

**A Quantitative Study on China's
Economic Pressure Generated by Its
Population Ageing: from 1980 to 2050**

MO Long

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Abstract: This paper tries to get a clear understanding of China's economic pressure generated by its population ageing by quantifying the coordination between population ageing and economic growth. This study makes a quantitative analysis of such coordination by employing the method developed by the author and recent data from various institutes such as the United Nations and the World Bank. Results indicate that China's ageing-generated economic pressure is largely attributable to incoordination between population ageing and economic development. China's population ageing has been outrunning and will continue to outrun its pace of economic development from 1980 to 2050. The AECI (ageing-economics coordination index), which quantifies China's prematurity of population ageing as against its economic growth and reflect its ageing-generated economic pressure, is likely to reach a peak by around 2040. China's prematurity of population ageing is at an elevated level in the world and one of the most serious among the developing countries with similar or lower economic development level than China. This incoordination is even more pronounced in many parts of China (including more than half of the western provinces). The paper also makes a quantitative analysis of the necessity and possibility of easing China's ageing-generated economic pressure by readjusting its birth control policies. The method developed in this research is applicable not only to China, but also to other countries as well.

Keyword: Population ageing; economic development; coordination; economic pressure

Author: MO Long is Professor and Director of the Institute of Population Research of Guangxi Zhuang Autonomous Region, China; Adjunct Professor of University of Montreal, Canada; PhD of Demography. E-mail: molongcn@hotmail.com

A Quantitative Study on China's Economic Pressure Generated by Its Population Ageing: from 1980 to 2050

It is of special significance to be aware of the economic and social pressures that China's population ageing imposes on its modernization process in this new century. On the one hand, China's population size has been a critical factor affecting its economic and social development, whereas population ageing has become one of the biggest challenges China has to cope with in this century. Researches done at home and abroad all testify to statements such as that population ageing will pose a great challenge to a rising China in the 21st century, (e.g. OECD, 2005) and that "how China meets its ageing challenge will determine whether it becomes a prosperous and stable developed country." (Jackson and Howe, 2004) Therefore, a clear understanding of the economic and social pressures caused by population ageing is an important prerequisite for the country to cope with the challenge in a proper way. On the other hand, population development strategy is the most essential and fundamental of all the strategies designed for economic and social development. One of the most important and difficult tasks in formulating and implementing China's population development strategy is to evaluate the pressure caused by China's population ageing, compare it with the pressure caused by a large population size, and strike a balance in solving problems related to a large population and an ageing population. This has aroused heated debates (Editorial Board of Population Research, 2006, 2007) over recent years on whether China has got old before getting rich, highlighting the importance of a scientific understanding of China's economic and social pressures generated by its population ageing.

In order to get a scientific understanding of the economic pressure generated by population ageing, this paper makes a new attempt to make a quantitative evaluation of the coordination between population ageing and economic development. We, in this present research, will not adopt the traditional method to directly evaluate the economic and social pressures just by studying China's economic and social problems brought forth by its population ageing. In fact, due to the complexity of the economic and social influence of population ageing, such evaluation is difficult, unproductive, and controversial even in the developed countries which suffered population ageing earlier than China and have done more researches in this regard than China.

(Henripin et Loriaux, 1995)

The basic idea of this paper is as follows. Macroscopically speaking, the economic and social pressures generated by population ageing are attributable to a large extent to the incoordination between the two. As a rule, population ageing, if outrunning the pace of economic and social development, would constitute greater economic and social pressures. Therefore, an estimation of the coordination between the ageing population and economic and social development may reveal, to a large extent, the economic and social pressures caused by population ageing. Since economic development plays a fundamental and crucial role in human development, a clear understanding of the economic pressure imposed by population ageing is the most important and fundamental in fully understanding its economic and social pressures. Accordingly, this paper would like to focus only on the coordination between population ageing and economic development.

The relationship between population ageing and economic and social development has been the very core of the issue of population ageing, and a quantitative evaluation of such relationship has been a headache in demographic studies. The new method proposed in this paper, as well as the more comparable, credible population and economic data that involved a longer span of time and were recently released by some international organizations including the United Nations and the World Bank, make it possible to make a quantitative evaluation of the coordination between the population ageing of a certain country or region and its economic growth and thus to reflect the corresponding economic pressure.

The research framework is like this: First, a new method is developed to determine the coordination between population ageing and economic development. Then, the paper, by using this new method and the relevant indexes, and making use of the latest population and economic data of the United Nations, the World Bank and other organizations, makes a quantitative analysis of China's ageing-economics coordination between 1980 and 2050. We will try to answer the following questions: Has China got old before getting rich? To what extent? Will China's population ageing continue to outrun its economic growth? What's the future tendency and extent? To what extent will the rapid population ageing weaken China's international competitiveness? To what extent do population ageing and economic development coordinate with each other in different places of China? How great are the discrepancies? What influence will these

discrepancies have on how China copes with the challenge of population ageing? To what extent can different birth policies relieve China's ageing-generated economic pressure?

1. Method and Data

1.1 Method

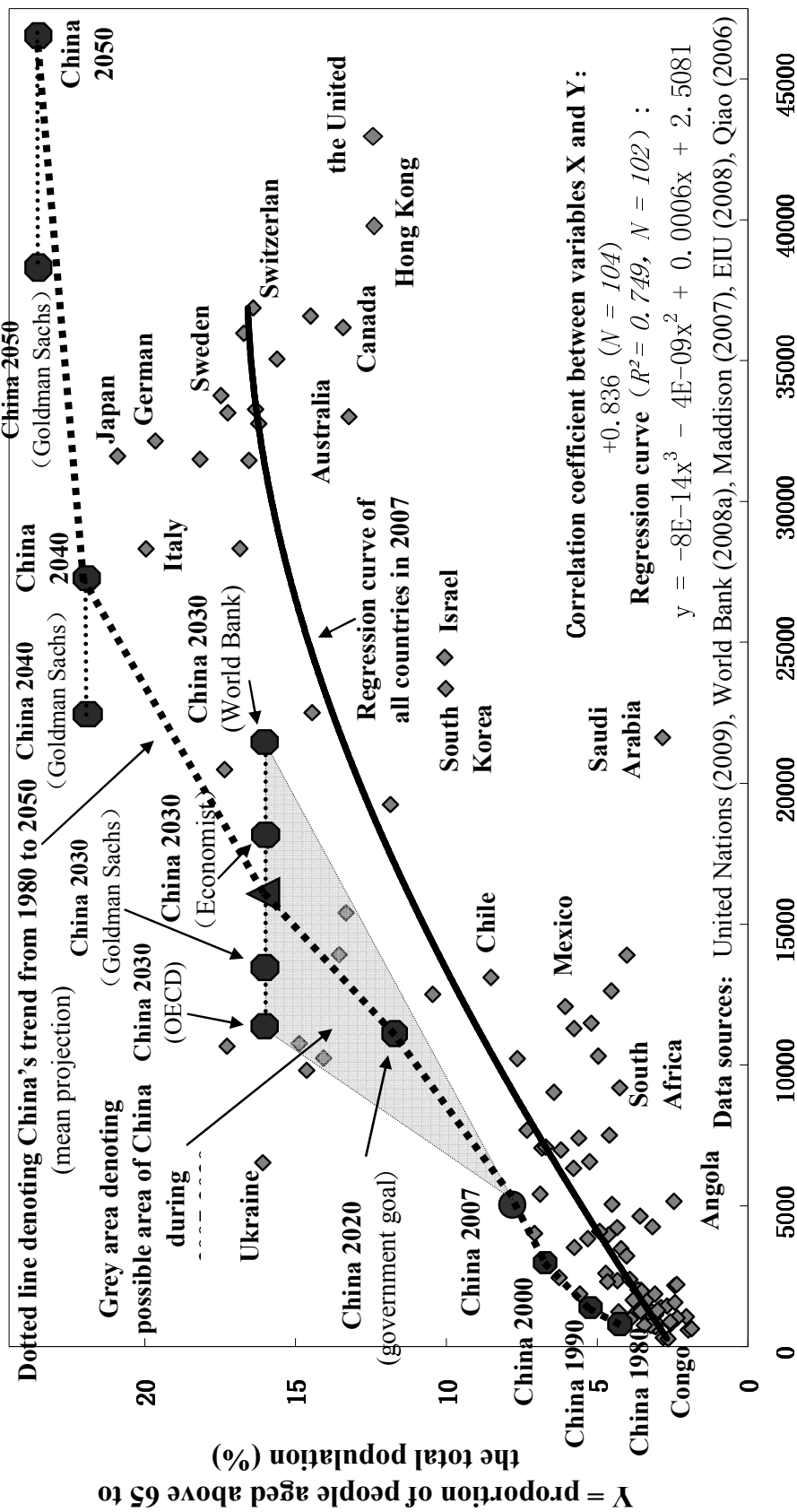
Previous researches tell us that there exists close positive correlation between population ageing and economic development. For instance, a research finding of the World Bank (1995) says that, in the one hundred and more countries analyzed, there is a marked tendency that the percentage of the senior citizens grows alongside with the increase of a country's per capita income. Such relationship is not spurious correlation; on the contrary, this relationship can be explained by theories of population ageing dynamics. Large quantities of theoretic and empirical studies have confirmed that the root cause of population ageing is the continued decrease of death rate and fertility rate, especially the latter. However, in this modern era, both the decrease of death rate and that of fertility rate, to a large extent, are positively related to economic development.

According to our systematic and in-depth analysis of the latest data, the above-mentioned rule is not supported just by incidental cases in certain years or certain countries. Fig 1 illustrates the scattered distribution of two variables, one being the percentage of people aged 65 and above among the total population of 104 countries and regions¹ with a population of over 5 million each in 2007, and the other being the per capita GDP of these countries and regions in 2007. Their trinomial regression curve has high goodness of fit ($R^2 = 0.749$), and thus can be regarded as being able to represent the general rule of these 104 countries and regions in the year 2007. This rule can be summed up as follows: generally speaking, the higher a country's per capita GDP, the bigger the ratio of its people aged above 65 to its total population. With the coefficient reaching +0.836, these two variables are highly positively correlated.

Further analysis of historic data of these 104 countries and regions shows that the correlation coefficient between these two variables maintained between +0.787 and +0.884 from 1980 to 2007. In particular, the coefficient has stayed above +0.830 since 1982. That is to say, the two variables have manifested stable positive correlation worldwide for 28 successive years.

¹ Except for very few countries that are excluded due to lack of data, our survey includes all the other 104 countries and regions which have a population of over 5 million each.

Fig 1 - Coordination between population ageing and economic development: A comparison of different countries in 2007 and China's trend from 1980 to 2050



Note: This figure analyzes 104 countries and regions with a population of above 5 million each in 2007 and relevant data

From this fact we get some inspiration -- Since there is a stable positive correlation between the two variables and the tendency can be illustrated and described by regression curves, we can define those countries whose population ageing conforms to the general rule as the synchronized model; then those whose population ageing is remarkably higher and those remarkably lower than the general rule will be defined as premature population ageing and delayed population ageing respectively. That is to say, a country's population ageing may be premature or delayed as compared to its economic development level. Then the proximity of a certain country's scatter point to the regression curve can reflect its ageing-economics coordination.

As such, we can develop a quantitative method to evaluate the coordination between population ageing and economic development as follows:

(1) Ageing-Economics Coordination Index, to be shortened as AECEI,

$$AECEI_{i,j}^k = 100 \times \left(Y_i^k - \hat{Y}_{i,j}^k \right)$$

where

$AECEI_{i,j}^k$ = the ageing-economics coordination index of k country (or region, the same hereinafter) in the year i with the year j as the base year

Y_i^k = the ratio of people aged above 65 of k country (region) to its total population

$\hat{Y}_{i,j}^k$ = the ratio of people aged above 65 of k country (region) to its total population in the year i calculated by using the per capita GDP of k country in the year i as a function of the ratio of people aged above 65 of the whole world to the world's total population in the year j (base year)

$i = 1980, 1981, \dots, 2050$ (in this paper)

$j = 2007$ or 2030 (in this paper)

$k = 1, 2, \dots, 104$ (2007 in this paper), or:

$k = 1, 2, \dots, 70$ (2030 in this paper)

$$AECEI_{i,2007}^k = 100 \times \left(Y_i^k - \hat{Y}_{i,2007}^k \right)$$

$$= 100 Y_i^k - 7.818 \text{ E-}14 (X_i^k)^3 - 3.656 \text{ E-}9 (X_i^k)^2 + 6.228 \text{ E-}4 X_i^k + 2.508$$

Unless otherwise stated, 2007 is regarded as the base year in this paper. Then,

$$X_i^k = \text{per capita GDP of } k \text{ country (region) in the year } i \text{ (PPP, constant price of 2005, international US dollar)}$$

Other variables as defined above.

(2) Meaning and application of AECI

AECI reflects the degree of population ageing of a certain country -- which is represented by its ratio of people aged above 65 to its total population – and its relative coordination with economic development which is represented by its per capita GDP as compared to the general trend of the world in the base year. Its geometric meaning is as follows: its absolute value, visualized in the scattered distribution map, is the vertical distance between the scatter point of the two variables and the regression curve. When the scatter point is above the curve, AECI is a plus; when the point is below the curve, AECI is a negative. When $AECI \geq 1^2$, the country or region is undergoing premature population ageing; and the greater the AECI, the more premature it is. When $-1 < AECI < 1$, the country's population ageing synchronizes with its economic development; and the smaller the absolute value of AECI, the more synchronized the two variables are. When $AECI \leq -1$, the country is experiencing delayed population ageing; and the greater the AECI, the more delayed it is.

(3) Significance, credibility and limitations of the new method

Different from previous methods, the method proposed in this paper can not only distinguish the different types of coordination between population ageing and economic development, but also quantify the different degrees of coordination. The quantifiability of coordination makes it possible to compare the coordination of different countries and regions or that of a certain country or region at different times as well as their consequent economic pressure. Therefore, this method is applicable not only to China, but also to other countries.

As determined by the nature of the index, the coordination degree calculated by this method can only reflect the relative economic pressure caused by population ageing of a certain country as compared to that of other countries. It should be noted that this method cannot be directly adopted to judge whether population ageing of a certain country in a certain period exerts positive or

² The author chooses $AECI = 1$ and $AECI = -1$ as the cut-off values distinguishing the three types of population Ageing simply based on his own experiences, which is a little subjective.

negative influence on its economic development.

1.2 Data sources

This research utilizes data for two indexes, namely per capita GDP and the ratio of people aged above 65 to the total population. Unless otherwise stated, GDP is calculated according to purchasing power parity (PPP) and the constant price in the year 2005. Such choice, aiming to ensure the comparability of GDP of different countries and regions as well as that of different years, can be supported by the recently-released GDP data of different countries in different years.

The data of per capita GDP of different countries in different years between 1980 and 2007 are cited from the *World Development Indicators 2008* issued by the World Bank. (World Bank, 2008a) In 2007, the World Bank, in cooperation with the statistic bureaus of different countries including that of China, made a recalculation of the GDP accounted in PPP in previous years and thus revised the GDP data of many countries including China. (World Bank, 2008b) Therefore, what we cite here are data considered credible and comparable by the World Bank whereas the per capita GRP (gross regional product) of different provinces, municipalities, and autonomous regions are cited from *China Statistics Yearbook 2008*. (National Bureau of Statistics of China, 2005)

The data of China's per capita GDP from 2008 to 2050 are predictive. We have made use of the latest prediction by the World Bank (World Bank, 2008c), OECD (Maddison, 2007) and Goldman Sachs (Qiao, 2006). With the help of these predictions and the GDP data of China in 2005 released by the World Bank, we worked out China's total GDP in future years as predictions of these organizations. In addition, we also used EIU's (the Economist Intelligence Unit of the UK) prediction about the per capita GDP of 70 major economies³ in 2030.

And the data of different countries' total population and the ratio of people aged above 65 in different years between 1980 and 2050 are cited from the United Nations' *World Population Totals for 1980-2050* (2008 edition), the predictions of which are what we call mean projection. (United Nations, 2009)

³ EIU made predictions of the economic development (including GDP) of 82 countries and regions with the highest GDP in the world. The 70 major economies are those among the 82 whose predicted population size would surpass 5 million each by 2030, with only Taiwan excluded due to lack of data. We intentionally excluded those with a population of less than 5 million in order to prevent population and economic contingencies from affecting research result.

2. Results and Analysis

2.1. A quantitative analysis of whether China has got old before getting rich (1980-2007)

A quantitative analysis of the data of different countries in the world between 1980 and 2007 attests to the opinion put forward by Prof. WU Cangping in 1986 and greatly cited in China and abroad, claiming that China has got old before getting rich. China's AECI from 1980 to 2007 stayed between 1.9 and 2.8, making it fall into the category of premature population ageing. This important feature of China's population ageing in this period can be observed in Fig 1 in which the fold line of China is completely and remarkably above the regression curve.

We also find that, up till now, China is among the top of the world in terms of its prematurity of population ageing as against its economic development. In 2007, China's AECI was 2.3, ranking the 13th among the 104 countries with a population of over 5 million each (whose AECI were between -10.7 and 9.7). Five eastern European countries and former Soviet Union countries including Ukraine (9.7) and Bulgaria (8.7) are far more premature than China. And it can also be observed that even Japan (4.8), Italy (4.5), Germany (3.5) and Russia (3.3) are countries whose population ages faster than that of China.

Yet viewed from another perspective, one may find that China is the one whose population ageing is the most serious among developing countries whose economic development level are more or less the same. Among the 53 developing countries whose total population is over 5 million each and whose per capita GDP is below US\$ 6000, the AECI of China, whose per capita GDP is US\$ 5046, is 2.3, ranking the top and leaving behind a majority of these developing countries whose per capita GDP is below 1.

2.2 Future Tendency of China's Population Ageing (2007-2050)

Based on the economic development goal set by the Chinese government for the year 2020 and the prediction for China's total or per capita GDP during 2007-2050 by major international economic and financial organizations, as well as the population prediction by the United Nations, we try to prefigure the tendency of China's coordination between its population ageing and economic development from 2007 to 2050. While Fig 1 reflects a comparison of China's predicted coordination with the real coordination of the 104 countries and regions whose population was

over 5 million each in 2007 and their general rule (regression curve), Fig 2 is a comparison of China's predicted coordination with that of 70 major economies in 2030 and their general rule (regression curve). In both Fig 1 and Fig 2, the trend line of China from 1980 to 2007 represents the real observed value while that from 2007 to 2050 is a mean projection worked out by adopting the mean value of all the predicted values released by authoritative organizations.

The development tendency of China's ageing-economics coordination exhibits the following characteristics:

1. China's population ageing is likely to go on outrunning its economic development throughout the first half of the 21st century. We come to this conclusion either by taking the highest or the lowest predicted per capita GDP, either by comparing it with the real observed value of various countries in 2007 or with the predicted value of these countries in 2030, either by comparing it with the 104 countries with a large population or with the 70 major economies. The visual manifestation of this feature is that in both Fig 1 and Fig 2, the possible trend line of China from 2007 to 2050 is notably above the regression curve.

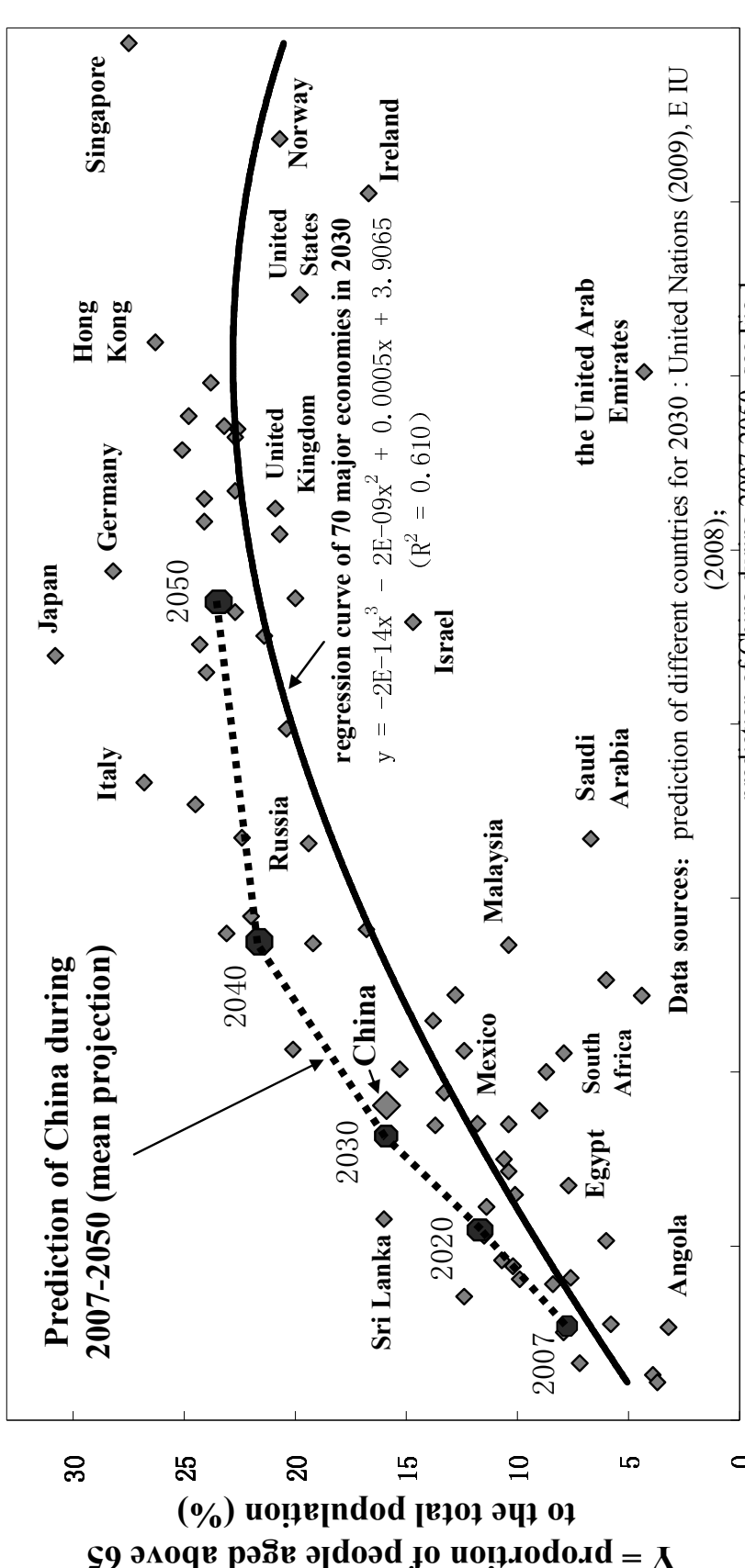
2. The prematurity of China's population ageing is likely to be intensified, which is proved by regression analysis taking either 2007 or 2030 as the base year. The vertical distance between China's possible trend line and the regression curve, i.e. the intensity of China's population ageing, increases as time goes on from 1980 to 2040, especially from 2020 to 2040.

3. By 2030, China is likely to remain a country typical of premature population ageing, but still it will not become the most serious. Compared with the 70 major economies, by 2030, China's ageing-economics coordination index is 3.2⁴, ranking the 13th, preceded by twelve countries including Japan (9.8), Italy (7.5), Singapore (7.2) and Bulgaria (6.6) and followed by other 57 countries whose coordination indexes are mostly below 2.

4. By 2030, China will possibly remain one of the countries whose ageing process outruns its economic development among its peers whose economy develop at similar level. It is estimated that by the year 2030, the per capita GDP of 25 countries out of the 70 major economies will be less than US\$ 20 thousand (that of China is expected to reach US\$ 18,074). And China will top the

⁴ AECEs of the 70 major economies in the third and fourth part of this section are calculated with 2030 as the base year.

Fig 2 - Coordination between population Ageing and economic development: A prospect for 70 major economies in 2030 and China's trend during 2007-2050



Note: referring to 70 countries and regions whose total GDP are ranked at the top 82 in 2007 and whose total population is predicted to go beyond 5 million by 2030 (excluding Taiwan whose data are inaccessible)

25 countries in population ageing and its coordination index (3.2) will rank the third, preceded by Sri Lanka (6.3) and Vietnam (4.8), but remarkably higher than the other 22 countries whose coordination indexes are below 2.2 and average -0.4. (See Fig 2) It should be noted that this characteristic of China's population ageing is also exhibited in 2007 as shown in Fig 1. Therefore, this long-standing characteristic will have profound impact on China's economic and social development.

5. China's prematurity of population ageing as against its economic development may arrive at the peak by about 2040. The vertical distance between China's possible trend line and the regression curve between 1980 and 2050 as shown in both Fig 1 and Fig 2 reaches a maximum by 2040⁵. In other words, if the prediction in this paper is to come true, China's economic pressure generated by its population ageing will begin to aggravate starting from 2020s and reach a peak by 2040. China's ageing-economics coordination index by 2040, if calculated with 2007 as the base year, will reach 4.4, almost three times that of 2007 (2.3).

6. The economic pressure China is to face at the beginning of 2040s is likely to be greater than that the developed countries have so far been confronted with at the same economic development level. On the one hand, according to our survey, Japan and Italy, among all the developed countries, are the ones with the biggest economic pressure caused by population ageing either in 2007 or 2030, which is reflected in their high AECI. On the other hand, according to our mean projection, China's per capita GDP will approach or reach the level that these two countries reached in 2007; however, by that time, China's population ageing will be more serious than that of these two countries in 2007. (See Fig 1) Nevertheless, China is not the only country that faces such severe challenge. For instance, Bulgaria and Cuba, prior to China, will have to cope with the same difficulty by about 2030.

7. With economy being developed rapidly on a long-term basis and population ageing going downhill, our ageing-generated economic pressure may be eased by the middle of this century. This is illustrated by the AECI trend line (the vertical distance between the trend line and the regression curve) during this period as compared with other countries (see Fig 2). What merits our attention is that, to realize this prospect, it is necessary for Chinese economy to maintain its continued and rapid development momentum for another forty years after having been so for thirty

⁵ This conclusion cannot be drawn during 2045-2050 in Fig 1.

years. That is to say, China will encounter bigger economic pressure than other countries.

2.3. Rapid population Ageing and China's international competitiveness

China's population ageing is characterized by its special rapidity (Mo, 2002). It is predicted by the United Nations that China's population ageing will be the fastest from 2016 to 2038, during which the ratio of people aged above 65 to its total population will rise from only 10% to 21%. It takes China only 22 years to complete its population ageing process while other developed countries need 55 years on the average. (United Nations, 2009)

Large quantity of theoretic research in population economics and the practice of developed countries have shown that high-level and rapid population ageing may have negative impact on economic development. For this reason, many authoritative research centers have regarded the forthcoming rapid population ageing as the most critical adverse factor influencing China's economic development in the first half of this century. (e.g Jackson and Howe, 2004; OECD, 2005; Qiao, 2006)

Now, we are going to assess the influence of China's forthcoming rapid population ageing on its international competitiveness by comparing the ageing-economics coordination of China with that of some representative developing and developed countries.

Firstly, most of the mid-and-long term predictions for China's economic development say that China's economy will continue to grow. Despite its momentum of continued long-term growth since the end of 1970s which is very rare in human history, China has to face up to the great challenges brought about by its premature population ageing. By about 2040, after the peak of population ageing, which is to come between 2016 and 2038, will be a consequent peak of economic pressure. Suppose China's economic growth fails to meet expectations, there will be greater ageing-generated economic pressure and greater impact on its international competitiveness.

Secondly, China's prematurity of population ageing as against its economic development is most prominent compared with other large developing countries. Research findings show that among countries with the same per capita GDP, China ranks higher than the five emerging countries (India, Russia, Brazil, South Africa and Mexico) in terms of population ageing since 1980. There's even a bigger gap if compared with Hong Kong and South Korea which belong to

the four Asian tigers. Therefore, with accelerated population ageing, the adverse factor of population will be more unfavorable in China's future development, especially by around 2040.

Lastly, by 2030s or 2040s, China will have to face bigger economic pressure than the major developed countries have been confronted with at the same development level. Data analysis shows that China's population ageing will be notably higher than the seven industrialized western countries, namely the United States, Japan, Germany, the United Kingdom, France, Canada and Italy, when their per capita GDP were at the same level as China is at now.

In a word, the rapid population ageing near at hand is likely an adverse factor crippling China's international competitiveness, which will be especially serious in 2030s and early 2040s.

2.4. China's Regional Disparity in Ageing-economics Coordination

There exists regional disparity in China in terms of economic development, and so does there in terms of population ageing. (Mo, 2002) In view of their coexistence, we have every reason to presume that there also exists regional disparity in China in terms of coordination between population ageing and economic development, and this presumption has been confirmed by our quantitative analysis.

By comparing the coordination index of China's 31 provinces, municipalities, and autonomous regions in 2007 with that of 104 countries and regions with a population of over 5 million each⁶, we find that population ageing of Chinese provinces, municipalities and autonomous regions are generally higher than the countries and regions with the same per capita GDP. In particular, population ageing in some provinces and municipalities like Chongqing and Sichuan is higher by a large margin.

Further calculation reveals that ageing-economics coordination of these provinces, municipalities, and autonomous regions fall into two categories, between which there is a wide gap in AECI. Most of them, to be exact, 29 provinces, municipalities, and autonomous regions are undergoing premature population ageing, including Chongqing (6.8)⁷, Sichuan (6.4), Anhui (6.0), Hunan (5.5), Shaanxi (4.8), Hubei (4.8), Guizhou (4.7), Guangxi (4.7), Jiangxi (4.4), Liaoning

⁶ The population of any of the 31 provinces, municipalities, and autonomous regions of China in 2007 exceeds 5 million, hence the comparability.

⁷ Figure in the bracket indicates the Ageing-economics coordination index calculated with 2007 as the base year. The same hereinafter.

(4.1), Hainan (4.0), Gansu (3.6), Fujian (3.5), Helongjiang (3.5), Jiangsu (3.4), Yunnan (3.2), Jilin (3.2), Hebei (3.1), Shandong (2.9), Henan (2.5), Shanghai (2.4), Zhejiang (2.4), Tibet (2.2), Shanxi (2.1), Qinghai (1.8), Inner Mongolia (1.7), Xinjiang (1.6), Ningxia (1.5) and Tianjin (1.4). The rest two belong to synchronized type, namely Guangdong (-0.3) and Beijing (-0.5).

The comparison of China as a whole with other countries tells us that China faces great economic pressure caused by its population ageing. This analysis here further indicates that the economic pressure imposed on most provinces, municipalities and autonomous regions is even greater. In 2007, the ageing-economics coordination index of 22 provinces, municipalities, and autonomous regions out of the total 31 provincial bodies (excluding Hong Kong, Macao and Taiwan) is much higher than the national average, with Chongqing, whose coordination index is nearly 3 times that of the national average, at the top of the rank.

The incoordination between population ageing and economic development in western areas merits our special concern. In 2007, among the 12 western provinces, municipalities, and autonomous regions, the AECI of 7 of them reached between 3.2 and 6.8, markedly higher than the national average (2.3), highlighting the great economic pressure these areas suffered. And such situation is likely to be intensified in the future. It is predicted that, except for Tibet, the population ageing speed of the rest 11 provinces, municipalities, and autonomous regions in West China will be faster than the national average⁸; and that by 2050, the average ageing speed of the western areas will be faster than the national average. By then, among the top ten fastest ageing provincial bodies, six will be from the western areas. (ZHA Rui-chuan, ZENG Yi, GUO Zhi-gang, 1996)

2.5. Fertility Policy Option and China's Ageing-generated Economic Pressure in the Future

The premise for understanding this issue is to make clear the present birth reality of China. However, demographers have voiced different opinions⁹. While the Chinese government and the United Nations suggest that China's total fertility rate is about 1.8 (e.g. Research Group for National Population Development Strategy, 2007; United Nations, 2009), some others believe that the total fertility rate is 1.6. (ZENG Yi, 2006; TIAN Xue-yuan et al., 2007; WANG Qian, 2008; PRB, 2008)

⁸ This is generally attributed to outflow of young population and delayed transformation of birth rate in western areas.

⁹ C.f/ LI Jianmin (2009).

For this reason, we simulated the variation trend of China's ageing-economics coordination from 2007 to 2050 by adopting two projections. The first is the mean projection recently made by the United Nations, which says that China's total fertility rate will go up to 1.85 between 2020 and 2025 from 1.77 during 2005-2010, and will then stay the same until 2050. (United Nations, 2009). The other projection is made by Prof. ZENG Yi based on the premise that the current policies remain unchanged, which supposes that the total fertility rate of China stays at 1.61-1.62 from now on till 2012, and then drops to 1.50 by 2030, 1.47 by 2035, and 1.41 by 2050. (ZENG Yi, 2006) These two projections reveal their different estimation of the present birth reality and of the future birth trend if the present policies remain unchanged.

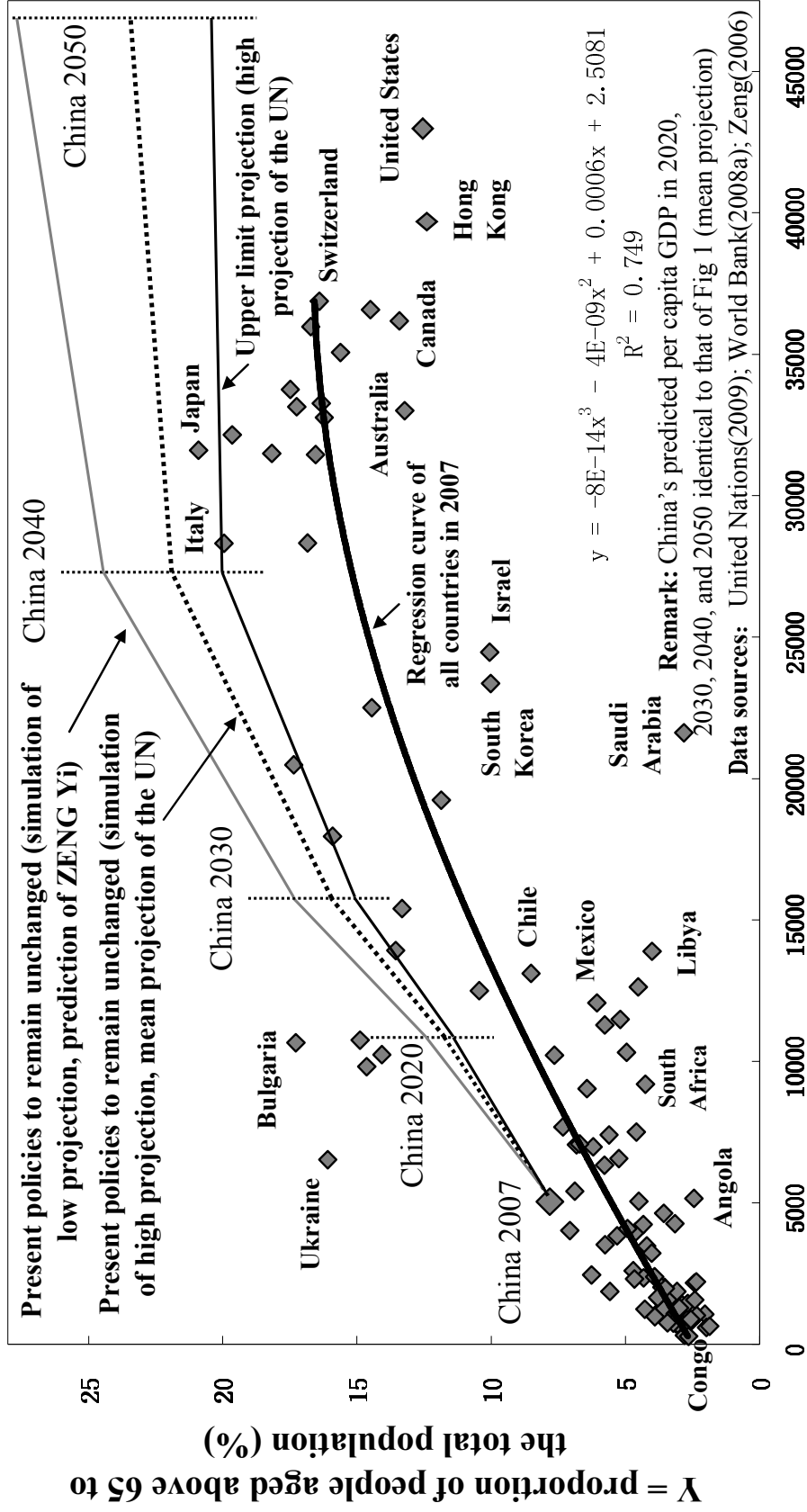
Moreover, we take the latest projection by the United Nations as the upper limit projection for relaxing birth policies. This projection presumes that China's total fertility rate would gradually increase from 1.77 during 2005-2010 to 2.35 during 2020-2025. According to this projection, China's total population will reach a maximum of 1.62 billion by 2050 and continue to rise by a small margin. This means that China will fail to realize its goal "to control its population peak at about 1.5 billion by the middle of this century", which is written in the *Research Report on National Population Development Strategy*. Considering the large population size of China, there's little probability of relaxing birth policies to a greater extent than this projection allows. The fact that the United Nations takes this possibility as a high projection also illustrates the point.

By relying on the method proposed in this paper and the AECI indexes, we would now evaluate the necessity and possibility of easing China's ageing-generated economic pressure by readjusting birth control policies.

According to the simulation results (Fig 3), firstly, if the existing birth policies remain unchanged, the future China will have to face very severe challenges of premature population ageing no matter whether judged by the high projection or the low projection. If the present birth rate and the future trend do conform to the low projection, the challenge would be more severe. In particular, by 2030-2050, China's prematurity of population ageing would surpass all the countries whose per capita GDP reached in 2007 the same level as China would reach by 2030-2050¹⁰. In other words, if this occurs, China's prematurity of population ageing in 2030s and 2040s would be

¹⁰ This is shown in Fig 3 by that the two fold lines during 2030-2050 supposing China's present policies remain constant are far above the scatter points of all the countries whose per capita GDP in 2007 were at the same level.

Fig 3 - Influence of fertility policies on China's Ageing-economics coordination during 2007-2050



Remark: China's predicted per capita GDP in 2020, 2030, 2040, and 2050 identical to that of Fig 1 (mean projection)

Data sources: United Nations(2009); World Bank(2008a); Zeng(2006)

Note: scattered distribution of the 104 countries and regions with a population of above 5 million each in 2007 and relevant data

unprecedented in human history¹¹, surpassing even Japan and Italy which are facing great challenges at present.

Secondly, even if the upper limit projection is adopted to relax birth control, China's premature population ageing cannot be fundamentally changed.

Thirdly, compared with the two projections supposing that the current birth policies remain unchanged, especially with the low projection, the upper limit projection relaxing birth control would markedly improve China's ageing-economics coordination by 2030-2050. Taking China's AECI in 2040 calculated with 2007 as the base year for instance, the last projection (with AECI being 4.8) would be 27% and 48% lower than the first two projections. And we thus reveal in a quantitative way the effectiveness of easing ageing-generated economic pressure by readjusting birth policies and the possible intervals.

Lastly, the research finding in this paper may serve as a reference for future exploration into proper ways to coordinate China's population ageing and economic growth. If the present birth policies remain unchanged, China's real ageing-economics coordination would be somewhere between the two curves simulated on the basis of the two projections made on the premise of retaining the present policies. And the proper path to realize coordination between the two during 2007-2050 may be somewhere between the real path of retaining the present policies and the simulated path of relaxing birth control policies.

3. Conclusion

Population ageing is a global phenomenon, an inevitable outcome of economic development and social progress. Economic and social development can, to some extent, offset the negative influence of population ageing. It is in this sense that human society has the capacity to adapt to population ageing. (Henripin et Loriaux, 1995) The reason why China faces greater challenges than other countries lies in its prominent incoordination between population ageing and economic and social development, in which that between population ageing and economic development plays an essential and critical role. By employing our new method and the more systematic and credible data recently released by the United Nations and the World Bank, we made a quantitative study of the many major issues involved in China's ageing-economics coordination. Our finding

¹¹ i.e., this has never occurred with other countries at the same economic development level.

may help bring a better understanding of the core issue of China's population ageing, i.e. the relationship between population ageing and economic and social development.

Based on the above quantitative analysis, we may come to the following conclusion: China's population ageing has been outrunning and will continue to outrun its economic growth from 1980s to the middle of this century. With China's population entering a period of fast ageing that will last 22 years from 2016 to 2038, such situation would be even worse despite China's rapid economic development, and may come to a peak by about 2040. According to statistics, either in 2007 or in 2030, China's prematurity of population ageing as against its economic growth is at an elevated level in the world, and one of the highest among its peer developing countries with the same economic development level. This means that China will face great ageing-generated economic pressure in its modernization efforts in this century. This negative population factor is likely to cripple China's international competitiveness in the future, and put China in an inferior position in economic competition in terms of human resource support. Prematurity of population ageing as against economic development prevails in many parts of China, including more than half of the western areas. The attempt to regulate by using fertility policies as a lever cannot bring about a thorough change to the fact that China's population ageing is premature as against its economic development in the first half of this century, but it may notably ease the incoordination between the two and relieve China's ageing-generated economic pressure.

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