Examination of future cohort fertility in Japan

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Introduction

National Institute of Population and Social Security Research (NIPSSR) in Tokyo, Japan, released striking results of their population projections for Japan in 2006-2055 (Kaneko et. al. 2008). According to their projections, the total population started to decline since 2005 and about 30% of the total population in 2005 will be lost in 50 years. During the same period, population aging accelerates unprecedented pace. The proportions of elderly population aged over-65 doubled from 20% in 2005 to 40% in 2055. As a result, Japan is and will continue to be the most aged society with a sizable population in the world.

What facilitates such a radical shrink and aging of population is a combination of the world highest life expectancy, continuing low fertility and a relatively low degree of migration inflow to the country. In a given assumption of low migration inflows in future Japan, prospects of future fertility ought to be responsible for the rapid developments of future Japanese population. According to the projection, cohort total fertility rate (CTFR) which is observed as 1.96 in the 1955 cohort, is estimated to decline steadily in successive cohorts and expected to converge at 1.20 in the 1990 cohort and onwards. In particular, it is expected in the 1990 and younger cohorts that 37% of women remain childlessness through their reproductive careers. This figure is tripled from the observed 1955 cohort. Will it be a real feature of Japanese families in the future?

This study reviews the latest official fertility projections for Japan and applies several alternative methods and assumptions to essentially the same data used for the official projections. This study explores which methods would better predict the future levels of CTFR. Not like the official fertility projection, however, this study projects fertility levels of only the 1960s and the 1970s cohorts who are currently well into the reproduction ages.

The fertility projection for Japan 2006-2055

In the latest fertility projection for Japan, CTFR is estimated by two-step procedure. First, censored part of cohort age-specific fertility rates (ASFR) are projected by generalized log gamma distribution model (GLG model) which is an extension of Coal-McNeil nuptiality model (Kaneko 1993, 2003). The model estimates ASFRs by birth order. Then, the estimated ASFRs are summed across reproductive ages to get total fertility rates of each birth order. CTFR is finally obtained by summing up these parity-specific total fertility rates.

As any other models of this kind, however, GLG model cannot estimate reliable CTFR when projected cohorts are so young that their reproductive histories do not have enough data points. It is

said that GLG model can accurately estimate age pattern of first birth if a cohort reaches at age of 30. The same is true for the 4th and higher ordered birth at age of 34. They correspond to the 1975 and the 1971 cohort, respectively, in the latest projection which is based on the 2005 population. Therefore, the projection system has to predict fertility schedule (ASFR by parity) of the younger cohorts than the 1971-1975 cohort by making reasonable assumptions.

In the second stage, therefore, another projection method is used to estimate CTFR for the 1990 cohort as a target cohort which levels of CTFR attenuate to a constant level. ASFRs by parity for younger cohorts than 1971-1975 are assumed to gradually converge to the CTFR of the 1990 cohort by fitting mathematical curves from logistic and sigmoid functions. The younger cohorts than the 1990 cohort are also assumed to have more or less the same levels of CTFR as the 1990 cohort. In this way, the projection system can get stable estimates of fertility schedule for cohorts younger than 1971-1975 cohorts. In the latest projection, the 1990 cohort is called a reference cohort. CTFR of a reference cohort is estimated as following;

$$CTFR = (1-\gamma) * CEB * \delta$$
$$= (1-\gamma) * (CEB^{*}(afm) * \kappa) * \delta .$$

γ: Proportion of Never-married at age 50, CEB: Couple's completed fertility
δ: Effects of divorce, widowhood, remarriage and extra marital birth
CEB*(afm): Expected couple's completed fertility from mean age at first marriage (afm)
κ: Coefficient of marital fertility change

The projection model first estimate γ, proportion of never-married at age 50 and afm, mean age at first marriage from an extended version of Coal-McNeil nuptiality model which is the same model as the one used in the first step of the projection (Kaneko 1993, 2003). Age-specific first marriage rates for future cohorts are extrapolated by fitting double exponential function to the age-specific hazard rates of first marriage. Then, the system estimates the completed fertility of first married couples, CEB from age at first marriage. The parameter κ allows correlations between first marriage and marital fertility to be changed by cohort. On the other hand, the effects of divorce, widowhood, remarriage and extra marital birth are rather treated as residuals and assumed to have a proportional effect on CTFR, which can vary across cohorts[1].

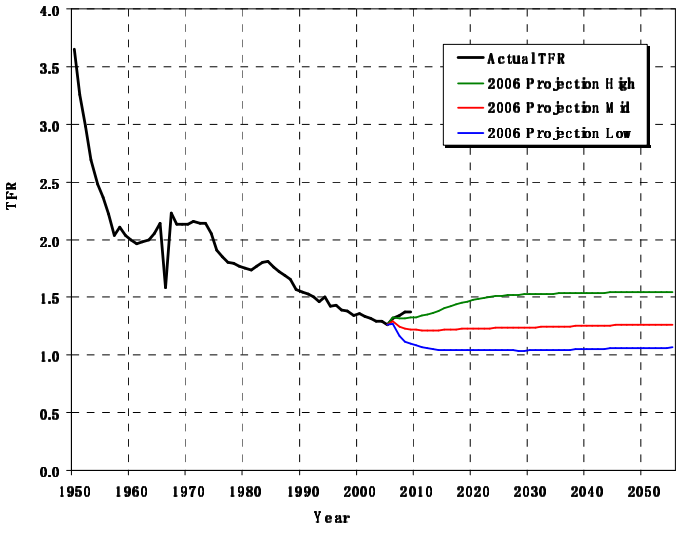
As it is shown, the second part of fertility projection is conditional on the timing and occurrences of first marriage. Thereafter, the system determines precise relationships between nuptiality and marital fertility based on empirical data such as census, vital statistics and nationally representative survey data. The projection system is elaborate since it follows behavioral interpretations of past and current Japanese fertility, e.g. more than 97% of total birth occurs among

[1] In the projection, δ changes from 0.952 in the observed 1955 cohort to 0.925 in the 1990 cohort.

married couples since the 1970s. It also makes possible to project several nuptiality and fertility indices such as proportion of life-time celibacy, mean age at first marriage, marital fertility and its changing parameter over cohorts. These indices can inform intuitively how levels of CTFR are determined by other demographic behaviors. They can also serve for other types of simulation purposes.

On the other hand, the determination system of the 1990s cohort TFR has a number of points to argue. First, incorporating first marriage induces more assumptions on fertility forecast, e.g. proportions of extra-marital birth, effects of divorce, bereavement and remarriage, and its changes over time. For example, divorce is increasing in younger marriage cohorts in Japan. It is expected that roughly one third of first marriage may end in divorce among those who married in 2002 (Raymo, Iwasawa and Bumpass 2004). It is extremely difficult to foresee the trend of divorce and remarriage as well as the effects of these events on fertility of the future cohorts. Furthermore, instead of non-marital childbearing, pre-marital pregnancy is rapidly increasing in Japan. The vital statistics show that 26.7% of first birth is followed by conceptions in 2004 (Ministry of Labour, Health and Welfare 2006). Therefore, even if the proportion of extra-marital birth is still low, a part of first marriage is not a cause of (first) birth but a consequence of it. This might induce a different pattern of nuptiality and marital fertility from previous cohorts. In sum, the current projection system is very precise and sophisticated but may be less flexible for future changes in marriage and fertility.

Figure 1. Trends of TFR and Projected TFR in the Past Projections



In fact, the projected fertility has been showing slight divergence from the actual period TFR (PTFR) in the past three years. Figure 1 displays the trends of PTFR and projected PTFR in the

current projection[2]. After reaching the recorded low at 1.26 in 2005, PTFR in Japan has been rising in 2006-2008. As a result, the actual PTFR reached at 1.37 in 2008 while the predicted value from the mid-variant projection is 1.23 in the same year. Although how such an increase in period TFR affects cohort TFR should be carefully examined, this discrepancy might imply that the latest fertility projection could not incorporate the recent changes in the patterns of nuptiality and fertility which might upward the levels of fertility in later cohorts.

Data and Method

This study explores the future levels of cohort fertility in Japan by applying an alternative method which may be less elaborate but more flexible in assumptions on the future relationship between nuptiality and fertility.

First, the study uses the data from cohort ASFR by parity which is essentially the same as the latest projection, but includes the latest fertility data beyond 2005 which corresponds to the period increase in TFR shown in Figure 1. In the first part of projection, Coal-McNeil nuptiality model with the generalized log gamma distribution, suggested by Kaneko (1993, 2003), will be employed to cohort ASFRs by parity to estimate fertility schedules of censored cohorts with reasonable data points.

In general, the study proposes less elaborate but more flexible methods to project future fertility in Japan where rapid changes are taking place in nuptiality and fertility behaviors. By comparing the results from the latest fertility projection, the study re-examines possible fertility trajectories of future Japan.

References

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[2] Although the projection model is to estimate CTFR, PTFR is obtained by decomposing projected CTFR into single-age and single-year fertility rates and reconstructing the rates as a period measure.