Demographic Components of Future Population Change and Their Implications

Haebong Woo
Research Fellow, KIHASA

1. Introduction

Low fertility and future population change

Korea's fertility rate started going down below the replacement level in the early 1980s and kept falling to a greater extent in the 2000s and afterward. With a view to addressing the ramifications that might arise from low fertility, the Korean government embarked in 2006 on the Basic Plan on Low Fertility and Aging Society, which is in its third 5-year iteration since 2016[1].

Korea's protracted low fertility has raised intense social concerns, but the long-term implications it has for future population changes have yet to gain enough attention. Indeed, the Third Basic Plan on Low Fertility and Aging Society has among its goals raising the total fertility rate to the replacement level (2.1) by 2045. What we need at this point is to consider whether the demographic problems Korea is facing can be resolved once and for all by raising fertility rate, if not whether the fertility target as stated in the Third Basic Plan is attainable at all. This study is aimed at examining how more than three decades of sub-replacement fertility will affect population change, in terms in particular of depopulation and population aging.

Looking at the growth and decline of the population as forecast in Statistics Korea's Population Projections (medium variant projection of 2016), this study employs a decomposition method that quantifies the contribution of fertility, mortality, migration, and age-structure factors to population changes. Additional simulations are used to examine how population changes will play out in the long run.[2]

Statistics Korea's Population Projections (2016), the first of its kind to cover a period as expansive as 100 years (2015~2155), provides a useful reference point showing a long-term process of population change.[3] In my reference scenario, I used the values as estimated in the 2016 Population Projections. In estimating the contribution of key factors associated with population change, I used the "cohort-component method."

2. Decomposition of future population change

Population projection scenarios and their composition

The standard scenario employed in this study is Statistics Korea's "medium variant scenario" (2016). To decompose the contribution of each of the key factors, I produced three different population projections based on the cumulative effect of the assumed changes in those demographic components.[4] The first scenario assumes zero net migration with the mortality

---

1 Third Five-Year Basic Plan on Low-fertility and Aging Society (2016~2020), p. 42, Government of Korea

2 Statistics Korea's medium variant scenario is used as the reference scenario. The question of the accuracy of Statistics Korea's projections is not considered in this study.

3 Population Projections: 2015~2065, Statistics Korea (2016)

4 For further information about the decomposition method employed in this study, see: Andreev, K., Kantorova, V., & Bongaarts, J. (2013). Demographic components of future population growth. Technical Paper No. 2013/3. NY: United States; Bongaarts, J., &

and fertility rates as assumed in Statistics Korea's standard population projection scenario. Here, the difference in projected population size between the zero-net-migration scenario and the standard scenario suggests the extent to which migration contributes to future demographic dynamics. The second posits the fertility schedule as assumed in the zero-net-migration scenario, while keeping the mortality rate at the 2015 level (age-specific). The difference in projected population size between the zero-net-migration scenario and the constant-mortality scenario is attributed to mortality. The third is the second scenario with the assumption of a fertility rate rising immediately from its baseline-year (2015) level to the replacement level [Net Reproduction Rate (NRR) = 1]. The contribution of fertility in this case is the difference in projected population size between the "replacement-level fertility" scenario and the constant-mortality scenario.

[Table 1] Various population projection scenarios and their composition

Scenarios	Composition
Standard	Fertility, mortality, and migration as used in Statistics Korea's Population Projections 2016 (medium variant projection)
Zero-net-migration	Standard scenario with the assumption of zero-net-migration
Constant-mortality	Zero-net-migration scenario with the assumption of age-specific mortality kept at its baseline-year (2015) level
Replacement-level fertility	Constant-mortality scenario with the assumption of replacement-level fertility

Demographic decomposition of future population change

According to Statistics Korea's medium variant projection (2016), the Korean population will decline by 25.20 million to 25.815 million, representing only 50.6 percent of its 2015 size of 51.015 million. As [Figure 1] and [Table 2] illustrate, migration and mortality are projected to add 2.967 million and 4.104 million, respectively, to the population, whereas the fertility rate (-27.421 million) and momentum (-4.851 million) are found to contribute to depopulation. What primarily drives the population decline over the 100-year period is low fertility (the difference between the replacement rate and the estimated rate). What's notable with respect to the decomposition of population change is that, as has been the case with other countries of protracted low fertility, Korea is showing signs of entering a period of negative population momentum. The onset of negative population momentum means that, even if the fertility increases to the replacement level over time, the population will decline in the long run due to its initial age structure (assuming zero-net migration and a constant mortality rate.) In Statistics Korea's medium variant scenario, the contribution of population momentum to population decline (4.851 million) is greater than mortality's contribution to population growth (4.104 million).

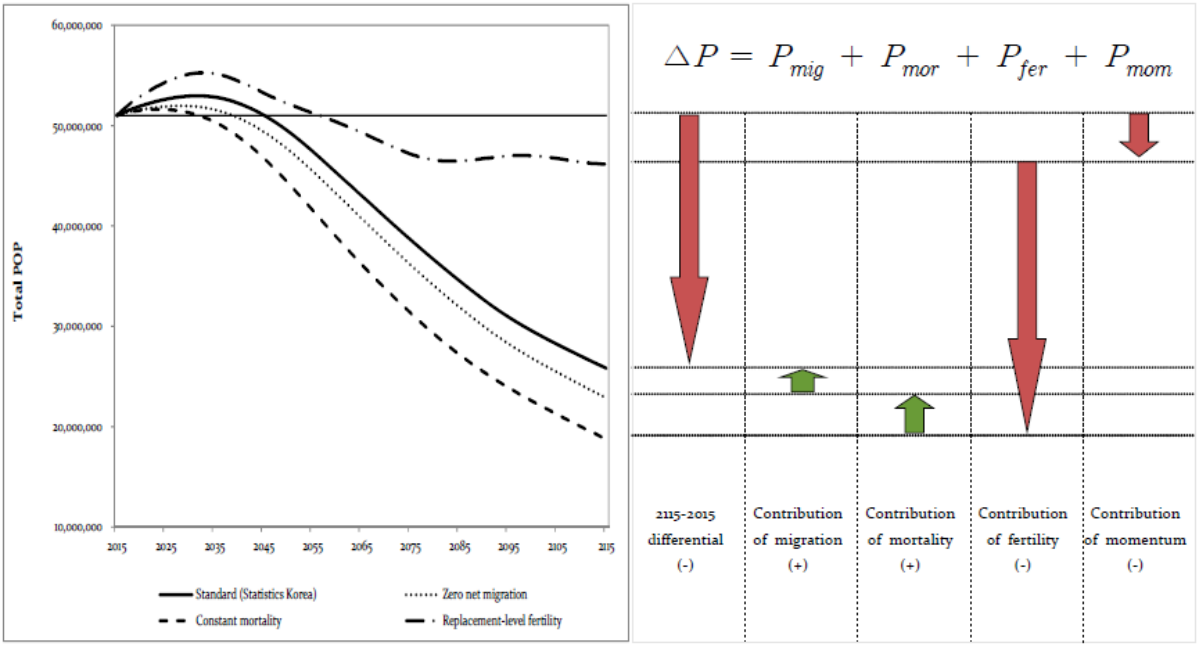
Migration and mortality rates are shown to contribute to increases in the old-age population and the working-age population. Conversely, fertility is found to contribute to decreases in both the old-age and working-age populations. The contribution of mortality rate is stronger to increases in the elderly population than to increases in the working-age population, an outcome attributable to the fact that recent improvements in mortality reduction have been at their most substantial in the elderly population. For both the old-age population and the working age

Bulatao, R. A. (1999). Completing demographic transition, *Population and Development Review*, 25(3), 515-529.

population, the contribution of each of migration, mortality rate, and fertility rate moves in the same direction. However, age structure contributes simultaneously to increases in the old-age population and to decreases in the working-age population, indicating that population momentum is closely associated with population aging.[5]

[Figure 1] Population change components and their contributions to Statistics Korea's medium variant scenario (2015~2155)

(Unit: person)



[Table 2] Population change components and their contributions to Statistics Korea's medium variant scenario (2015~2155)

Unit: ten thousand people

	ΔMigration	ΔMortality	ΔFertility	ΔMomentum	ΔOverall
Overall	2,967	4,104	-27,421	-4,851	-25,200
Old-age population (65 and over)	1,123	3,703	-3,909	3,517	4,434
Working-age population (15~64)	1,580	368	-17,677	-9,289	-25,018

3. Population momentum and its effect

Population momentum

Population momentum is defined as the tendency for a population to continue to grow or decline in the long run even after an instant drop (or rise, for that matter) in fertility to the replacement level.[6] This has to do with the effect of age structure. The Korean population is a case in point, which, driven by positive momentum, has been growing even until now, even as its fertility rate has remained well below the replacement level since the early 1980s. Conversely,

[5] For further conceptual and empirical understanding of the close relationship between population momentum and population aging, see: Kim, Y. J., & Schoen, R. (1997). Population momentum expresses population aging. *Demography*, 34(3), 421-427.

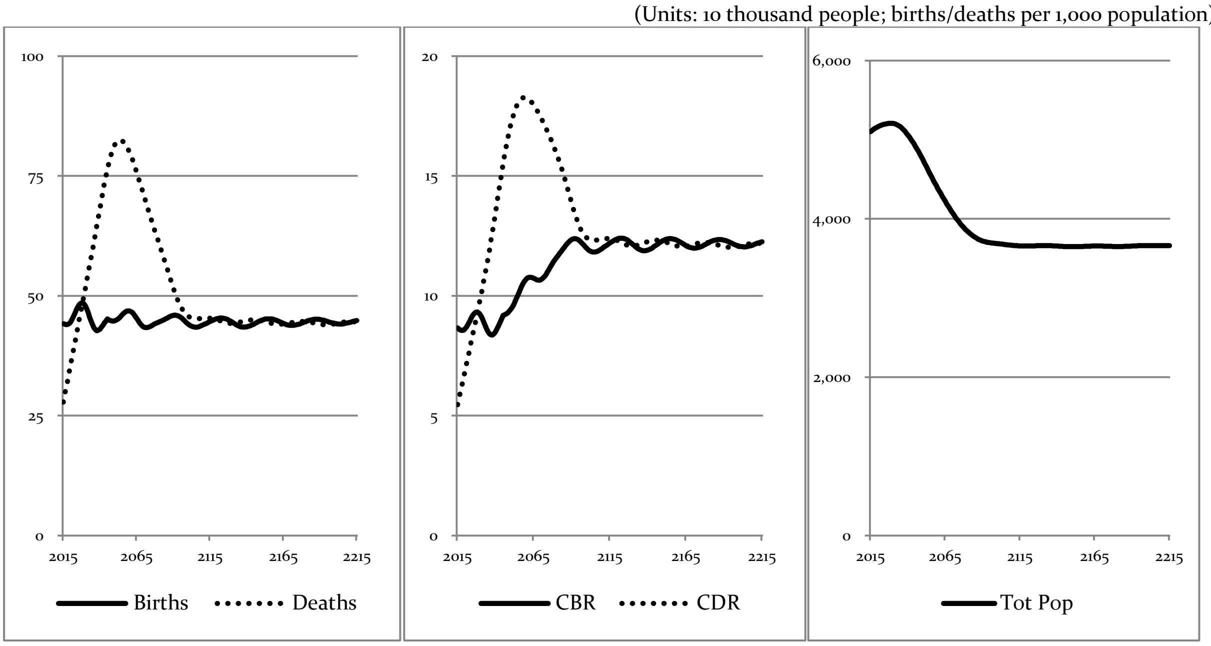
[6] Population momentum is an application of the stable population model, one of the fundamental tools used in mathematical demography. Stable population refers to an imaginary population that, with its age-specific fertility and mortality rates staying constant, either grows or shrinks over time at a constant rate. Population momentum assumes constant replacement-level fertility by which the population reaches a new equilibrium level where the sizes of different age groups remain stationary over time.

even if the fertility rate, having remained at sub-replacement levels for more than three decades, increases by leaps and bounds to the replacement level, what follows may well be a shrinking number of newborns, as those in childbearing age as a share of the population has been shrinking all along.

The population simulations in [Figure 2] show how, as the fertility rate increases over time to reach the replacement level (NRR=1) by 2045, as assumed in the Third Basic Plan on Low Fertility and Aging Society, the dynamics of births/deaths (left), crude birth rate/ crude death rate (middle), and the total population (right) will develop over time. As the simulations suggest, even if the fertility rate increases to reach the replacement level by 2045, the total population will decrease for a substantial period of time before plateauing (assuming zero net migration with stationary mortality).

[Figure 2] Process of population momentum (2015~2215)

(Units: 10 thousand people; births/deaths per 1,000 population)



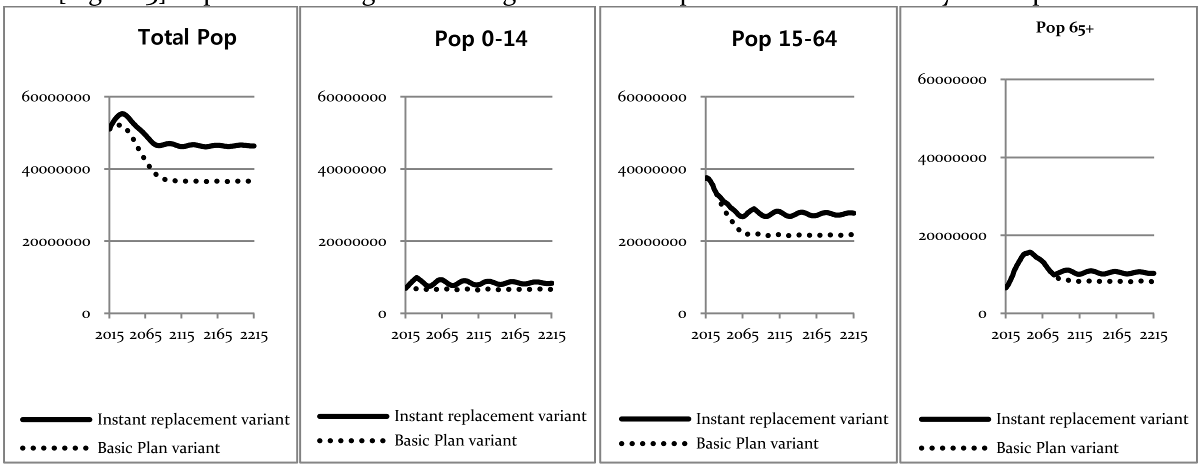
Note: Crude birth rate is the number of births per 1,000 mid-year population in a given year; crude death rate is the number of deaths per 1,000 mid-year population in a given year.

Replacement-fertility variant and the process of population momentum

In our decomposition of Statistics Korea's Population Projection estimates (medium variant scenario), we assumed that the fertility rate would increase immediately from its base-year level in 2015 to the replacement level (replacement-level fertility scenario). However, this is a highly unlikely scenario, considering that Korea's fertility rate has remained at "lowest-low" (sub-1.3) levels from the early 2000's on. It is worthwhile, then, to consider how population changes would play out with a slower increase in fertility rate.

[Figure 3] shows two different population simulations. One is the case of the fertility rate increasing instantly to the replacement level; in the other, the fertility rate rises more slowly to reach the replacement level in 2045. The total population is forecast to decline by some 9 percent in the first case and by as much as 28 percent in the second, from its baseline-year size in 2015. Considering that fertility rates in the advanced parts of the world have stabilized at sub-replacement levels, it may be too optimistic to assume that Korea's fertility rate will rise to reach the replacement level by 2045. It is highly likely, then, that the actual extent of population decline attributed to population momentum will be larger than is assumed based on the Basic Plan scenario. [Figure 3] also shows that the slower the recovery of fertility to the replacement level, the larger the extent to which the working-age population will decline.

[Figure 3] Population changes according to different replacement-level fertility assumptions



4. Conclusion

Population momentum and population policy

Despite the expected improvements in mortality rates and migration, the change the Korean Population has seen over the last three decades in its age structure will likely lead to a population decline in the long run. Furthermore, the longer it takes for the fertility rate to rise to the replacement level, the greater the extent of depopulation may be due to the combined effect of population momentum and low fertility. The effect of population momentum is making it harder for Korea to deal with the low-fertility predicament and its ramifications. Seen from another angle, the ongoing effect of population momentum bespeaks the importance of “timely” action. To be sure, even after many years of policy intervention, there has been little if any sign of fertility increase. This has put to question, to some extent at least, the effectiveness of policy interventions that are aimed at increasing fertility rate. But active policy responses to the current situation of “lowest-low” fertility remain crucial all the same, as, in the long run, the implications an increasing—albeit slowly and to a limited extent—fertility rate has for future population changes are widely different from the implications of a continuing “lowest-low” fertility rate.

Population policy in times of population decline

Unlike in the past, population decline observed today is accompanied by population aging, somehow making it all the more difficult to address population issues. Worse still, Korea is likely to see, in the process of population aging, not only the size of its elderly population grow, but also its working-age population rapidly decline. Therefore, policy considerations will need to be focused on the roles that certain groups, including older people and women, can play in contributing to sustainable development. As the impact of the population change Korea is to face in the future will likely go beyond the industrial and labor sectors to all social dimensions, the socioeconomic system will need to be aligned to respond to population decline.