptions

Given the evidence that urbanization is under way and the likelihood that substantial rural–urban fertility differences will persist, we formulated a model to explore how urbanization will affect population growth in China. The model incorporates a migration flow from rural to urban areas by single year of age and ignores migration from urban to rural areas, which is expected to be insignificant in the foreseeable future. Because international migration is unimportant in China, we assumed that death was the only exit from the model. The dynamics of the model are based on the calculation procedures of multi-regional population projection (Rogers, 1975; Rogers and Willekens, 1986; Willekens and Rogers, 1978). We also designed the model to allow for shifts in both the TFR and the mean age of childbearing for successive cohorts. Compared with the classical method of long-term population projections, our model has some additional merit in its structural specification and the projection methodology employed, notably the disaggregation according to the rural–urban dichotomy and casting fertility level and timing in cohort terms.

The model requires specification, for each cohort and each calendar year, of age-specific fertility and mortality rates for rural and urban populations and age-specific migration rates from rural to urban areas. A discussion of how these age-specific rates were derived is presented below; specific numerical information concerning the various assumptions on demographic variables is given in the Appendix.

We used the model to project Chinese population growth under three basic scenarios (i.e., sets of assumptions) regarding levels of migration and changes in the level of fertility and in the mean age of childbearing. The first, baseline scenario assumes no migration between rural and urban areas and no changes in mean age of childbearing. The second scenario assumes substantial rural-to-urban migration, with the age-specific rates of migration following the pattern derived from China's 1987 One Percent Population Survey, but no changes in mean age of childbearing. The third scenario assumes substantial migration together with an increase in the mean age of childbearing.

To capture the likely pattern of rapid urbanization in China, we assumed in the second and third scenarios that the proportion of the population classified as living in rural areas would decline from 63.1 percent in 1987 to 50 percent in 2000, 40 percent in 2020, and 20 percent in 2050. The level of rural-to-urban migration in each year was calculated as the level required to meet these target percentages.[6]

Because an increase in age of childbearing can significantly reduce period fertility and thus slow population growth, we included such an increase in the third scenario. The influential analysis of Bongaarts and Greenhalgh (1985) demonstrated that under a two-child policy the population of China could be limited to well below 1.2 billion by the end of this century and reach 972 million to 1.11 billion in the year 2050 if, starting in 1985, women's minimum age at first birth was, respectively, 29 or 25, and the minimum spacing interval between their first and second births was four years.

We assumed in our third scenario that an increase in the average age of childbearing of the magnitude implied by Bongaarts and Greenhalgh's calculations would occur, but that this increase would take place gradually instead of being imposed all at once in 1985. Furthermore, instead of a minimum age of childbearing we specify a mean age of childbearing with a distribution around that age that is comparable to the current distribution. In particular, we assumed that the mean age of childbearing for all births would increase from its current level of 26.5 in rural areas and 26.3 in urban areas to 28.5 in rural areas and 28.0 in urban areas for the cohort that reached age 15 in 1987. Then the mean age of childbearing would further increase to age 30 for both rural and urban cohorts reaching age 15 in the year 2000 and to age 31 for the cohorts reaching age 15 in the year 2020 and afterwards. This assumption of increasing mean age of childbearing for cohorts implies

that the period mean age of childbearing increases from 26.5 for rural areas and 26.3 for urban areas in 1986 to 28.7 for rural areas and 28.4 for urban areas in 2000, with a further increase to 30.2 for both rural and urban areas in 2020 and to 31 for both rural and urban areas in 2050.

Even a gradual increase over a period of more than 60 years in the mean age of childbearing to age 31 would constitute a radical change in Chinese fertility patterns, and it is by no means clear whether such a change can or will take place. Chinese fertility patterns have changed radically over the last 30 years (Zeng, Vaupel, and Yashin, 1985), and it is possible that further dramatic changes will occur. It should be noted that late ages of childbearing are not unprecedented—in various European countries in the nineteenth century, marriage was delayed until around age 30 and childbearing until even later.

Our assumption of an equivalent mean age of childbearing in both rural and urban areas in the next century implies a greater delay in childbearing in urban areas because urban women tend to have fewer children. As noted above, the mean age of childbearing in 1986 in urban and rural areas was similar—26.3 and 26.5, respectively. As shown in Table 1, however, the mean age at first birth and at higher order births was substantially lower in rural areas than in urban areas. The projected continuing differential in urban and rural TFR thus implies that increasing the mean age of childbearing to age 30 or 31 will require a greater delay in first births in urban areas than in rural areas. We believe that this may be possible because urbanites will be more responsive not only to policies requiring lower fertility but also to those requiring delayed childbearing. The shift of the farmers currently living in urban areas into nonagricultural occupations will help facilitate delayed childbearing in urban areas. Hence, urbanization is likely to have a dual impact on Chinese population growth.

In running the three scenarios, we used a medium-fertility assumption according to which the TFR of successive cohorts gradually declines from the 1987 level of 2.72 in rural areas and 1.96 in urban areas to 2.10 in rural areas and 1.70 in urban areas in 2050. These assumptions imply an overall fertility level of rural and urban areas combined that is very close to the United Nations medium variant released in 1989.[7]

One of the key assumptions about future fertility employed here is that rural-to-urban migrants will achieve the same fertility level as the urban population. Some analysts may argue that this assumption is implausible because migrants may be less constrained by restrictive urban birth control policies than current urban residents and because the one-child policy in urban China may be changed in the next century. We would agree that there is substantial uncertainty about migrants' fertility rates in the future and that our assumption may turn out to be off the mark. Nonetheless, we think it is plausible for several reasons. Migrants usually possess higher educational

or technical skills than the average in their areas of origin. These selective characteristics of migrants may facilitate adoption of family planning practice if proper services are provided. Migrants need to save money for housing and must make special efforts to adapt to their new environment: such pressures may result in fewer, delayed births. Some of the migrants may not move together with their spouse, and the interruption of the couple's sexual life may also delay childbearing. Such factors may account for the results of a recent migration survey of 74 cities and towns with a sample size of 100,267 persons: the survey indicated that the average number of children ever born to migrant urban residents aged 50 or older was 7 percent lower than the number of children born to their nonmigrant counterparts (CASS, 1988).[8]

Because our projections run to 2050, urban fertility levels will be influenced by the behavior not only of migrants but also of the urban children of migrants. As the urban population grows, the composition of its members will change. In particular, a greater proportion of the population will be employed in the private business and industrial sectors. Government policy may be less effective in regulating individuals in these sectors than in regulating the current urban population. Additional changes in the effectiveness of government policy—and in the thrust of policy—can be expected as China develops. Furthermore, people's attitudes may change: in particular, economic development may be accompanied by a desire for fewer children. Any prediction about the net effect of such changes in policies and preferences is problematic. Recognizing the cloud of uncertainty, we merely argue that a tendency for urban fertility rates to remain below rural rates seems plausible. Our basic purpose is to explore some of the consequences of this possibility.

In evaluating the plausibility of our assumption about urban fertility levels, it should be noted that what we assumed is that on average each urban couple will have about two children (1.96) in this century and that this figure will gradually decline to 1.7 by the middle of the next century. This implies a convergence of the fertility level among agricultural workers in urban zones (the proto-urbanites referred to earlier), rural-to-urban migrants, and the original urban residents. Whereas the rural fertility level (TFR) is 43 percent higher than in urban areas in 1986, we assumed that in the year 2050 the rural TFR will be only 23 percent higher than the urban TFR. This implies a narrowing gap between fertility levels in rural and urban zones in the next century.

We assumed that modest but steady progress would be made in reducing mortality rates over time. Details about the speed of the assumed fertility and mortality decline are given in the Appendix.

After we ran the three scenarios under the migration, fertility, and mortality assumptions as specified above, we reran the scenarios under alternative fertility assumptions and under assumptions of slower urbanization and of less delay in childbearing to test the sensitivity of the results. In the

following two sections we describe the results of the basic scenarios on population growth and population aging. We then describe the results of the sensitivity analysis.

Effects on population growth

Table 2 presents the projected Chinese population in the years 2000, 2020, and 2050 under the three scenarios about migration and mean age of childbearing. As noted above, each of these scenarios incorporates identical assumptions as to the course of mortality and the course of urban and rural fertility. Figure 3 displays the model's projections for every year from 1987 through 2050.

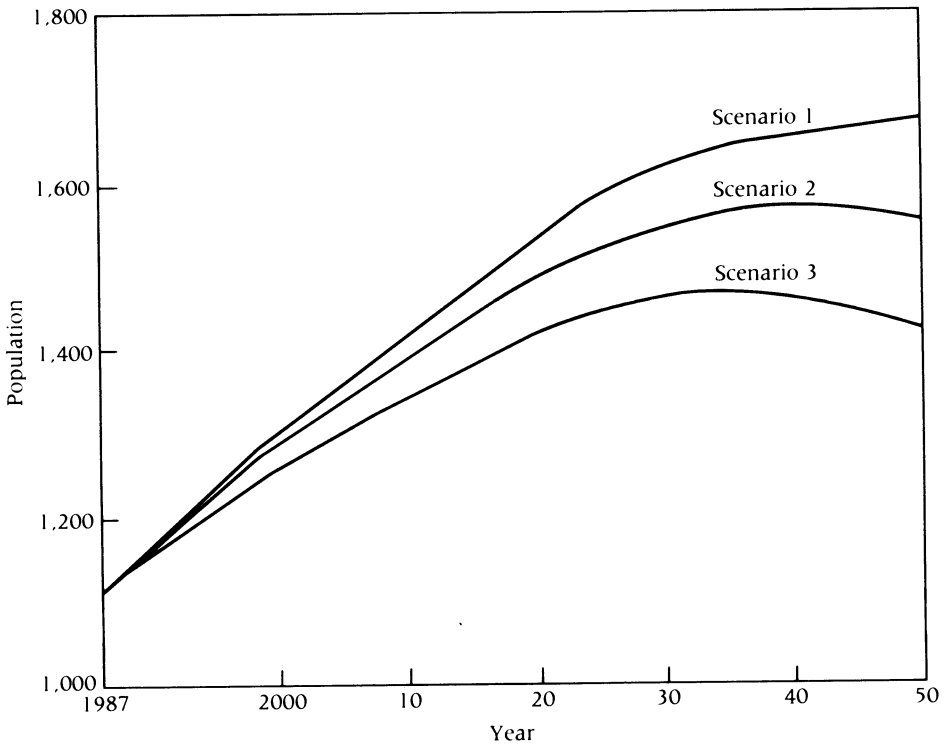
As can be seen from Table 2 and Figure 3, the total population steadily rises to 1,690 million people in 2050 in the absence of rural-to-urban migration (scenario 1). When the pattern of rural-to-urban migration described earlier is assumed to occur, the population reaches a peak around 2035 and then starts to decline to about 1,557 million in 2050 (scenario 2). This implies that rural-to-urban migration alone might reduce the population size of China by 8 million in 2000, 38 million in 2020, and 133 million in 2050. If urbanization is accompanied by an increase in the mean age of childbearing (scenario 3), the Chinese population is 31 million persons smaller in 2000 than it would have been without migration and without increases in the mean age of childbearing, 112 million smaller in 2020, and 259 million smaller in 2050.

The reduction in population size attributable to rural-to-urban migration is not equal to the number of births averted between 1987 and 2050, since some of those born in this interval will have died by the year 2050. We have calculated that there would be 1,439, 1,272, and 1,138 million newborns between 1987 and 2050 under our three scenarios. This means

TABLE 2 Projected Chinese population (in millions) by place of residence under the medium-fertility assumption and under alternative assumptions as to rural-to-urban migration and as to the cohort mean age of childbearing (CMAC)

	"Scenario 1" No migration and constant CMAC			"Scenario 2" With migration and constant CMAC			"Scenario 3" With migration and increasing CMAC		
Year	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
1987	674	394	1,068	674	394	1,068	674	394	1,068
2000	839	458	1,297	645	645	1,289	633	633	1,266
2020	1,032	502	1,534	598	898	1,496	569	853	1,422
2050	1,220	470	1,690	311	1,246	1,557	286	1,145	1,431

FIGURE 3 Projected Chinese population (in millions) under three alternative scenarios



NOTES: Scenario 1 assumes no rural-to-urban migration and constant cohort mean age of childbearing (CMAC). Scenario 2 assumes migration and constant CMAC. Scenario 3 assumes migration and increasing CMAC. In each of the three scenarios fertility and mortality assumptions are identical. For fertility, urban and rural rates are assumed to differ. See text for details.

that rural-to-urban migration alone may avert about 167 million births from 1987 to 2050 and that rural-to-urban migration plus an increase in the mean age of childbearing may avert 301 million births in the same period.

Urbanization has a relatively small impact on population growth between 1987 and 2000 compared with its stronger impact after 2000. The explanation lies in the proportion of the population living in rural areas, the locus of relatively high fertility. Reducing the rural proportion from 63 percent to 50 percent between 1987 and 2000 makes only a small difference in fertility, compared with the impact of reducing the rural proportion from 50 to 20 percent of the population between 2000 and 2050.

Effects on population aging

Table 3 presents the projected percentage of the Chinese population aged 65 years and older in 2000, 2020, and 2050 for the country as a whole and

TABLE 3 Projected percentages of the Chinese population aged 65 years and older under the medium-fertility assumption and under alternative assumptions as to rural-to-urban migration and as to the cohort mean age of childbearing (CMAC)

	"Scenario 1" No migration and constant CMAC			"Scenario 2" With migration and constant CMAC			"Scenario 3" With migration and increasing CMAC		
Year	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
1987	5.5	5.4	5.5	5.5	5.4	5.5	5.5	5.4	5.5
2000	6.7	8.0	7.2	7.8	6.6	7.2	8.0	6.7	7.4
2020	9.5	13.8	10.9	13.7	10.0	11.3	14.6	10.4	11.9
2050	16.6	25.0	18.9	22.9	20.8	21.2	26.4	22.2	23.1

for rural and urban areas. The percentage elderly is presented for each of the three scenarios. Figure 4 plots the projected percentages of the population aged 65 and over in rural and urban areas and in the country as a whole under the third scenario.

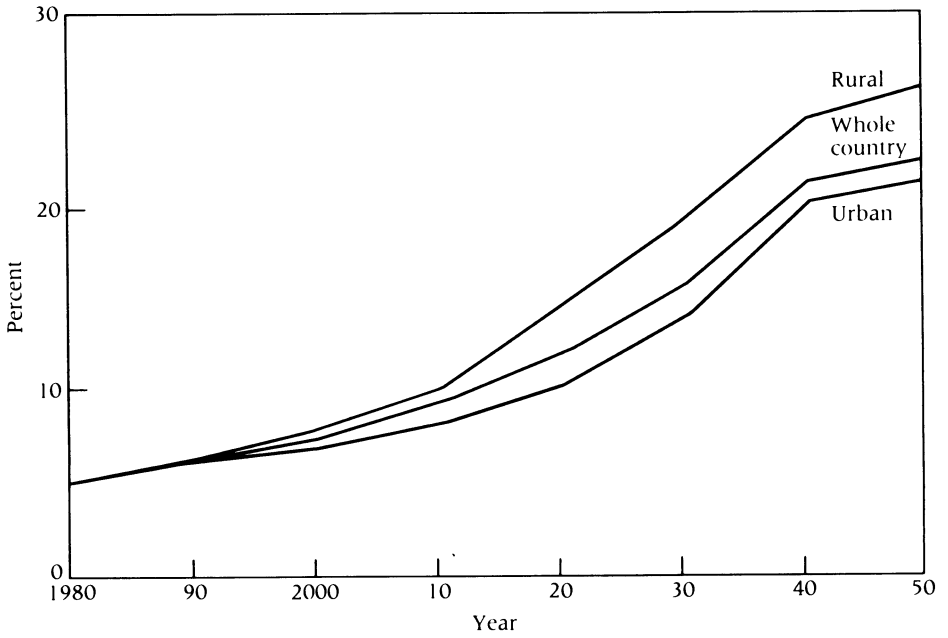
If we assume no rural-to-urban migration, then the urban population will age rapidly. Some of this effect can be attributed to progress in increasing life expectancy, but most of the effect is due to the very low level of fertility in urban areas. Under the no-migration scenario a quarter of the urban population would be 65 or older by the year 2050.

This process is reversed when migration is permitted. Under that assumption (scenarios 2 and 3), a steady stream of younger people flows into urban areas from the countryside. Accordingly, by 2050, some 23 to 26 percent of those living in rural areas would be elderly, compared with 21 to 22 percent in urban areas.

For the country as a whole, the aging of the population is a function of the birth rate, which determines the size of the younger population compared with the older population already born. Hence, when no migration is assumed, 19 percent of the total population is 65 or older in 2050, compared with 21 and 23 percent under the alternative scenarios. Under all three scenarios, the proportion elderly is much larger than the 1987 level of 5.5 percent.

Given the aging of the Chinese population, from a public policy standpoint what is the preferred pattern of distribution of the elderly between rural and urban areas? Three considerations may lead Chinese policymakers to prefer a younger urban population. First, with the expected productivity advances in rural areas, the labor force required for agricultural production may steadily decline. Second, a relatively young, adaptable work force may be needed in towns and cities to stimulate the development of the industrial and service sectors. Third, the traditional Chinese three-generation family is more likely to persist in rural areas than in towns and cities (Zeng, 1986),

FIGURE 4 Projected percentages of the Chinese population aged 65 years and older in rural and urban areas and the whole country, assuming rural-to-urban migration and increasing cohort mean age of childbearing ("scenario 3")



so that older people can be better taken care of by family networks in rural areas.

The gains in life expectancy in China will result in a substantial increase in the number of young and middle-aged persons who are surrounded simultaneously by elderly parents or grandparents and young children (Zeng, 1988). Counteracting this effect, an increase in the mean age of childbearing would widen the differences between the ages of successive generations, reducing the likelihood of the simultaneous existence of three or more generations in the same family.

The demographic impact under alternative fertility assumptions

As we have explained, the projections presented above were all made under a moderate assumption about fertility in China. We assumed that the total fertility rate of successive cohorts gradually declines from the 1986 levels of 2.72 and 1.96 for rural and urban areas to levels of 2.10 and 1.70 in 2050. To test the sensitivity of the projections to this assumption, we also computed the implications of a high-fertility assumption under which the TFR of suc-

cessive cohorts is held at 1986 levels, and of a low-fertility assumption under which rural and urban TFRs steadily fall to 1.60 and 1.00 by year 2050. Details on the assumed speed of these declines can be found in the Appendix. Table 4 presents the projected Chinese population under the three basic scenarios described in Table 2, but incorporating these two "high" and "low" alternative fertility assumptions. Table 5 shows the percentages of the total population and of the rural and urban populations that are aged 65 or older.

The outcome of the projections presented in Tables 4 and 5 can be summarized as follows:

(a) The high-fertility assumption results in rapid population growth to levels in 2050 that may be unacceptable to policymakers in China. The low-fertility assumption results in very rapid aging of the population, with some 30 percent of the population aged 65 or older by the year 2050. This may also be unacceptable to policymakers.

(b) When fertility rates are high, the impact of rural-to-urban migration and of increasing mean age of childbearing on population growth is further magnified. The high-fertility assumption implies that rural-to-urban migration alone (scenario 2) would reduce the population size by 236 million. When such migration is also accompanied by an increase in the mean age of childbearing (scenario 3), the population size would be reduced by as many as 436 million, compared to what it would be with no migration and no delayed childbearing.

(c) If rural fertility were kept well below the replacement level, as is assumed in the low-fertility projections, the projected massive rural-to-urban migration would result in extreme population aging in rural China: under the lowest population growth projection shown in Table 5, more than 35 percent of the rural population would be aged 65 years or older.

TABLE 4 Projected Chinese population (in millions) by place of residence under alternative assumptions as to rural-to-urban migration and as to cohort mean age of childbearing (CMAC), under alternative fertility assumptions

		No migration and constant CMAC			With migration and constant CMAC			With migration and increasing CMAC		
Year		Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
1987		674	394	1,068	674	394	1,068	674	394	1,068
2000	High fertility	852	461	1,313	652	652	1,303	639	639	1,277
	Low fertility	801	443	1,244	619	619	1,238	611	611	1,222
2020	High fertility	1,107	520	1,627	630	944	1,574	592	887	1,479
	Low fertility	888	450	1,338	526	788	1,314	510	765	1,275
2050	High fertility	1,528	530	2,058	324	1,458	1,822	324	1,298	1,622
	Low fertility	833	341	1,173	219	877	1,096	211	845	1,056

TABLE 5 Projected percentages of the Chinese population aged 65 years and older by place of residence under alternative assumptions as to rural-to-urban migration and as to cohort mean age of childbearing (CMAC), under alternative fertility assumptions

Year		No migration and constant CMAC			With migration and constant CMAC			With migration and increasing CMAC		
		Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
1987		5.5	5.4	5.5	5.5	5.4	5.5	5.5	5.4	5.5
2000	High fertility	6.6	7.9	7.1	7.7	6.6	7.2	7.9	6.7	7.3
	Low fertility	7.1	8.2	7.5	8.1	6.9	7.5	8.3	7.0	7.6
2020	High fertility	8.9	13.3	10.3	12.9	9.5	10.7	14.0	10.0	11.4
	Low fertility	11.1	15.4	15.8	15.7	11.3	12.9	16.3	11.6	13.3
2050	High fertility	13.3	22.1	15.6	18.9	17.9	18.1	22.8	19.7	20.4
	Low fertility	24.3	34.5	27.3	32.6	29.5	30.1	35.4	30.2	31.3

The demographic impact of slower urbanization and less delay in childbearing

As we have discussed above, our assumption about rural-to-urban migration is that the proportion of the Chinese population living in urban areas will increase to 80 percent by the year 2050. Our assumption about delayed childbearing is that the mean age of childbearing will gradually rise to 31 for the cohorts reaching age 15 in 2020 and thereafter. What would be the demographic impact if urbanization proceeded less rapidly and there was less delay in childbearing? To explore these possibilities we ran projections under two additional alternative specifications. In the first of these two alternative projections, we assumed that the proportion of the Chinese population living in urban areas would slowly increase, to 42.5 percent in the year 2000, 50 percent in 2020, and 60 percent in 2050. We also assumed that there would be no increase in the mean age of childbearing. In the second alternative projection, we assumed that the more gradual pace of urbanization would be accompanied by an increase in the average age of childbearing to age 29 for the cohorts reaching age 15 in the year 2000 and that there would be no further change thereafter. The results for population growth and aging are presented in Tables 6 and 7.

Even under the conservative assumptions of these additional projections, urbanization and delayed childbearing have substantial effects, as can be seen by comparing the baseline figures in Tables 2 and 3—for the no-urbanization, no-delay scenario—with the figures for the two new projections. The assumed slower rate of urbanization alone will reduce the total population size by 75 million. Reduced urbanization plus the less substantial increase in mean age of childbearing would reduce the population size by

TABLE 6 Total population size in China (in millions) by place of residence under two alternative projections assuming less rapid urbanization and less substantial increase in cohort mean age of childbearing (CMAC), under the medium-fertility assumption

	With less rapid urbanization and constant CMAC			With less rapid urbanization and less increase in CMAC		
Year	Rural	Urban	Total	Rural	Urban	Total
1987	674	394	1,068	674	394	1,068
2000	839	454	1,293	735	543	1,278
2020	757	757	1,514	730	730	1,460
2050	646	969	1,615	611	916	1,527

TABLE 7 Proportion of the Chinese population aged 65 and older under two alternative projections assuming less rapid urbanization and less substantial increase in cohort mean age of childbearing (CMAC), under the medium-fertility assumption

	With less rapid urbanization and constant CMAC			With less rapid urbanization and less increase in CMAC		
Year	Rural	Urban	Total	Rural	Urban	Total
1987	5.5	5.4	5.5	5.5	5.4	5.5
2000	7.2	7.1	7.2	7.3	7.2	7.3
2020	11.4	10.9	11.1	11.8	11.2	11.5
2050	19.6	20.5	20.2	21.3	21.4	21.3

163 million. Furthermore, the alternative projections do not lead to exceptionally rapid population aging or to a substantial imbalance in the proportion elderly in urban versus rural areas.

Conclusion

Urbanization in China will probably proceed for economic reasons. Under current policies, the proportion of the population living in rural areas may fall relatively rapidly. Because urban areas are likely to continue to have substantially lower fertility rates than rural areas, this urbanization may reduce national birth rates and hence slow population growth. Our simulation study suggests that urbanization alone may result in a population in the year 2050 that is 133 million persons smaller than would be the case in the absence of rural-to-urban migration.

The study also suggests that urbanization will result in a comparatively younger population in urban areas. This may help economic growth and reduce the need for the state to replace the family in providing care for the elderly.

If the mean age of childbearing increases, even gradually, population growth will also be significantly reduced. Our projections indicate that a gradual increase in age of childbearing, accompanied (and facilitated) by urbanization, might reduce the population size by about 260 million in 2050, compared with the population size that would be expected in the absence of urbanization and delay of childbearing. These results suggest that simulations of China's population growth and aging may yield constructive insights for policy analyses. Our study is a first step that can be extended and strengthened in numerous ways. Given the great uncertainties about future conditions, and especially about institutional changes and policy directions, it is crucial to emphasize that the model provides insights and not predictions. The key insight is that urbanization and delayed childbearing in China may substantially reduce population growth.

Appendix Data and assumed values of the demographic variables for the projections

Data used

The base population, that of mid-1987, classified by rural–urban residence, age, and sex, as well as the rural–urban fertility and migration schedules used in our projections, are derived from the One Percent Population Survey conducted in 1987 by the State Statistical Bureau of China (State Statistical Bureau, 1988a; see note 1). We have divided the population figures derived from the survey by the sampling fraction to obtain population estimates for China as a whole.

Rural-to-urban migration rates by single year of age and by sex were also derived from the One Percent Population Survey. The schedules have a peak value at ages in the early 20s, which is more or less consistent with migration patterns in other countries.

The rural and urban mortality schedules by single year of age were obtained from 1982 census data (CASS, 1987). We did not use 1986 mortality data from the One Percent Population Survey because there were too few deaths recorded at some older ages to permit confident and direct calculation of mortality rates by sex, place of residence, and single year of age.

Assumed values of the demographic variables

We made "high," "medium," and "low" fertility assumptions for the projections, as displayed in Table A-1. As demonstrated in several analyses (Bongaarts and Greenhalgh, 1985; Coale, 1984; Li, 1989), an increase in age of childbearing would significantly slow population growth in China while allowing most couples to have two children. We therefore assumed an increasing mean age of childbearing for each cohort, as shown in Table A-2. If one simply increases the period mean age of childbearing in the successive projection years, births at higher maternal ages will be overestimated and cohort total fertility rates will be distorted. Therefore, we used

TABLE A-1 Assumptions about cohort fertility (total fertility rates)

Cohorts reaching age 15 in year	"High"		"Medium"		"Low"	
	Rural	Urban	Rural	Urban	Rural	Urban
1987	2.72	1.96	2.50	1.90	1.80	1.40
1990	2.72	1.96	2.40	1.80	1.70	1.30
2000	2.72	1.96	2.30	1.70	1.60	1.20
2020	2.72	1.96	2.20	1.70	1.60	1.10
2050	2.72	1.96	2.10	1.70	1.60	1.00

TABLE A-2 Assumptions about cohort mean age of childbearing (CMAC)

Cohorts reaching age 15 in year	Increased CMAC		Constant CMAC	
	Rural	Urban	Rural	Urban
1987	28.5	28.0	26.5	26.3
2000	30.0	30.0	26.5	26.3
2020	31.0	31.0	26.5	26.3
2050	31.0	31.0	26.5	26.3

a cohort approach in setting the mean age of childbearing as well as the fertility level in our projections.

Our assumptions about life expectancy at birth are shown in Table A-3. These assumptions are basically the same as those used in most other projections, for example, United Nations, 1989; the increase in life expectancy is modest. Some recent research, however, suggests that there may be significant improvements in mortality in the next century (e.g., Vaupel and Gowan, 1986; Ahlburg and Vaupel, 1989; Ogawa, 1988; Feeney, 1988; Guralnik, Yanagishita, and Schneider, 1988). For an analysis of the demographic impact of possible low mortality on population aging in China in the next century, see Zeng (1989).

The scenarios were based on both male and female population data. We used these data to estimate the age composition of migrants by sex. In order to preserve the sex balance in rural and urban areas, we assumed that the total number of male migrants is equal to the total number of female migrants. This may not be entirely realistic since migrants' sex ratios may deviate from unity at particular stages of

TABLE A-3 Mortality assumptions: Life expectancy at birth

Calendar year	Rural		Urban	
	Male	Female	Male	Female
1981	65.8	68.6	69.3	73.0
2000	69.0	72.0	72.0	76.0
2050	75.0	77.5	78.0	81.0

economic development. Nevertheless, it is unlikely that this differential will have much impact on the effects of urbanization on population growth in China as a whole.

Notes

The authors thank T. Paul Schultz and Karin Hyde for very helpful suggestions and acknowledge the comments provided by Sidney Goldstein and Judith Banister on an early version of the article. Most of the research reported here was carried out while Zeng Yi was a visiting research scholar at the Center for Population Analysis and Policy at the University of Minnesota.

1 The One Percent Population Survey was conducted by the State Statistical Bureau. The standard enumeration time of the survey was 1 July 1987. With a sampling probability of 1 percent, 10,711,652 persons were surveyed, covering all provinces, autonomous regions, and municipalities in mainland China. In addition to the questions asked in the 1982 census, three questions on migration were incorporated in the survey: (1) duration of current residence; (2) for the most recent move, the province of origin and the category (city, town, or countryside) of the area of origin; and (3) reason for the most recent move (State Statistical Bureau, 1988a).

2 Another breakdown based on the distinction of small, medium, and large cities might be considered. We decided not to do so in our projections because the available fertility and mortality data are not classified by city size and because there is great uncertainty regarding the future distribution of small, medium, and large cities. The most recent statistics distinguish rural, town, and city populations. However, we combine towns and cities into a single urban category in this exercise. We have done so not only because town and city populations have many similarities but also because we believe there would be much greater uncertainty in projecting future proportions of town and city populations separately than in projecting urban population of towns and cities combined. With economic development some towns may grow into cities without physical migration of population, and it is not clear whether and when the current policy on encouraging the development of small towns may be modified in the future, given the considerations of optimum size of human settlements.

3 The State Family Planning Commission organized the two-per-thousand fertility and contraceptive survey in July 1988: 2.15 million persons were actually surveyed, of whom 459,269 ever-married women aged 15 to 57 were interviewed in detail on 67 items, such as background, marriage, histories of pregnancy, contraception, breastfeeding, childbearing, mobility, and so on. The survey covered all provinces, autonomous regions, and municipalities in mainland China.

4 Because the definition of rural areas in the survey is the same as that used by the State Statistical Bureau (SSB), we used the TFR of rural areas from the two-per-thousand survey report. However, the report listed the urban TFR classified by statistical categories that differ from those used by SSB and by us in this article. We therefore estimated the 1982–88 urban TFR using the method of proportional allocation. We based our proportions on data from the two-per-thousand survey on the TFR of the whole country and of rural areas. We used the urban population proportions published by SSB.

5 The one-per-thousand fertility survey was conducted by the State Family Planning Commission in 1982, covering 28 provinces, municipalities, and autonomous regions (except Taiwan and Tibet). A total of 310,462 women aged 15 to 67 were questioned in person on age, ethnic origin, place of residence, marital status, occupation, education, birth control measures, abortion, and birth history (such as the number of children ever born, number of living children, birth order and date of birth of each child, and marital status and date of first marriage).

6 Our assumption on the urban proportion of the population in China at the end of this century is similar to that used by Banister

in her rural–urban population projection (Banister, 1986). However, our assumption differs substantially from the one recently suggested by the United Nations (1989, p. 326), which specifies the urban proportion of the Chinese population as 20.2, 20.4, 20.6, 21.4, 22.9, and 25.1 percent in the years 1975, 1980, 1985, 1990, 1995, and 2000, respectively. The UN assumption might represent a reasonable extrapolation of past data but it does not, in our opinion, capture the radical changes of the 1980s. Another possibility is that the UN used published figures on the proportion of persons who are entitled to state commercial food rations—20.1, 19.8, and 19.9 percent in 1985, 1986, and 1987 respectively (State Statistical Bureau, 1988b, p. 207)—as the base for extrapolating future Chinese urban populations. Unfortunately, this is not appropriate. On the one hand, the government tried very hard to limit the number of persons entitled to state commercial food rations because they require a large subsidy from the state. On the other hand, many rural people migrated to urban areas to live and work there without food rations by relying on food purchased from the free market or other channels. Many of these migrants even have residence permits from the government. The issuance of residence permits that do not entitle holders to food rations is one of the new methods of managing the recent flow of rural-to-urban migration.

7 The comparison between our fertility assumption and the UN medium variant is as follows:

Zeng and Vaupel		UN 1989	
Year	**TFR**	**Year**	**TFR**
2000	1.94	1995–2000	1.90
2020	1.83	2020–25	1.80

Note that our figures here refer to the combination of rural and urban period TFRs; for the UN figures, see United Nations (1989, p. 327).

8 The survey also found that third or higher order births occurred widely among those women who temporarily migrated from rural areas to urban areas but have no urban residence permit (the so-called floating population). We believe that the higher fertility level of the floating population is due to the fact that they are covered neither by the family planning network of the areas where they originally came from nor by the network in the urban areas in which they are currently living. National regulations on family planning for the floating population are under active discussion and are expected to be implemented nationwide. Such regulations may facilitate the adoption of family planning by migrants.

References

Ahlburg, Dennis A., and James W. Vaupel. 1989. "Projections of the US population under alternative fertility, mortality, and migration assumptions," paper presented at the Annual Meeting of the Population Association of America, Baltimore, Maryland, 30 March–1 April.

Bai Jianhua. 1986. "Status of China's urban–rural population," *Population Research*, No. 2 (in Chinese).

Banister, Judith. 1986. "Urban–rural population projection for China," Staff Paper of the Center for International Research, No. 50 (Washington, D.C.: US Bureau of the Census).

Bongaarts, John, and Susan Greenhalgh. 1985. "An alternative to the one-child policy in China," *Population and Development Review* 11, no. 4: 585–617.

CASS. 1987. *Demographic Year Book of China 1986*. Edited and published by the Population Research Institute, China Academy of Social Sciences.

———. 1988. *China Migration of 74 Cities and Towns Sampling Survey Data (1986)*, Special issue of *Population Science of China* (June). Population Research Institute, China Academy of Social Sciences.

China Population Information Centre. 1984. *Analysis on China's National One-per-thousand-population Fertility Sampling Survey.*

Coale, Ansley J. 1984. *Rapid Population Change in China, 1952–1982.* Washington, D.C.: National Academy Press.

Feeney, Griffith. 1988. "The aging of the Japanese population: 1955–2025," Nihon University Population Research Institute, Research Paper Series.

Goldstein, Sidney. 1985. "Urbanization in China: New insights from the 1982 census," Papers of the East-West Population Institute, No. 93.

———, and Alice Goldstein. 1985. "Population mobility in the People's Republic of China," Papers of the East-West Population Institute, No. 95.

Guralnik, Jack M., Masaki Yanagishita, and Edward Schneider. 1988. "Projecting the older population of the United States," *The Milbank Quarterly* 66, no. 2.

Hu Huanyong. 1982. *A Brief Survey of China's Population Geography.* Shanghai Foreign Language Education Press.

Li, Shaomin. 1989. "China's population policy: A model of a constant stream of births," Ph.D. dissertation, Princeton University.

Ma Xia. 1988. "Criterion for urban–rural classification and the level of urban development," *Population and Economics,* No. 6 (in Chinese).

Ogawa, Naohiro. 1988. "Aging in China: Demographic alternatives," *Asia-Pacific Population Journal,* No. 1.

Rogers, Andrei. 1975. *Introduction to Multiregional Mathematical Demography.* New York: John Wiley.

———, and Frans Willekens (eds.). 1986. *Migration and Settlement: A Multiregional Comparative Study.* Dordrecht, Netherlands: D. Reidel.

SSB (State Statistical Bureau of China). 1988a. *Tabulations of China 1% Population Sample Survey (National Volume).* Department of Population Statistics, SSB.

———. 1988b. *China Population Statistics Year Book, 1988.* Beijing: China Prospective Press.

United Nations. 1989. *World Population Prospects, 1988.* Population Studies No. 106, Department of International Economic and Social Affairs. New York.

Vaupel, James W., and Ann E. Gowan. 1986. "Passage to Methuselah: Some demographic consequences of continued progress against mortality," *American Journal of Public Health* 76, no. 4: 430–433.

Willekens, Frans J., and Andrei Rogers. 1978. "Spatial population analysis: Methods and computer programs," Research Report RR-78-18. Laxenburg, Austria: International Institute for Applied Systems Analysis.

Zeng Yi. 1986. "Changes in family structure in China: A simulation study," *Population and Development Review* 12, no. 4: 675–703.

———. 1988. "Changing demographic characteristics and the family status of Chinese women," *Population Studies,* 42, no. 2: 183–203.

———. 1989. "Ageing of the Chinese population and policy issues: Lessons learned from a rural–urban dynamic projection model," in *International Population Conference, New Delhi,* 20–27 September, Vol. 3, pp. 81–101. Liège: IUSSP.

———, James W. Vaupel, and Anatoli I. Yashin. 1985. "Marriage and fertility in China: A graphical analysis," *Population and Development Review* 11, no. 4: 721–736.