The Speed of Population Aging in Bangladesh

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Received: 18 March 2013 / Revised: 15 May 2013 / Published: 15 November 2013

ABSTRACT

In this study, an attempt has been made to measure the speed of population aging based on secondary data collected from the Bangladesh Bureau of Statistics (BBS) and international data base (IDB), US census Bureau. Conventional indices and Kii's index have been applied to measure the population aging of Bangladesh. From the analysis, it is observed that the conventional indices expose an exaggerated degree of population aging. The conventional measures consider arbitrary cut off points as well as certain age categories rather than each category of age structure. The study reveals that the Kii's index shows less exaggerated degree of population aging or different trend of the aging process than conventional indices. The Kii's index uses all categories of age structure of population.

Keywords: Conventional indices, Kii's index, Regression model, Age structure.

1 Introduction

The proportion of elderly in a population tends to increase due to decline in fertility and mortality rate. The world (both developing and developed countries) is facing global aging of their population (Rice, 1996). The number of elderly in the developing countries has been growing at a phenomenal rate. According to present indications, most of this growth will take place in developing countries and over half of it will be in Asia, with the two major population giants, namely India and China contributing a significant proportion of this growing elderly (Rajan, Mishra and Sarma, 1999; Rajan, Sarma and Mishra, 2003). The UN defines a country as 'Aging" or "Greying Nation" where the people over 60 years reaches 7 percent to total population. By 2001 India has exceeded that percentage (7.47 percent) and is

expected to reach at 12.6 percent by the year 2025. Improved life expectancy has contributed to an increase in the number of elderly persons (Chakrabarti and Sarkar, 2011)

The percentage of elderly population in Bangladesh is 7.10 (Uddin et al., 2012). This percentage of elderly population is projected to increase 17 percent by the year 2050 (WPP, 2006). The change in age structure of Bangladesh population will have a profound impact on economic and social condition.

Aging is one of the emerging problems in Bangladesh. It has been gradually increasing with its far-reaching consequences (Rahman and Akter, 2007). India is expected to undergo a faster decline in fertility in the immediate future compared to mortality, because mortality is already at a low level. The aging process in India will, therefore, be faster than in other developing countries (Rajan, 2006)

Population aging is the outcome of declining fertility and mortality. It is closely related with the demographic transition. Decreasing the proportion of children and increasing the proportion of elderly people in total population can tremendously change the age structure (Dandekar, 1996). The decline in fertility and mortality is generally correlated with the increase in expectation of life at birth which has been approaching close to 80 years in many developed countries of the world (Nangia and Kumar, 2011). Since population aging refers to changes in the entire age distribution, any single indicator might appear insufficient to measure it. Although, the conventional measures of population aging have been applied by the researchers but these indices are not free from limitations.

Rosset (1964) examined the appropriateness of these conventional measures as a measure of population aging. He suspected that the measures that use the proportion of certain age categories had different cognitive values so that it could not be argued that one measure was better or worse than the other. Median age is also an imperfect measure of demographic aging. Rosset also stated that France ranked the first place of aging country when the proportion of old was used as a measuring of population aging but the eleventh place when the median age was used.

While developing the index for measuring population aging, Kii (1982) observed that the difficulties in using the proportion of those 65 years and over as an index of population aging is the minimal representation of the age variation in a population-basically only two, the 65 years and over and the rest. The measure ignores the age variation within each category, which changes over the years. Less important but nonetheless significant, in conceptualizing this index as a measure of population aging is the arbitrariness involved in creating the ‘old’ age category. He also observed that the proportion of old, the ratio of old to non-old and the ratio of the young to old exaggerated the degree and trend of the aging process.

Since the entry into the old age floats rather than being fixed at the conventional 65 years, as the age specific mortality condition changes. Ryder (1975) proposed an alternative measure of population aging by designating the entry into old age in terms of the number of years remaining until death. The proportion of population above the age corresponding to life expectancy at 10 years may be used as an index of aging. He applied this index to the US population but found afore mentioned difficulty. Also, age variation in the total population are summarized into two broad categories-people above the age at which 10 years of life remains and the rest based on mortality table.

The aging index (AI) is a more sensitive index for measuring population aging. Since, it is based on classifying a population into three broad age categories: the old, the young and the adult. The variation of each age category is not well represented, particularly for the adult group. This group also consists of the largest proportion of a population with low mortality condition. The AI also becomes over sensitive to fluctuations in the birth rate. Since this index does not take into account the variations in the entire age distribution of a population, the degree of aging in specific year will be exaggerated when fertility drops sharply (Kii, 1982; Valaoras, 1958; Hermalin, 1966). The median age for measuring population aging has a similar difficulty. Since, the median divide the distribution into two equal parts and the median value is simply the age half a population is older (or younger) than, variations in the age are above and below the median are not well represented. Therefore, the objective of the study is to measure the speed of population aging of Bangladesh by using conventional indices and Kii's index. A comparison has also been made between conventional indices and Kii's index.

2 Materials and Methods

The present study uses population census data during the year 1961 to 2001 from different Statistical Year Books of Bangladesh published by the Bangladesh Bureau of Statistics (1974, 2001, 2004) and the projected data for 2011 from International Data Base (IDB), US census Bureau (www. census.gov/population/data/idb). All the indices have been calculated based on the data from 1961 to 2011. The conventional indices as well as Kii's index of population aging have been applied to Bangladesh population and a comparative study has been carried out.

2.1 Conventional aging indices

The conventional aging indices are: proportion of old persons (P_{60}), aging index (AI) and the median age. The proportion of old person (P_{60}) is the ratio of the number of persons aged 60 and over to the total population. The aging index (AI) is the ratio of the number of persons aged 60 and over to per 100 persons age between

0 and 14 years. The ratio of the old to non-old ($P_{60/0-59}$) is the ratio of the number of persons aged 60 and over to per 100 persons age between 0 and 59 years. The old age dependency ratio (OADR) is an indirect measure of population aging. This is the ratio of the number of persons aged 60 and over to the number of persons age between 15 and 59 years.

2.2 Kii's index of population aging

The traditional measures of population aging have basically three shortcomings (Kii, 1982). First one is the use of cutoff point for old and young age of population. For example, the cutoff point of old age is 65, for developed countries and 60, for developing countries. Similarly, the cutoff point of young age is 15 in developing countries and 20 in developed countries. Second, the accuracy of any measure increases as the observable range of variability increases. Third, the traditional measures consider only certain age group of population. For example, the proportion of old (P_{60}) consider only two groups of age distribution: the age of 60 and over and the entire population. It is also observed that the conventional measures exaggerate the aging trend. The traditional measures consider the change of age cohorts but ignore the total pattern of the age structure of population. To overcome the shortcomings of traditional measures of aging, Kii (1982) proposed an index which takes into account the all available age category of population. It is assumed that the ages and the proportion of persons corresponding to age groups are correlated. His proposed line can be expressed as follows:

$$Y = \alpha + \beta X$$

Where, Y (class mid-value) is the age of population and X is the proportion of person belonging to age group. The α and β are the intercept and slope of the trend line respectively. In fact, this β, the regression coefficient is the index of population aging. Here, the coefficient (β) considers each group of age structure. To calculate the index, we consider 16 age groups where 15 of them are 5 year length between 0 and 74 years of age and the rest age group is 75 or more. Note that the age 87.5 is assumed as the mid-value of open-end class.

3 Results and Discussion

The aging trends of Bangladesh population during the period 1961 to 2011 using the conventional indices and Kii's index have been presented in Table 1 and Table 2. The comparison of these indices has also been presented in Table 3. Kii's index and the conventional indices have been portrayed graphically for better understanding of the speed of aging process.

An increasing trend of population aging has been observed according to the conventional measures (Figure 1 and Figure 2). Similarly, Kii's index is applied to measure the population aging of Bangladesh and found that the country's population has aged consistently throughout the period 196 to 2011 (Figure 3). The Aging index (AI) is the most sensitive index to the proportion of young among the conventional indices. For example, the high degree of aging in 2001 and 2011 is explained by the fact that at that time fertility rate was significantly decreased. This was because of the successful family planning program. The index, P_{60} is also a sensitive index to the proportion of young. But it is less sensitive than AI (Figure 4). Researchers (Valaoras, 1985; Coale, 1956) have observed that the aging of population as measured by the proportion of old (P_{60}) is seriously affected by the fertility rate. The increasing trend of P_{60} merely does not imply the increasing trend of the old people but also may imply the decreasing trend of young population. Kii (1982) argued that an increase in the proportion of old does not necessarily mean the aging of a population.

According to the median age, the Bangladesh population became even younger between 1961 and 1974, which the Kii's index does not show (Figure 5). This is because of the baby boom cohort still young in 1974. On the other hand, the fertility rate was very high at that time and the largest proportion in the age distribution exists between 0 and 14 age categories. Although, the median age is the best approximation among the traditional aging indices for measuring the degree of population aging (Figure 4), it does not take into account the entire shape of the age structure of population. On the other hand, the Kii's index considers each category of the age distribution. This implies that Kii's index is not only influenced by the young population but also all categories of the age structure of a population.

The old age dependency ratio (OADR) is an indirect measure of population aging. It is observed that the ratio (OADR) has increased slowly for Bangladesh population (Table 1). Actually, this index is not used for measuring the aging of population but has been used as an approximate measure of social and economic dependency.

Table 1: Conventional indices (P_{60}, AI, median age), ratio of old to non-old and OADR for Bangladesh population, 1961 to 2011

Year	P_{60}	AI	Median age	OADR	$P_{60/0-59}$
1961	0.0522	11.3183	17.5352	10.7205	0.0551
1974	0.0568	11.8029	16.1550	12.2761	0.1093
1981	0.0563	12.0810	16.8160	11.7869	0.0597
1991	0.0542	11.9634	17.7562	11.0147	0.0573
2001	0.0613	15.5801	20.5710	11.2371	0.0653
2011^{p}	0.0713	20.8029	23.2818	12.1603	0.0767

Table 2: Kii's index of aging (b) for Bangladesh population, 1961 to 2011

Year	Kii's index (b)	R^2	Adj(R^2)
1961	4.003	0.765	0.748
1974	4.095	0.793	0.778
1981	4.333	0.839	0.827
1991	4.536	0.854	0.843
2001	5.427	0.921	0.916
2011^p	6.65	0.960	0.957

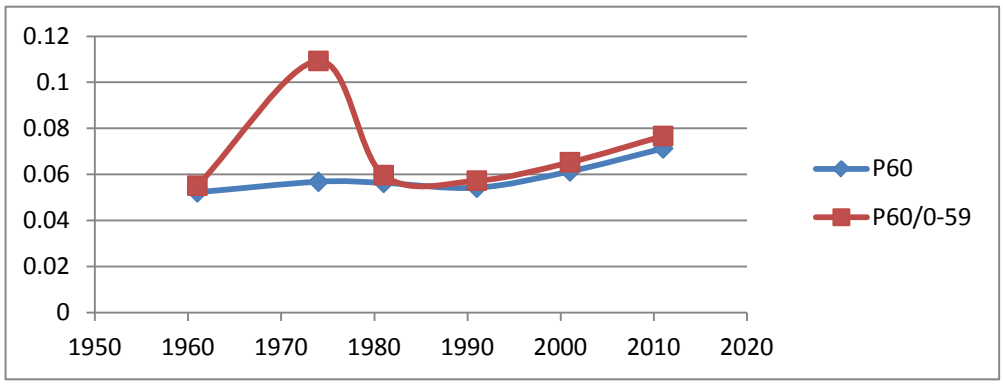

Figure 1: Trend of P_{60} and $P_{60/0-59}$

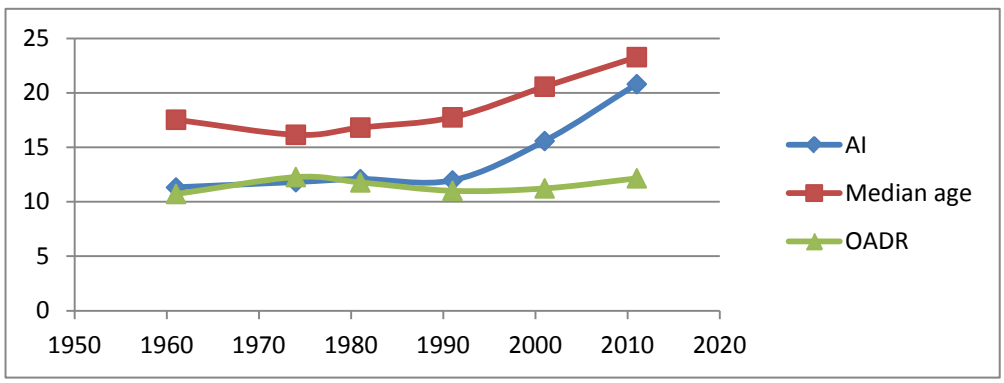

Figure 2: Trend of AI, Median Age and OADR

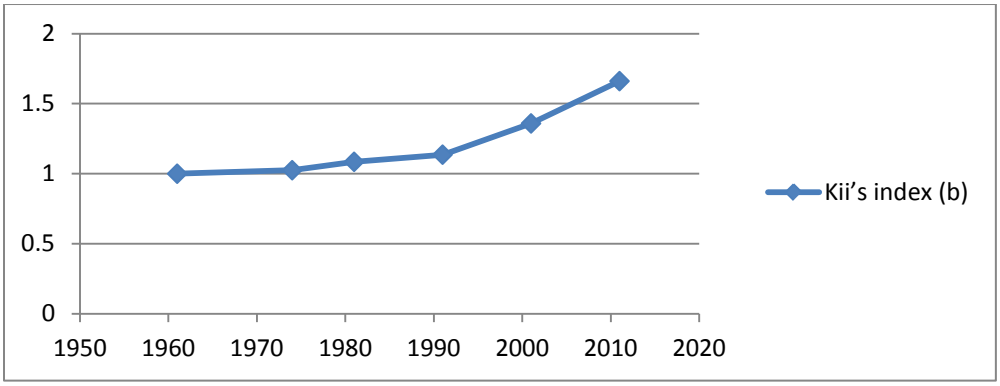

Figure 3: Trend of Kii's index

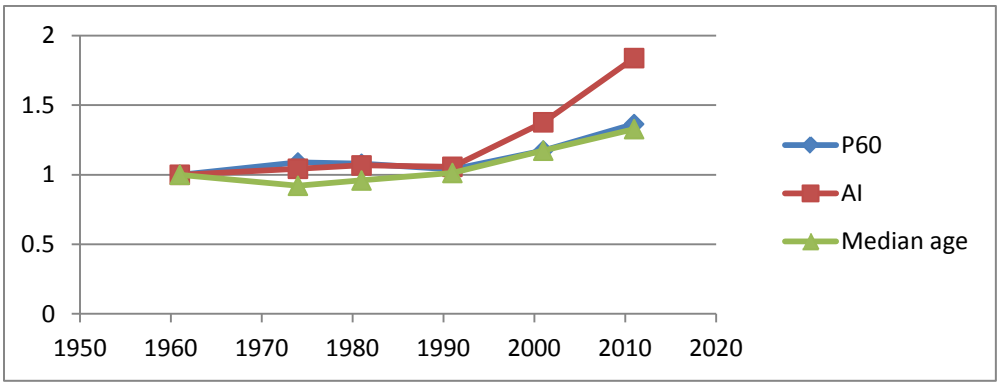

Figure 4: Comparison among conventional indices

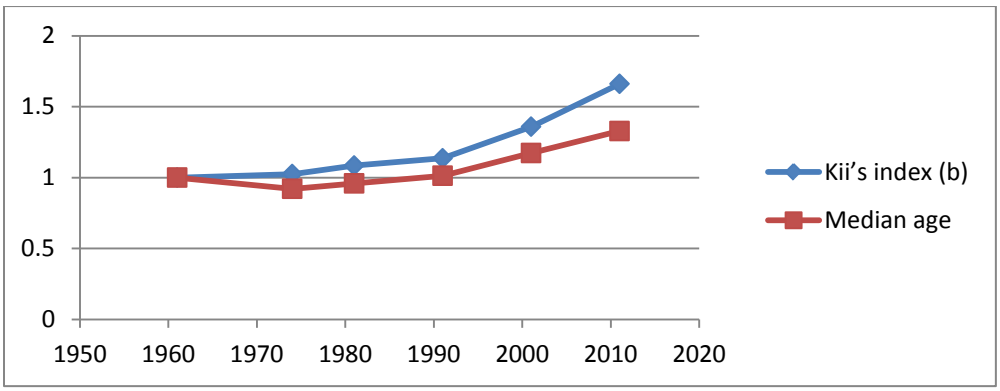

Figure 5: Comparison of Median age and kii' index

3.1 The Speed of aging by using Kii's index and conventional indices

A smooth increasing trend of aging has been observed by the Kii's index. On the other hand, the conventional indices of population aging do not show smooth increasing trend over the study period. These indices show little bit fluctuating increasing trend (Table 3, Figure 6 and Figure 7). Nevertheless, the Kii' index is a better approximation for measuring the degree and trend of population aging as this index use each category of age structure**.**

Kii's index exhibits less degree of aging speed than the AI (Table 3 and Figure 6). According to the model fitting criteria, it is found that the Kii's measure fits the data well (Table 2). Thus, Kii's measure may be considered as one of the best measures of demographic aging process.

Since the aging process deals with the entire age structure of a population, it should not be categorical. The conventional measures give emphasis only certain groups of age distribution but ignore the total age structure. If the entire age structure of a population is more appropriate basis for measuring the degree of population aging, then the shape of the age distribution should be the focusing point rather than the proportion of certain age groups or the ratio of two age groups or some other age groups. All the conventional indices (P_{60}, Median age, AI) contain change in the volume of age cohort but ignore the total shape of the age distribution.

The Kii's index considers the entire shape of the age distribution of a population as expressed by the coefficient of the regression model. In fact, this index is conceptually more meaningful for measuring the speed of aging of population than the conventional indices. Again, since this index is the coefficient of linear regression model (LRM) and the coefficient measures the average change of certain variable hence this index is an approximate representation of the shape of the age structure of a population. The coefficient of determination (R^2) varies over the period 1961 to 2011 having various shape of age distribution but even the smallest value of R^2 is relatively high enough to the good fit of the model.

Table 3: Standardized values for Kii's index and conventional indices (1.00 for 1961)

Year	Kii's index (b)	P_{60}	AI	Median age	$P_{60/0-59}$
1961	1.000	1.000	1.000	1.000	1.000
1974	1.025	1.088	1.043	0.921	1.986
1981	1.085	1.079	1.067	0.959	1.084
1991	1.136	1.038	1.057	1.013	1.042
2001	1.359	1.174	1.377	1.173	1.186
2011^p	1.661	1.364	1.838	1.328	1.392

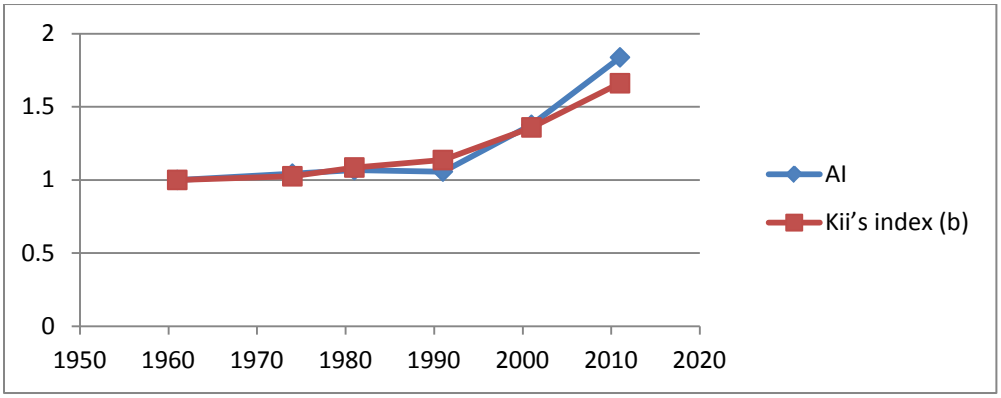

Figure 6: Comparison between Kii's index and AI

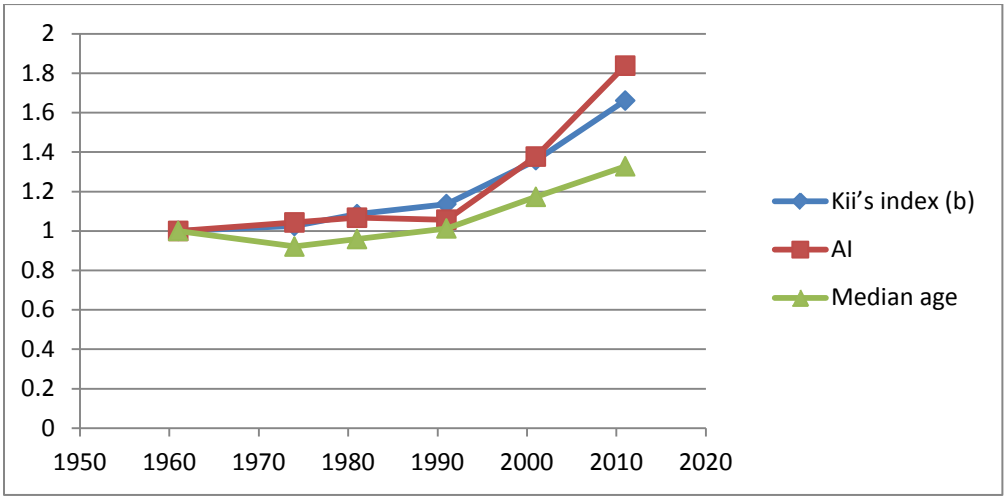

Figure 7: Comparison among Kii's index, Median age and AI

4 Conclusions

From the above analysis, it can be concluded that the conventional measures expose an exaggerated degree of population aging. These measures consider arbitrary cut off points as well as certain age categories rather than each category of age structure. The Kii's index shows less exaggerated degree of aging or different trend of the aging process than the conventional indices in Bangladesh.

Acknowledgements

The authors wish to express their sincere thanks to the Higher Education Quality Enhancement Project (HEQEP), UGC, Bangladesh for providing their support. The

authors are also grateful to the reviewers for their useful comments and suggestions, which have greatly helped in improving the paper.

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Appendix

Proportion of Old Person (P_{60})

The ratio of number of persons age 60 and over to the total population of a country at a certain time is known as proportion of old person (P_{60}). If $N(t)$, $N_{60}(t)$ is the total population and total number of person age 60 and over of a country at time t, then the proportion of old person is defined as

$$P_{60} = \frac{N_{60}(t)}{N(t)}$$

Aging Index (AI)

The ratio of the total number of persons age 60 and over per 100 persons age below 15 is known as Aging index. If $N_{60}(t)$, $N_{15}(t)$ is the total number of person age 60 and over and the total number of person age below 15 of a country at time t, then the Aging Index is defined as

$$AI = \frac{N_{60}(t)}{N_{15}} \times 100$$

Proportion of old to Non- old ($P_{60/(0-59)}$)

It is another measure of aging at peak. The ratio of the total number of person age 60 and over to the total number of person age 59 or less is known as proportion of aged to non aged. If $N_{60}(t)$, $N_{0-59}(t)$ is the total number of person age 60 and over and total number of person age 59 or less of a country at time t, then the proportion of aged to non-aged is defined as

$$P_{60/(0-59)} = \frac{N_{60}(t)}{N_{0-59}}$$

Old-Age Dependency Ratio (OADR)

The ratio of the number of persons age 60 years and over to per 100 persons age between 15 and 59 years is known as old age dependency ratio. If $N_{60}(t)$, $N_{15-59}(t)$ is the total number of persons age 60 years and over and the total number of person age between 15 and 59 of a country at time t, then the old-age dependency ratio is defined as

$$OADR = \frac{N_{60}(t)}{N_{15-59}(t)} \times 100$$