

Choi, Yongok

Research Report

Longevity Risk in Korea

KDI Focus, No. 69

Provided in Cooperation with:

Korea Development Institute (KDI), Sejong

Suggested Citation: Choi, Yongok (2016) : Longevity Risk in Korea, KDI Focus, No. 69, Korea Development Institute (KDI), Sejong,
<https://doi.org/10.22740/kdi.focus.e.2016.69>

This Version is available at:

<https://hdl.handle.net/10419/200869>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



KDI FOCUS

August 11, 2016 (No. 69, eng.)

For Inquiry: KDI Communications Unit

Address: 263, Namsejong-ro, Sejong-si 30149, Korea

Tel: 82-44-550-4030 **Fax:** 82-44-550-0652

Authors | Yongok Choi, Fellow at KDI(82-44-550-4129)

KDI FOCUS | Analysis on critical pending issues of the Korean economy to enhance public understanding of the economy and provide useful policy alternatives

Korea's Leading Think Tank

www.kdi.re.kr

Longevity Risk in Korea*

Yongok Choi, Fellow at KDI

“Korea’s unprecedented rapid growth in life expectancy at birth is mainly attributable to a decline in elderly mortality rates. Indeed, the unanticipated increase in life expectancy and elderly population could complicate the government’s long-term consolidation efforts and present a serious obstacle to formulating and streamlining policies. Accordingly, the next crucial step in the face of mounting longevity risk is to conduct preemptive research on Korea’s elderly mortality rates. The government must acknowledge the exposure to longevity risk and make every efforts to compile accurate data on life expectancy and population projections in order to build a consensus on the gravity of the impending risks and seek a solution which could include a fiscal automatic stabilizer.”

I. Introduction

In line with the rapid growth of the economy, life expectancy at birth in Korea has exhibited a sharp upward turn. Generally, longevity is a blessing for individuals and society as a whole. However, unexpected longevity can generate financial risks for related economic agents; exacerbating government balance sheets through unforeseen spending in social security benefits such as health insurance and long-term care, bloating

* This article is written based on “A Study on Measuring and Managing Longevity Risk” by Yongok Choi.

<Table 1> Increase in Life Expectancy at Birth

Year of Birth	Korea (yrs)	Japan (yrs)	US (yrs)	UK (yrs)
1960	52.4	67.8	69.9	70.8
2014	82.4	83.7	78.8	81.1
Annual average increase 1960-2014	0.56	0.29	0.16	0.19

the expenditures of defined-benefit pension providers and individuals outliving their retirement savings.

This study assesses how fast Korea's life expectancy has risen, analyzes what has led to the systematic under-forecast of life expectancy and the elderly population, and presents the potential risks¹⁾ arising from such underestimations. In particular, the long-term impact on government balance sheets of the unforeseen increase in the senior population is quantitatively analyzed and suggestions on mitigating the longevity risks are introduced.

II . Rapid Increase in Life Expectancy

OECD statistics show that Korea's life expectancy has risen at the fastest pace among member nations.

In Korea, life expectancy at birth surged from 52.4 years in 1960 to 82.4 years in 2014,²⁾ posting the sharpest rise among OECD member countries, according to OECD health statistics. As reported in <Table 1>, although the increase in life expectancy is a worldwide phenomenon, Korea is considerably outpacing advanced countries.

Life expectancy, calculated with the latest death probability, provides important information for economic agents as it not only affects individuals' decision-making but is also vital in formulating health care policies and determining insurance premiums. However, the figures are often misinterpreted.

It is highly likely that life expectancy estimates based on the period life table are underestimated compared to the actual average remaining life span.

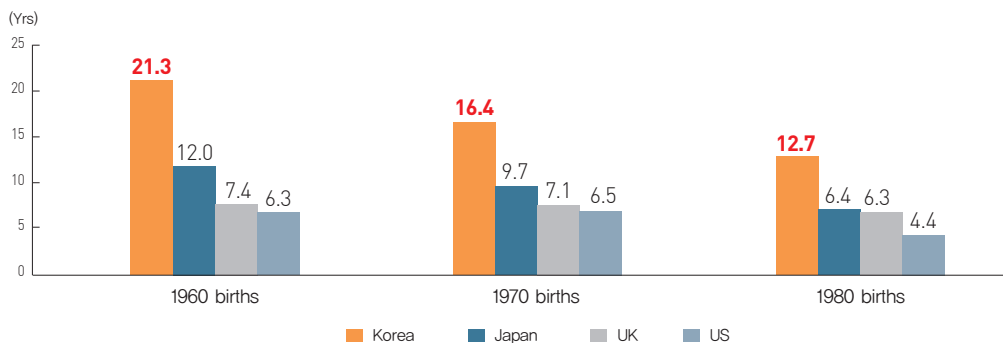
Most national statistical offices in charge of compiling life expectancy data, including Statistics Korea, release life expectancy figures based on the so-called *period* or *static* life tables. However, it is highly likely that these figures are underestimated compared to the actual average remaining life span since the period life table assumes that the age-specific death probability in the future is identical to that in the present. Given that mortality rates for all age groups continue to decrease over time, the average actual life span would exceed the level presented in <Table 1>.

Accordingly, the difference between life expectancy based on the period life table and the actual average life span, i.e. the unexpected increase in life expectancy, has been substantial and one-sided. Korea, in particular, exhibits a much larger discrepancy among

1) In this article, we focus on aggregate longevity risk.

2) 1960 data was compiled from <https://data.oecd.org/healthstat/life-expectancy-at-birth.htm>. 2014 data was compiled from Statistics Korea's 2014 Life Table.

[Figure 1] Unexpected Increase in Life Expectancy



the above four countries. [Figure 1] presents the discrepancy in life expectancy for those born in 1960, 1970 and 1980, as of 2013; the difference between the initial estimates for life expectancy at birth and the recalculated life expectancy using the most recent data.³⁾ As it can be seen, although the life expectancy of Koreans was initially 52.4 years in 1960, it rose to 73.7 years upon recalculation, an unexpected increase of 21.3 years. Korea's discrepancy for the 1960 cohort is almost double that of Japan (12.0 yrs) and more than triple that of the US (6.3 yrs). Similar patterns can be observed for those born in 1970 and 1980, and this phenomenon is attributed to the fact that Korea's mortality rate has improved much faster than other countries.

It should be noted that the rise in the actual average remaining life span could be higher than the results shown in [Figure 1]. If we calculate life expectancy based on the *cohort* life table, which takes into account the improving trend in mortality, the life expectancy for 1960 birth-survivors (aged 53 yrs as of 2013) and the life expectancy of those born in 1960 are 35.8 years and 77.8 years, respectively. These figures are larger by 4.8 years and 4.1 years, respectively, than the estimates based on the period life table (See Choi (2015) for further details).

Some project that, similar to the experiences of advanced economies, the pace of increase will slow considerably as life expectancy rises. As for Japan, which has one of the longest life expectancies in the world, the increase pace for life expectancy slowed by more than 40% after peaking at 80 years in 1996, rising approximately 0.18 year on average per year compared to 0.31 year when life expectancy was in the 70 year-range. However, despite reaching 80 years in 2008, there are yet to be signs of such a slowdown in Korea, which posted only a slight drop in the yearly average increase at 0.4 year.⁴⁾

Although unexpected longevity is prevalent across the globe, in terms of magnitude, Korea will experience a much bigger shock than any other developed country.

Despite reaching 80 years in 2008, Koreans' life expectancy continues to rise.

3) Here we use data from the HMD (human mortality database), with the exception of Korea's data, which was obtained from Statistics Korea.

4) One reason that the elderly mortality rates in Korea has improved faster than other developed countries could be the prevalence of national health examinations. Jee et al.(2014) show that the examinations reduce mortality rates.

<Table 2> Contribution to the Improvement in Mortality Rates by Age to the Increase in Life Expectancy

Period	Increase in life expectancy (annual avg.)	Contribution to the improvement in mortality rates to the increase in life expectancy		
		Children(0-14 yrs)	Working age(15-64 yrs)	Elderly(65 yrs and over)
1970-1985	6.51 yrs (0.43 yr)	40.9%	49.8%	9.3%
1985-2000	7.58 yrs (0.51 yr)	22.4%	46.8%	30.7%
2000-2014	6.38 yrs (0.46 yr)	6.9%	35.4%	57.7%

III . Causes of the Recent Rise in Life Expectancy

Mortality rates determine life expectancy, and it is a well known fact that as the economy develops, mortality rates also improve in the order of: children, middle-aged females, middle-aged males and the elderly. In other words, the increase in life expectancy is mainly attributable to a decline in children's mortality in the early economic development phase, followed by an improvement in the elderly mortality rates as the economy enters a mature phase. This typical pattern can be observed in Korea, as shown in <Table 2>. The increase in life expectancy from 1970 to 1985 can be explained by the improved mortality rates of children and the working age population, while the rise after 2000 is attributed to that of the elderly population; after 2000, 57.7%⁵⁾ of the total increment is contributed by the improved mortality rates of the elderly.

Statistics Korea releases period life tables every year and population projections every five years. The projected elderly population for the next five decades is utilized as key assumptions in long-term fiscal projections for the social security system, including the national pension and national health insurance. Considering that the recent increase in life expectancy is mostly due to the improved mortality rates of the elderly and that the government's long-term fiscal projections are based on Statistics Korea's population projections, an in-depth assessment on the mortality rate forecasting performance of the elderly is necessary.

[Figure 2] illustrates how forecasting errors for the 65 years and over population have changed over time in previous Statistics Korea's population projections.⁶⁾ The most salient feature is that this fraction of the population has been under-forecast in most projections,⁷⁾ due to an over-forecast of elderly mortality rates.⁸⁾ Another characteristic is that cumulative errors continue to grow over time in most cases, which implies that there is a consistent under-forecast of the improvement pace in mortality rates; although a certain degree of

5) As for the period from 2000 to 2014, the improved mortality rates of those aged 50 and over is found to have contributed to the increase in life expectancy by approximately 80%.

6) Compiled data from Statistics Korea's Population Projection (1991; 1996; 2001; 2006; 2011).

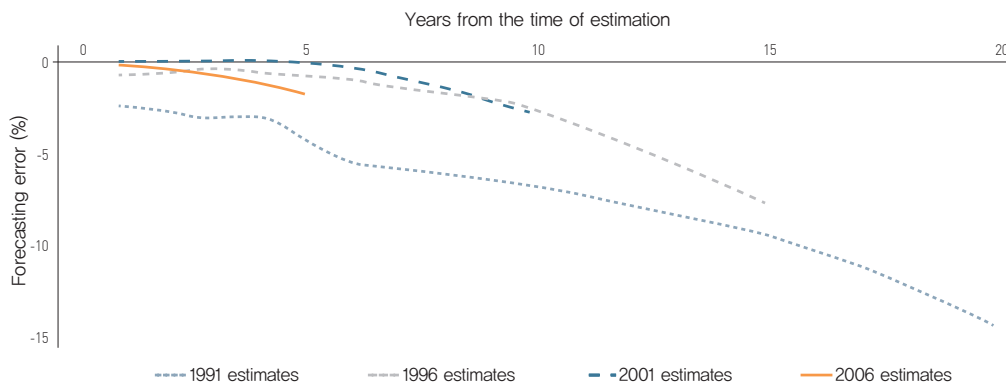
7) As an exception, the forecast error of the "Population Projection: 2000-2050" for the first four-year period is 0.04%.

8) Given that the cross-border migration rate of the elderly population is very small, it can be said that the error in the estimation for the elderly population is almost entirely due to the overestimation in mortality rates.

Analysis found that 80% of the increase in life expectancy after 2000 is attributed to the decrease in the mortality rates of those aged 50 years and over.

The elderly population has been consistently under-forecast by Statistics Korea.

[Figure 2] Forecasting Errors in Population Estimates for the 65 years and Over Population



improvement in mortality rates was forecast, the pace of improvement has been much faster. It is also worth noting that the performance in the 2006 estimates (red solid line)—obtained by adapting a worldwide mortality rate model⁹⁾—does not seem any better than those in previous projection results. As shown in [Figure 2], errors in the 2006 estimates rose faster than that in 1996 or 2001.

These systematic forecasting errors in the elderly population appear to continue for as long as Statistics Korea has forecast mortality rates with Lee-Carter type models using all available data from 1970 to the present. Globally used, although Lee-Carter type models are suited to the data when mortality rates improve in a linear pattern, it is flawed in that it assumes a universal pattern for mortality rate improvements for all time periods. Since the improvement pattern of Korea's mortality rates is constantly evolving over time, such a model may not be suitable. If used, it is highly likely that the mortality rates of children would be under-forecast while that of the elderly would be over-forecast.

IV . Consequences of Longevity Risk

Statistics Korea's population projection plays an essential role when the government formulates new schemes and streamlines existing policies. Now that massive social welfare expenditure, in response to population aging, is expected in the decades ahead, accurate population projections are particularly important. Take the basic pension adopted in 2014 as an example. The expenditure is set out in proportion to the elderly population, meaning that an under-forecast of the elderly population could act to weaken fiscal sustainability.

Specifically, it was found that the forecasting error for the 65 years and over population is approximately -10% on average in previous population projections for 15 years in the

It has been found that the forecasting error for the 65 years and over population is approximately -10% on average in the previous population projections for 15 years in the future.

9) Statistics Korea adopted the Lee-Carter(1992) model for the 2006 estimates, and then the model from Lee-Li (2005) for the 2011 estimates. The latter is known to perform better in estimating the mortality rates by gender in a single nation.

<Table 3> Estimates for Long-term Fiscal Expenditure (% of GDP)

Year	2020			2060		
	2011 Population Projection	Choi (2015)	Gap	2011 Population Projection	Choi (2015)	Gap
National Pension	1.6%	1.6%	0.0%	7.3%	8.2%	8.2%
Basic pension	0.8%	0.9%	0.0%	2.6%	3.1%	0.5%
National Health Insurance	0.9%	1.0%	0.0%	2.4%	3.5%	1.2%
National Basic Livelihood Security	0.6%	0.6%	0.0%	0.8%	1.0%	0.1%
Subtotal	4.0%	4.0%	0.1%	13.1%	15.8%	2.8%

Note: Due to rounding, percentages may not always appear to add up to the subtotal.

future (from the point of estimation). This under-forecasting error of 10% may have huge economic implications. According to the 2011 projection, the 65 years and over population is projected to reach 10.84 million in 2026. If the under-forecast of 10% is realized, the population will amount to 11.91 million, which is one million more than the 2011 projection. This means that there will be an unexpected increase of 0.7 million basic pensioners.¹⁰⁾

<Table 3> presents an estimation of the additional fiscal burden due to an unexpected increase in the elderly population. Here, we estimate the main fiscal expenditure using different elderly population projections; the 2011 population projection by Statistics Korea and a population projection using the improved mortality rate forecasting model by Choi(2015). Choi(2015)'s model allows nonlinear mortality improvement patterns which are in line with economic development and therefore, captures the recent big improvements in elderly mortality rates. According to his model, the 65 years and over population, as of 2060, will amount to 21.34 million, 21.1% more than the 2011 population projection by Statistics Korea. In order to focus on the impact of an unexpected increase in the elderly population i.e. longevity risk, here we set all variables other than population to the same value and estimate fiscal expenditure using an identical method.

The results show that the effects of the unexpected increase in the elderly population is a mere 0.1% of GDP in 2020, but rises to 2.8% in 2060. What's more concerning is that under-forecasting errors will continue to accumulate in a systematic manner, consequently deteriorating the fiscal balance sheet.

Under-forecasting of the elderly population could impose a serious obstacle to streamlining existing policies by weakening the necessity to reform the social security system. The National Pension Scheme has conducted three rounds of fiscal estimates so far. <Table 4> presents the 65 years and over population in 2050, which was used in each fiscal estimate. The projected elderly population for 2050 rose every time and the population

10) Basic pension recipients account for 70% of the elderly population.

Projections that take into account the recent improvement in mortality rates find that the 65 years and over population will reach 21.34 million by 2060, 21.1% more than Statistics Korea's estimates.

Accurate population projections are particularly important as huge social welfare expenditure with regards to aging is expected in the decades ahead.

<Table 4> Population Assumptions used in the National Pension Scheme's Fiscal Estimate

	65 years and over population in 2050 (1,000 persons)
1st fiscal estimation (2003)	15,271
2nd fiscal estimation (2008)	16,156
3rd fiscal estimation (2013)	17,991
Choi (2015)	20,625

used in the third estimate was larger by more than 2.7 million than the one used in the first estimate. And this figure is expected to grow. Indeed, the expenditure estimate used as important information to make guidelines for the national pension scheme reform—pushed forward by the government in 2007 to secure long-term sustainability of the national pension—seems significantly underestimated. Had the estimations been accurate at the time of reform, building social consensus on the necessity of a national pension scheme reform could have been much easier and enabled much stronger reform.

Under-forecasting the elderly population could impose a serious obstacle to streamlining existing policies by weakening the necessity to reform the social security system.

V . Conclusion and Policy Suggestions

Korea is experiencing an unprecedented rapid increase in life expectancy. The recent increase is mainly attributable to improvements in elderly mortality rates. The magnitude of the unexpected increase in longevity markedly exceeds that of advanced countries, implying that the financial risks the Korean government will have to face will be huge. Due to the considerable under-forecast of the elderly population in the government's long-term fiscal projection released in 2015, it seems very likely that the fiscal cost of social welfare could expand much more than expected. As such, recognition and mitigation efforts regarding longevity risk should be of the utmost importance.

Recognition and mitigation efforts to tackle longevity risk should be of the utmost urgency.

International organizations such as the IMF (2012) also warn that the additional costs related to longevity risk could total an astounding 50% of the 2010 GDP in advanced countries by 2050 in addition to the already-huge costs of aging; here, it must be emphasized again that due to the Korean government's excessive longevity exposure, longevity risk could push up debt-to-GDP ratios much more than expected.

Due to the consistently changing improvement patterns in Korea's mortality rates, Lee-Carter type models, which assume a universal pattern for mortality rate improvements, may not be suitable.

To effectively deal with longevity risk, it is vital that preemptive research on elderly mortality rates is conducted. Since the improvement pattern in Korea's mortality rates continues to change, Lee-Carter type models may not be suitable. Rather, an adequate mortality forecasting model tailored specifically to Korea must be developed via cooperation between demographers, sociologists and economists. To support this research, Statistics Korea should make every effort to compile and disclose credible data

on births, deaths, cross-border migration, etc. In particular, if Statistics Korea's mortality rate data adheres to Human Mortality Database (HMD) standards, it would help promote related research. In addition, the upper age limit must be pushed above the current level (100 yrs)¹¹⁾ and the annual release of intercensal estimates based on the latest data must be considered, until elderly population projections have stabilized.

Longevity risk is an undiversifiable, systematic risk that cannot be shouldered by the government alone. The government should inform the public of the actual conditions of longevity risk, which would help create an environment wherein economic agents can reach a consensus on burden-sharing.

Longevity risk is an undiversifiable, systematic risk that cannot be shouldered by the government alone. As such, in order to create an environment wherein all economic agents i.e. government, businesses and individuals can reach a consensus on burden-sharing, the government must disclose all information on the actual conditions of longevity risk to the public.

If necessary, developing a new indicator should be considered as a way of informing the public of the current conditions of longevity risk as life expectancy can be widely used to prepare for any impending risks. Currently, the life expectancy released by Statistics Korea is based on the period life table, and is structurally designed to underestimate the average residual life period of an individual. If the life expectancy compiled on the cohort life table is released, it would help individuals as well as businesses to manage longevity risk.

Furthermore, it may be worthwhile to contemplate implementing a 'fiscal automatic stabilizer' to the fiscal scheme of various pensions and health insurance to sustain balance sheets despite the unexpected longevity. In the current system, the government alone takes on the burden of longevity risk, implying that the fiscal burden from the current generation will most likely be passed on to the next. Accordingly, Korea should follow in the footsteps of countries like Sweden, Germany and Japan, who have introduced a fiscal automatic stabilizer which is designed to reflect and apply the increasing residual expectation of life in the decremental pension amount. If managed, based on a consensus on longevity risk, this method would help mitigate generational conflict.

Indeed, increasing life expectancy encompasses broad implications besides the fiscal elements. For example, compared to the past when the average life expectancy was only 60 years, it is now desirable for individuals and society as a whole to remain longer in the labor market. Korean society, however, still struggles with social institutions, traditions and customs that pose an obstacle to the necessary changes. Nevertheless, recent reform measures, such as transforming the strict seniority-based wage system into performance-based while extending the retirement age, are positive steps as is the upward revision of the definition for 'elderly' stipulated in the National Social Security System. Still, all efforts, of course, should be premised on a social consensus based on more accurate estimations on the elderly population and life expectancy. ■

11) According to the 2011 Population Projection, the population at age 100 and over is expected to exceed 80,000 in 2060.

References

- Choi, Yongok, *Study on Measuring and Managing Longevity Risk*, Policy Study, 2015-18, Korea Development Institute, 2015 (in korean).
- Jee, Sun Ha, JungHoon Ahn, JaYun Lee, YoonMi Yook, YeJin Mok, SunJu Lee, and JungUn Lim, *A Study of National Health Checkup Screening Impact on Mortality and Healthcare Expenditure in Korea*, Research Paper NC13-004, National Evidence-based Healthcare Collaborating Agency (NECA), 2014. 4, pp.1~56 (in korean).
- IMF, *Global Financial Stability Report*, 2012.
- Lee, R. D. and L. R. Carter, "Modeling and Forecasting US Mortality: Age Distribution, Range, and Ultimate Level," *Journal of the American Statistical Association* 87(419), 1992, pp.659~671.
- Li, N. and R. Lee, "Coherent Mortality Forecasts for a Group of Populations: An Extension of the Lee-Carter Method," *Demography* 42(3), 2005, pp.575~594.
- Ministry of Strategy and Finance, *2060 Long-term Public Finance Outlook*, 2015 (in korean).
- Statistics Korea, *2013 Life Table (nationwide, cities and provinces)*, 2014 (in korean).
- Statistics Korea, *2014 Life Table (nationwide, cities and provinces)*, 2015 (in korean).
- Statistics Korea, *Population Projection: 2000-2050*, 2001 (in korean).
- Statistics Korea, *Population Projection: 2005-2050*, 2006 (in korean).
- Statistics Korea, *Population Projection: 2010-2060*, 2011 (in korean).

- CDC(http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_02.pdf, Access date: 2016. 3. 4).
- HMD(<http://www.mortality.org>, Access date: 2016. 3. 4).
- Ministry of Health, Labour and Welfare(<http://www.mhlw.go.jp/wp/hakusyo/kousei/15-2/dl/02.pdf>, Access date: 2016. 3. 4).
- OECD(<https://data.oecd.org/healthstat/life-expectancy-at-birth.htm>, Access date: 2016. 3. 4).
- Office for National Statistics(<http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/datasets/lifetablesprincipalprojectionunit> edkingdom, Access date: 2016. 3. 4).