Population Momentum under low fertility in China: Trend, Impact and Implication

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Since 1990s, China's TFR has been under the replacement level for almost twenty years. It's estimated the driving force of the coming population growth in China will mainly be population growth momentum, which is the crucial consideration to stabilizing current fertility Policy by Chinese government. This paper estimates total, urban and rural, and age-specific population momentum, and simulates the effect of population momentum on population dynamics, with collecting and calculating some important data, including census data from 1953 to 2000, 1% sample survey of population in 1995 and 2005. Analytical results suggest that far from traditional view, population momentum in China is decreasing with time very quick, and China is in the turning point from positive to negative momentum. It reminds that government should pay more attention to this foreshow, and provide against a rainy day.

[Key Words] Population Momentum; Fertility; Mortality

Background

Since the beginning of the 1990s, the total fertility rate in China has been under replacement level for almost twenty years, which means China has joined the global club of low fertility countries.(Qiao 2005;Guo 2008) It's estimated the driving force of the coming population growth in China will mainly be population growth momentum, which also been the crucial consideration to emphasizing stabilizing current fertility Policy by Chinese government. (Chen 1995; National Population Strategy Report 2007; Zhai 2008; Wang et al.2008)

Researches on population momentum, which began in 1970s, mainly focus on inherent tendency of population growth. In the end of 20th century, Preston and Gulliot(1997)found population momentum exists not only in population growth, but also population decline. Around the year 2000, European population began to generate "negative momentum",(W.Lutz, et al 2003) which push us to consider inherent tendency of population decline. Though population momentum is mentioned frequently, few studies so far have discussed about China's population momentum in a systematic, accurate, and quantified manner. Moreover, it hasn't been known completely that population momentum's impact on China's population dynamics and future's development under low fertility.

In this paper, we analyze the changes of population momentum in whole country, urban and rural area, age-specific respectively, and simulate the effect of population

momentum on population dynamics, in order to reveal nonobviously inherent tendency.

Data and methods

Population momentum involves fertility and mortality in past years. The calculation needs several kinds of data, such as age-specific fertility, age-specific mortality, sex ratio at birth and age-specific population number et al. This paper aims to indicate population momentum prospective and methods under low fertility, not to evaluate data quality. So we use data published publicly in every year, do not discuss the quality of data used. However, for the purpose of scientifically evaluate population momentum to extreme, the admittedly adjusted data are taken into account.

Population momentum is measured by two methods. The first one is the expression for total, urban and rural population momentum in any closed population (Preston and Guillot 1997). There are three steps to calculate the value of population momentum.

(1)Estimation of replacement level fertility rates in the studied population

${}_5m_a = \delta \bullet {}_5m_a^F$ = actual age maternity rates；

NRR= $\sum_{a=15}^{45} {}_5m_a \bullet {}_5L_a^F$ =actual net reproductive rate；

${}_5m_a^* = {}_5m_a$ /NRR= replacement level age specific maternity rates；

(2)Estimation of the ultimate number of females births in the stationary population.

$A^* = \sum_{a=15}^{45} (a+2.5)_5 m_a^* \bullet_5 L_a^F$ = mean age at birth in the stationary population

$$_5 w_a = \frac{(\frac{_5 L_a^F}{2} \bullet_5 f_a^* + \sum_{y=a+5}^{45} {}_5 L_y^F \bullet_5 f_y^*)}{A^*}$$

$$B_S^F = \sum_{a=0}^{45} \frac{_5 N_a^F}{_5 L_a^F / 5} \bullet_5 w_a$$

(3)Estimation of ultimate population and momentum

$N_S^F = B_S^F \bullet e_O^{0F}$ =number of female in the ultimate population

$N_S^M = B_S^F \bullet SRB \bullet e_O^{0M}$ =number of males in the ultimate population (SRB=sex ratio at birth)

Population Momentum = $M_P = \frac{N_S^F + N_S^M}{N^F + N^M}$

The estimation needs data as below:

$_5 N_a^F$ = number of women α aged $\alpha + 5$ to in the actual population

$_5 L_a^F$ = person-years lived between ages α and $\alpha + 5$ in the actual female life table with radix of unity

N_F =total number of female in the population

N_M = total number of male in the population

e_O^{0F} = female life expectancy at birth

e_O^{0M} = male life expectancy at birth

δ = sex radio at birth

Another method is the equation of age-specific population momentum factor (Kim et al. 1991).

$$M_{\mathrm{K}}(x,x+y)=M_K \bullet \frac{C_L(x,x+y)}{C_n(x,x+y)}$$

M_K =Total population momentum factor

$M_{\mathrm{K}}(x,x+y)$=age-specific population momentum factor

$C_L(x,x+y)$=observed population proportion between ages x to $x+y$

$C_n(x,x+y)$= stationary population proportion between ages x to $x+y$

Most of data are from five national population censuses, 1% sample survey of population in 1995 and 2005. Mortality data in 1953 and 1964 are based on expectancy life during 1950 to 1969 in China's expectancy life and infant mortality.(Huang and Liu, 1995) So we can choose death level 13 in 1953, and death level 16 in 1964 from female life table from Coale's west model.

The change of China's population momentum

Total population momentum

Table 1 presents the change of total population momentum from 1953-2005. Obviously, since 1964, the power of positive growth momentum is disappearing rapidly during recent 50 years. We can tell that the momentum multiplier in 1953 equaled 1.35, grew up to 1.76 in 1964, but fell down to 1.19 in 2000, and continue to fall to 1.09 in 2005. In other words, suppose China's population keeps the replacement level since 1964, the size will continue to increase by 76 percent until it reaches stationary population. If China's population keeps the replacement level since 2005, the size will continue to increase by only 9 percent until it reaches stationary population. Population momentum in 1953 is lower than the one in 1964, which due to high mortality before the founding of PRC.

It is gripping that the declining speed of population momentum is also very fast from 1964 to 2005. The value has fallen down by 67 points of percentage. Population momentum factor fell down by 17 points of percentage every year.

We can see during past 60 years, the positive momentum discussed frequently is fading away virtually. The closer the value is to 1, the closer the population growth momentum is to zero.

Table 1 The Change of Total Population Momentum Factor, 1953-2005

Year	Total Population Momentum Multiplier
1953	1.35
1964	1.76
1982	1.57
1990	1.43
1995	1.29
2000	1.16
2005	1.09

Urban and rural population momentum

China's is typically dual structure in urban and rural society, this kind of dual structure also embodied in urban and rural population dynamics. There is great difference between urban and rural fertility levels. For example, the fertility level in urban areas, especially in big cities, has been low and lowest for more than 20 years.

It is similar with developed countries. Thereby, we need to know at least two questions. The first is whether population momentums in urban and rural areas are in same steps. The second is how these momentums will affect urban and rural population dynamics. The answers to these two questions will be helpful to understanding the real population dynamics and population change in future.

Table 2 indicates urban and rural population momentum from 1982 to 2005. In light of current trends, whatever cities or countryside, the population momentum is decreasing very quickly. In urban area, population momentum declined from 1.40 in 1982 to 1.00 in 2005. That is, the value in city has fallen down by 40 point of percentage during last 23 years, nearly dropping by 1.73 point every year. While the value in countryside declined from 1.59 in 1982 to 1.09 in 2005, it has fallen down by nearly 50 point of percentage during last 23 years, nearly dropping by 2.17 point every year. The decline speed of population momentum in rural area is faster than the one in urban area.

Comparing with city, the countryside's population momentum is much higher than the city's. In 2005, the value of city's population momentum equals 1, which shows that the power of population positive momentum is fading away, and China's momentum growth own to the momentum in rural area which is also weak. Even if rural fertility keeps replacement level since 2005, the rural population will grow by 9% until it reach stationary population. Our analysis shows China's cities are in the turning point of from positive momentum to negative one. The power of population

momentum in rural area is the main force of national population growth in future.

Table 2 The Change of Population Momentum Factor in Urban and Rural Area,1982-2005.

Year	Urban	Rural
1982	1.40	1.59
1990	1.29	1.52
1995	1.15	1.37
2000	1.12	1.20
2005	1.00	1.09

Age-specific population momentum

Population is composed with population with different ages. Exploring age-specific population momentum can further the understanding of age**-specific** population momentum contribute to the population growth momentum.

Though the total population momentum in China is essentially decreasing with time, yet the age-specific population momentums play the different roles. The average fertility age in China is about 26 year-old since 1982, we depart the age into three parts, that is, 0-26 year-old, 27-52 year-old, and >53 year-old. Yet, in order to observe the relationship between population momentum and population aging, we changed the cut-off point into 30 year-old, so the total population is devised into another three groups, namely, 0-29 year-old,30-59 year-old, and >60 year-old. Table 3 shows the

analysis following above age groups. We find there are several interesting points.

Firstly, actually, population momentum below 30 years of age keeps unchanged, equal 1, which shows when the fertility dropped to replacement level, the size of 0-30 year-old in the final stationary population is same with the one in primary population. The population momentum growth is unrelated with the population growth of this age group. We can call this age group “adolescent group”. That is, the driving force of population momentum growth does not come from adolescent group.

Secondly, the reducing speed of population positive momentum of the age group, 30-59 year-old, is surprisingly fast. In 2005, population negative momentum has appeared in population of the age group. Population positive momentum reduced from 1.97 in 1982 to 1.12 in 2000, which decline by 85 point of percentage. It suggests if China’s fertility level decline to replacement level in 1982, the size of 30-59 year-old will continue to increase by 97% until it reach the stationary population. If China’s fertility level decline to replacement level in 2000, the size of 30-59 year-old will continue to increase by 12% until it reach the stationary population. We name the age as “adult group”, the main part of labor force. So we find that current population momentum of the age appears strongly negative, which means if fertility in 2005 stay at replacement level, the final size of adult group will decrease by 20 percent than the one in 2005.

Thirdly, population positive momentum of above 60 year-old is diminishing rapidly. The value of population momentum in 2005 is about one second of the one in

1982. In 1982, population momentum is about 3.88, which means if fertility in 1982 stay at replacement level, the final size of the age group, above 60 year-old, will increase three fold until it stops. In 2005, population momentum is about 1.99, which means if fertility in 2005 stay at replacement level, the final size of the age group, above 60 year-old, will double until it stops. If we name above 60 year-old as " aged group", we can draw that population momentum growth stems from greater size of aged group.

From above analysis, though total population momentum is decreasing gradually, yet virtually the contributions of different age groups are different. Population momentum of the age group from 0 to 29 years old equals 1, and population momentum of the age group from 30 to 59 years old shows strongly negative momentum, meanwhile, the age above 60 years old shows strongly positive momentum. Obviously, population momentum growth means the aged population's rapid growth. In a sense, population positive momentum can be understood as the population born during high fertility period is in the period of progression from reproductive age to old age.

Table 3 The Change of the Age-specific Population Momentum Factor, 1982-2005

Year	**0-29**	**30-59**	**60+**
1982	1.00	1.97	3.88
1990	1.00	1.68	3.43
1995	1.00	1.36	2.80

2000	1.00	1.12	2.60
2005	1.00	0.84	1.99

Conclusion and Implication

Based on published data in every year, we explore the change of population momentum since 1950s and find some results different with traditional opinions of China's population momentum.

The power of population momentum of the positive growth is disappearing rapidly. The total population momentum of positive growth has been obviously falling down during recent 50 years. Since the 1980s, the urban and rural population momentum of positive growth is declining sharply although the rural population momentum was significantly higher than the one of the urban. At present, China's cities are in the turning point of population momentum from positive to negative growth while China's population growth was wholly attributable to momentum in the rural areas with momentum value being 1.09.

The total population momentum in China is essentially decreasing with time, yet the age-specific population momentums play the different roles. Actually, population momentum below 30 years of age keeps unchanged, but population momentum between 30 to 60 years of age has been negative and the force of population growth has been from the population above 60 years old since 2000.

Some opinions consider China's population growth is due to strong population positive momentum so China's fertility policy should keep stabilize low fertility for rather long time in future. However, the inherent trend has change greatly. Population momentum indicates the virtual trend behind population gradual growth, which shows positive momentum in China's is fading away, even in rural area. And most important thing is the growth in near future is mainly from aged population, which means if we do not catch proper opportunities to take action to stop the low or lowing fertility ahead of time, otherwise China's has to face a rapid aging society.

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