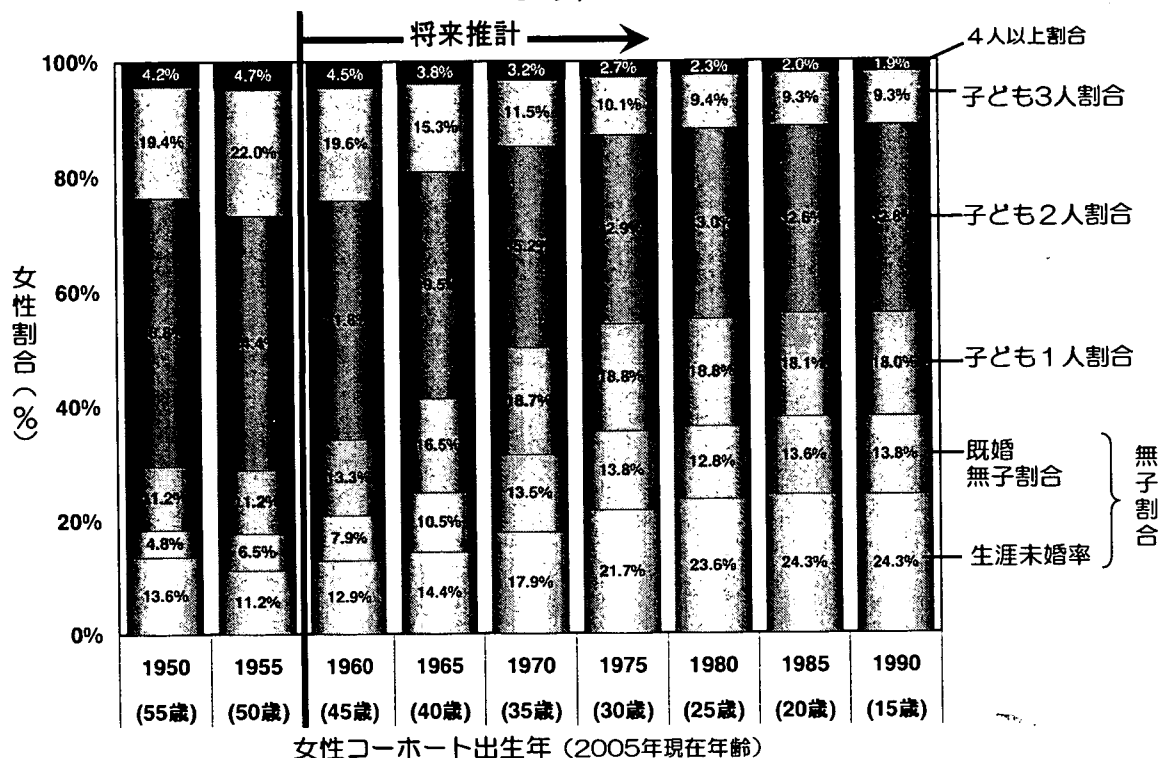


図1 コーホート別にみた女性の子ども・孫を持たない割合（出生中位仮定より）



同様に生涯無子割合を見ると、1950年、55年コーホートの実績値18.4%、17.7%からしだいに上昇し、90年コーホートでは38.1%に達している。また、生涯出生子ども数が1人の割合は、55年コーホートの11.2%から90年コーホート18.0%へ増加し、2人の割合は逆に44.4%から32.8%へと縮小する。図1には、この生涯出生子ども数の分布をコーホートごとに描いた。主に生涯未婚率の上昇によって無子割合が増大し、これまで半分弱を占めていた2人が減少し、90年世代では1/3を下回る割合となる。

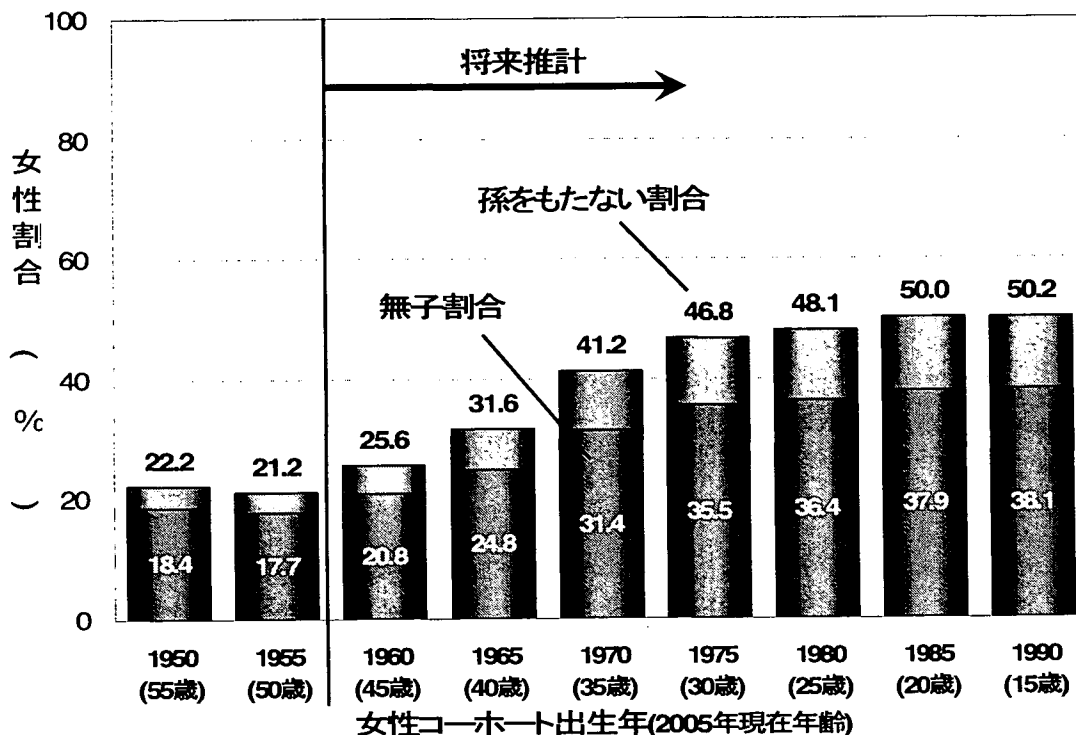
表2、図2には、無子割合に加え、孫をもたない女性の割合も示した。出生した子どもがいない女性は、孫以降の直系子孫もいないことになるが、子どもを持った女性でもその子ども（たち）が孫世代を出生するとは限らない。ここでは子世代も1990年生まれ世代と同様の出生仮定に従って結婚、出生をすることで孫の有無の確率を算出した³。その結果によると、50年、55年世代の実績では孫をもたない女性は、およそ5人に1人の割合だが、続く世代ではしだいに増えて行き、85年世代以降になると約50%の女性が孫をもたないことになる。すなわち、現在の日本人の生存状況と子どもの生み方を趨勢も含めて将来世代に投影すると、現在20歳より若い世代の女性では、2人に1人は孫以降の直系子孫をもたないという結果になる。こうした世代では従来のような家族同居の生活様式は一変するに違いない。これまで社会経済に対して家族が果たしていた機能は大幅に弱まるだろう。と

³ 子世代の男性も同様の仮定とした。

りわけ、彼らが高齢となっていったとき、縮小した家族・親族ネットワークの中で、従来それが担ってきた経済支援、介護等の助け合いの役割はどのように補われるのだろうか。

このような傾向は、本推計を基に行われた世帯数の将来推計によって、高齢者の単独世帯の増加としても捉えられている。「日本の世帯数の将来推計」では、2030年までのわが国の世帯動態が明らかにされており⁴、それによると今後の25年間で世帯主65歳以上の単独世帯は378万世帯から717万世帯へと86%増加する。しかも世帯主75歳以上でみると、197万世帯から429万世帯へと2.18倍に増大し、後期高齢者による独居が倍増する見通しとなっている。

図2 コーホート別にみた女性の子ども・孫を持たない割合（出生中位仮定より）



3. 結婚・出生に関する生存期間の内訳

つぎに、出生・死亡仮定から作成された多相生命表によって、女性の結婚・出生に関わる状態の生存期間の構成を見たい（表3、図3）。これは、平均寿命で表される各世代の生存期間のうち、未婚期間、子どものいない期間などの内訳を表すもので、いわば人生の使い方を知ることができる。これによるとすでに50歳に達している1950年、55年生まれコーホートでは、当時の乳幼児期の死亡率の高さを反映して平均寿命はそれぞれ80.8年、84.2年となっている。この中で未婚期間はそれぞれ25.3年、27.2年であった。したがって、未

⁴ 前掲脚注2).

婚期間の平均寿命に占める割合は 31%、32%と人生の 1 / 3 弱を占めていた。その後のコ
ーホートでは、平均寿命は 1990 年生まれ世代の 89.8 年まで順次伸長し、未婚期間では同世
代で 42.5 年、寿命に占める割合は 47%と半分弱までに増大している⁵。

表3 コーホート別にみた女性の未既婚・子ども数の生存期間と
平均寿命に占める期間の割合

(年)

	女性の生まれ年								
	実績		推計						
	1950	1955	1960	1965	1970	1975	1980	1985	1990
結婚・出生状態別期間									
平均寿命	80.8	84.2	86.1	87.6	88.4	89.0	89.4	89.6	89.8
平均未婚期間	25.3	27.2	30.5	33.2	36.6	39.8	41.5	42.4	42.5
平均無子期間	29.5	32.5	36.5	40.9	46.0	49.2	50.2	51.4	51.7
平均子ども1人期間	38.3	41.2	46.4	52.5	58.7	61.8	62.7	63.5	63.7
平均子ども2人期間	67.1	68.7	72.1	76.5	79.9	81.6	82.6	83.1	83.4
平均子ども3人以上期間	78.5	81.5	83.6	85.5	86.7	87.5	88.1	88.5	88.8
平均既婚期間	55.4	57.0	55.6	54.3	51.8	49.2	47.8	47.3	47.3
平均有子期間	51.2	51.7	49.6	46.7	42.4	39.8	39.2	38.2	38.1

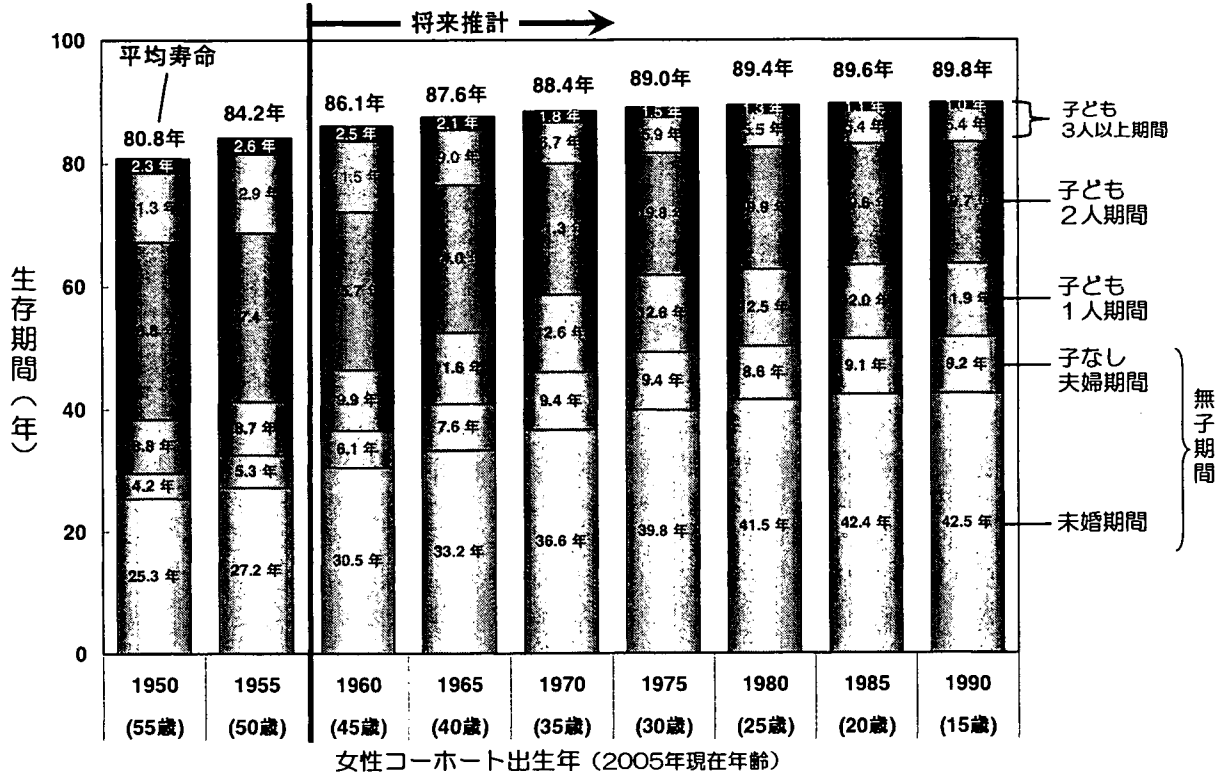
(%)

結婚・出生状態別期間割合									
平均寿命	100	100	100	100	100	100	100	100	100
平均未婚期間割合	31	32	35	38	41	45	46	47	47
平均無子期間割合	37	39	42	47	52	55	56	57	58
平均子ども1人期間割合	47	49	54	60	66	69	70	71	71
平均子ども2人期間割合	83	82	84	87	90	92	92	93	93
平均子ども3人以上期間割合	97	97	97	98	98	98	99	99	99
平均既婚期間割合	69	68	65	62	59	55	54	53	53
平均有子期間割合	63	61	58	53	48	45	44	43	42

これらの数値は、個人のライフコースというより、各世代の集団としてのライフコース
とみる方が適切であろう。すなわち、1990 年生まれの女性世代は、生涯に結婚するもし
ない人も含んでいるが、世代全員の生きる人生を総合すると、その 47%を未婚として過
すことを示している。同様に、子どもを持たない期間の平均は 51.7 年で、この女性世代
の人生の 58%は子どもを持たずに過ごす。図 3 によれば、女性の生涯にしめる未婚期間なら
びに無子期間が、若い世代ほど増大して行く様子がわかる。そして、子どもを 1 人でも持
ち、ともに生きる期間は、1955 年世代の 51.7 年、61%から、1990 年世代の 38.1 年、42%
に縮小する。こうした数値からも、今後わが国が経験する結婚や家族というものの変容の
実相がうかがえる。

⁵ ただし、ここでも 50 歳以降は結婚も出生も起こらないと仮定している。

図3 コーホート別にみた女性の生存期間（平均寿命）の内訳



おわりに

ここで行ったように初婚率、出生率、死亡率などの動態率に関する将来人口推計の仮定値から、人々のライフコース像を描き出して示すことは、仮定値の意味をより鮮明に示し、一般における推計への理解に役立つと期待される。とりわけ、ここでは年次的に推移する出生率の仮定値（ほぼ横ばいである）からは、読み取ることの難しい厳しい想定が明らかとなっているだろう。急速な人口減少、人口高齢化として知られるマクロ的変化の奥深い内側で、人々のライフコースの歴史的な変容が同時に進行していることは十分に理解しておかなくてはならない。

(2) Population Prospects of the Lowest Fertility with the Longest Life: The New Official Population Projections for Japan and their Life Course Approaches*

Ryuichi Kaneko**

Abstract

In this paper, first I briefly discuss the results and methods of the new round of the official Population Projections for Japan released in December 2006. They provide a sketch of expected demographic changes over a 50 year period from 2006 to 2055. The eventual total fertility rate is 1.26 (ranging from 1.06 to 1.55), and the female life expectancy is 90.3 (ranging from 89.2 to 91.5). As a result, the population is expected to fall by 30% by 2055, and the proportion of the elderly is to rise up to as high as 40.5%, which is twice the 20.2% of 2005, already the world's highest. The projections are unique not only in showing the world's lowest fertility assumptions with the highest life expectancy, but also in their sophisticated life course approach in constructing assumptions on vital rates. Through this framework, they provide measures for the projected life of women via the multistate life table techniques applied to the projected population. For instance, life time probability of childlessness and having no grandchildren are estimated as 38.1% and 50.2%, respectively, in cohorts born in 1990. The average life time spent in never married status increases to 42.5 years (or 47% of the life expectancy) in cohorts born in 1990 from 25.3 years (31%) in those born in 1950. These measures indicate that long, but less-reproductive and non-familial lives prevail among new generations, resulting in a drastic increase in elderly who have no offspring or family in the current sense.

Introduction

In this paper, first I discuss the results and methods of the new round of the official Population Projections for Japan released in December 2006. They provide a sketch of expected demographic changes over a 50 year period from 2006 to 2055, indicating a persuasive view that a substantial population decline with unprecedented population aging is an unavoidable part of the future of the society. The projections are unique not only in showing the world's lowest fertility assumptions with the highest life expectancy, but also in their sophisticated life course approach in constructing assumptions on vital rates. In this connection, I attempted to construct the multistate life table for the projected life of Japanese women to obtain their life course measures mainly by ultimate family status. The measures include life time probability of never marrying, childless, having no grandchildren and so on. The probabilities incorporate incidences from premature death before the events. The average life time spent in each family status such as never married state, childless state,

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and only-child state, are also examined. For example, the life time probability of childlessness and having no grandchildren are 38.1% and 50.2% respectively in cohorts born in 1990. They were 18.4% and 22.2% in cohorts born in 1950. As well, the average life time spent in never married status increases to 42.5 years (or 47% of the life expectancy) in cohorts born in 1990 from 25.3 years (31%) in those born in 1950. These changes set off a drastic increase in the near future of elderly who do not have offspring to live with or rely on in this society. I also briefly discuss possibilities for the life course approach to be the basis of the next framework of population projection.

Population Prospects

Based on the results of the 2005 population census and the newly obtained vital statistics, the National Institute of Population and Social Security Research announced a new population projection for Japan in December 2006. In this section, the outlines of this projection are briefly explained.

The projection covers the total resident population of Japan which is also the target population of the Census. The projection starts from the population at the time of the 2005 Census, and covers the period up to 2055, enumerating the population as of October 1 each year. It also includes calculations of the population up to 2105 in order to examine the long term demographic development assuming constant vital rates at the level of 2055.

The population (classified by sex and year of age) is projected through the cohort component method with assumptions on vital events and international migrations based on the past statistical trends. Because of the uncertainty in future movements of birth and death, three assumptions are made for each factor to produce a range of forecasts for the future population by means of nine variants, i.e. 3 x 3.

The assumed total fertility rate in 2055 is 1.26 for the medium fertility variant, 1.55 for the high variant, and 1.06 for the low variant. These are a set of the world's lowest fertility assumptions for official population projections. The life expectancy at birth in 2055 is 90.34 years and 83.67 years respectively for females and males for the medium mortality variant, 89.17 years and 85.41 years for the high variant, and 91.51 years and 84.93 years for the low variant. These are the mortality assumptions of the world's highest life expectancy.

When the results of the medium fertility variant are combined with the medium mortality level, the total population is projected to fall from 127.8 million in 2005 to 89.9 million in 2055 (Table 1, Figure 1). This is a loss of 37.8 million or 30% of the initial population. Initially, the decline takes place slowly, but after 2039 it accelerates to a pace of more than one million every year. The population changes that occur over the 50 year period are significantly unevenly distributed across age groups. The age group under 15 reduces by 10.1 million, the working age group (age 15 to 64) by 38.5 million, while the group of the elderly, aged 65 and over, increases by 10.7 million. The uneven changes of the three age groups results in an age structure that is totally different from the starting population. In 2050, the proportion of children under 15 is down to 8.4 per cent from 13.8 per cent in 2005. The working age group 15 to 64 is reduced to 51.1 per cent from 66.1 per cent in 2005. And the proportion of the elderly doubles from 20.2 per cent in 2005 to 40.5 per cent during the next 50 years (Table 1, Figure 1, see also Figure 2).

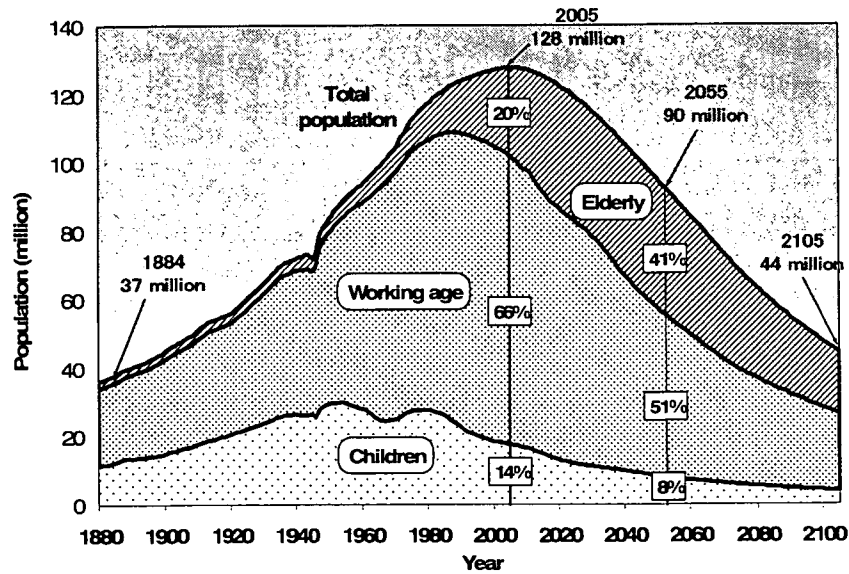
Table 1 Projected Future Population and Proportion by Age Group, 2005-2105:
the Variant with Medium-Fertility, Medium-Mortality Assumptions

Year	Population in 1,000			Proportion (%)			Dependency ratio (%)			
	Total	0-14	15-64	65+	0-14	15-64	65+	Total	Child	Old-age
2005	127,768	17,585	84,422	25,761	13.8	66.1	20.2	51.3	20.8	30.5
2010	127,176	16,479	81,285	29,412	13.0	63.9	23.1	56.5	20.3	36.2
2015	125,430	14,841	76,807	33,781	11.8	61.2	26.9	63.3	19.3	44.0
2020	122,735	13,201	73,635	35,899	10.8	60.0	29.2	66.7	17.9	48.8
2025	119,270	11,956	70,960	36,354	10.0	59.5	30.5	68.1	16.8	51.2
2030	115,224	11,150	67,404	36,670	9.7	58.5	31.8	70.9	16.5	54.4
2035	110,679	10,512	62,919	37,249	9.5	56.8	33.7	75.9	16.7	59.2
2040	105,695	9,833	57,335	38,527	9.3	54.2	36.5	84.3	17.2	67.2
2045	100,443	9,036	53,000	38,407	9.0	52.8	38.2	89.5	17.0	72.5
2050	95,152	8,214	49,297	37,641	8.6	51.8	39.6	93.0	16.7	76.4
2055	89,930	7,516	45,951	36,463	8.4	51.1	40.5	95.7	16.4	79.4
2060	84,592	6,987	42,778	34,827	8.3	50.6	41.2	97.7	16.3	81.4
2070	73,488	6,158	36,325	31,005	8.4	49.4	42.2	102.3	17.0	85.4
2080	63,387	5,304	31,505	26,578	8.4	49.7	41.9	101.2	16.8	84.4
2090	54,925	4,600	27,674	22,651	8.4	50.4	41.2	98.5	16.6	81.8
2100	47,712	4,093	24,144	19,475	8.6	50.6	40.8	97.6	17.0	80.7
2105	44,592	3,856	22,631	18,105	8.6	50.8	40.6	97.0	17.0	80.0

Source: NIPSSR(2006), *Population Projection for Japan: 2006-2055*, the medium-fertility and medium-mortality variant. The results for the period 2056-2105 are ancillary calculation with constant vital rates as of 2055.

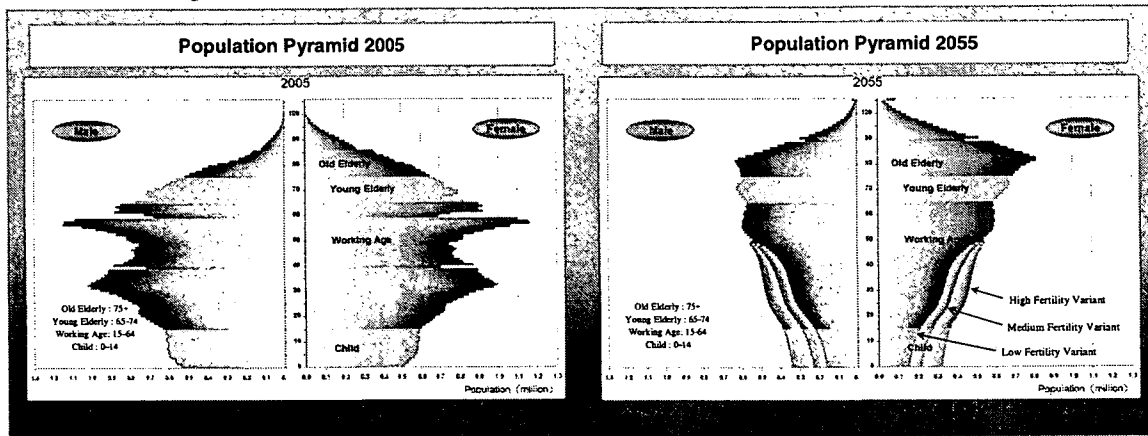
The amount of population loss over the 50 years ranges from 28.2 million in the high fertility with low mortality-variant to 45.4 million in the low fertility with high-mortality -variant. The proportion of elderly ranges from 36.3 per cent in the high fertility with high mortality-variant to 44.4 per cent in the low fertility with low mortality-variant. The ancillary calculation of the population in 2105 with vital rates assumed constant at the 2055 level is 44.6 million or 35 per cent of the initial population in the medium fertility with medium mortality-variant. The assumption of low fertility combined with high mortality results in the smallest total population of 33.6 million or 26 per cent of the starting population, while the result of the high fertility with low mortality-variant is the largest at 62.7 million or 49 per cent of the 2005 population size.

Figure 1. Growth and Reduction of Population of Japan: 1880-2105



Source: Ministry of Internal Affairs and Communications, Statistics Bureau, *Census*, NIPSSR(2006), *Population Projection for Japan: 2006-2055*, the medium-fertility and medium-mortality variant..

Figure 2. Population Pyramids of Japan: Present and Fifty Years Later



Source: Statistics Bureau, *Census 2005*, NIPSSR (2006), *Population Projection for Japan: 2006-2055* (three fertility variants with medium-mortality).

Assumptions

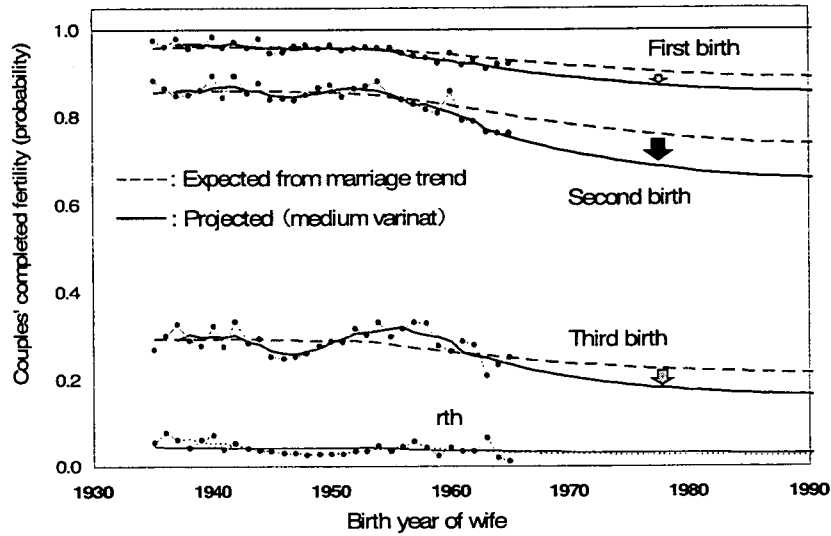
This unprecedented population comes out from assumptions of the world's lowest fertility prospects combined with the longest life expectancy. The eventual total fertility rate is 1.26 (ranging from 1.06 to 1.55), and the female life expectancy 90.3 (ranging from 89.2 to 91.5). How could it be possible for fertility to remain so low for a period of some 50 years? How could the life expectancy be highest?

Fertility Assumptions

Fertility assumptions underlying the projection were made on the basis of the cohort-fertility method, or the life course approach. That is a statistical projection of the level of completed fertility and the birth timing of each female birth cohort including those who have not yet completed their reproductive processes. Future annual age-specific and total fertility rates, which are required for the projection with the cohort component method, can be obtained by converting the cohort rates into the period rates. The age-specific fertility rates of cohorts were estimated or assumed separately by birth order using models with parameters for lifetime birth probability, birth timing and some other traits of the process.

For cohorts that had completed a substantial part of their reproductive processes, the entire processes were constructed by estimating the parameters of an empirically adjusted mathematical model through a statistical method (described later). For younger cohorts for which scant or no data were available, the fertility schedules are generated through reconstruction of reproductive life course formed by such behaviors as marriage and marital childbearing. Assumptions are set up with the following four parameters of reproductive behaviours; (1) the mean age at first marriage, (2) the proportion of never married, (3) the completed number of births from married women, and (4) the coefficient of divorce, bereavement and remarriage. Each of the parameters is projected according to trend derived from recorded data compiled for cohorts so that the completed life courses of future generations are assembled. For example, estimates and prospective trends of couple's birth probabilities by birth order, which sum up to (3) the average completed number of births from the couple, is illustrated in Figure 3. In the figure, the broken lines indicate trends of the expected life time probabilities of having a child of each birth order for first marriage couple resulted only from changes in marriage pattern. They show somewhat downward trend reflecting the trend of marriage delay. The solid lines indicate trends of the probabilities in medium fertility assumption in which the reductions from changes in couple's reproductive behaviors in addition to marriage delay are taken into account according to the observed trends through the national fertility surveys. For more information on the construction of fertility assumptions, see elsewhere (Iwasawa and Kaneko 2007).

Figure 3. Expected and Prospective Trends of Couple's Probability of Having Birth of Each Order by Wife's Birth Year



Source: NIPSSR (2006), the Thirteenth National Fertility Survey, 2005.

The assumptions on those four parameters of the female cohorts born in 1990 are shown in Table 2 for three alternative projection variants, i.e. Medium, High and Low¹. All of the assumed values of the components change to the same direction for fertility reduction even in the high variant, resulting in substantial decreases of the total fertility rate (TFR)².

Table 2 Assumptions for Measures of Fertility Components and Total Fertility Rates for the Reference Cohort (born in 1990)

Measures of Fertility Components	Observed: hort born in 1955	Assumptions of Population Projection: hort born in 1990		
		Medium	High	Low
(1) Mean age at first marriage	24.9	28.2	27.8	28.7
(2) Proportion never married at age 50	5.8 %	23.5 %	17.9 %	27.0 %
(3) Couples' completed fertility	2.16	1.70	1.91	1.52
(4) Effect of divorce, widowhood and remarriage	0.952	0.925	0.938	0.918
Cohort Total Fertility Rate (Japanese women)	1.94	1.26 (1.20)	1.55 (1.47)	1.06 (1.02)

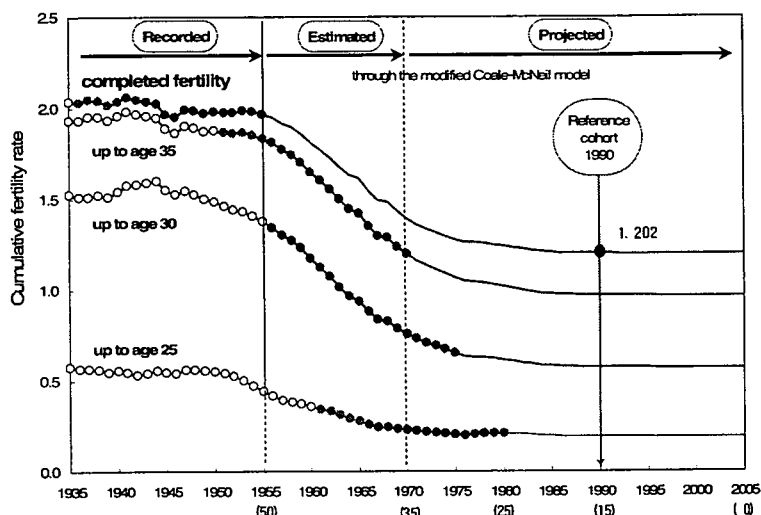
The parameters are translated into fertility schedules separately by birth order through a demographic model called the Generalized Log-gamma model (an extension of the Coale-McNeil model) with empirical adjustments specific to unique Japanese patterns (Kaneko, 2003). The resulting cohort trends of the cumulative fertility rate are shown in Figure 4 in the solid lines along

¹ The cohorts born in 1990 served as a reference whose values of parameters were most carefully examined.

² This construction is applied only for Japanese women. The fertility rates of women with foreign nationalities are produced in relation to those of Japanese, using the observed relationships to be fixed for the future.

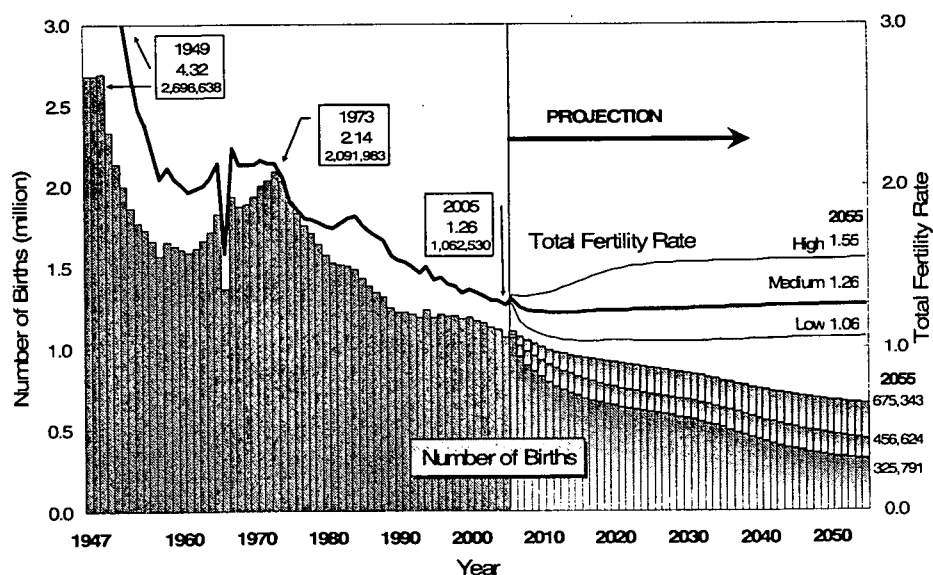
with the recorded values represented by dots. As stated above, these cohort fertility rates were converted into the period fertility rates as assumptions of the cohort component procedure. The transitions of assumed TFR are shown in Figure 5 along with projected number of births which exhibit extensive reductions.

Figure 4. Recorded and Projected Cohort Trends of the Cumulative Fertility Rate at Selected Age: 25, 30, 35, and Completed (Age 50)



Source: NIPSSR (2006), Population Projection for Japan: 2006-2055 [the medium-fertility assumption].

Figure 5. Number of Births, and Total Fertility Rate in Japan Trends and Prospects: 1947-2055



Source: Ministry of Health, Labor and Welfare, *Vital Statistics*. NIPSSR (2006), *Population Projection for Japan: 2006-2055* (the three fertility variants with medium-mortality assumption).

The assumption building through estimation and projection of cohort measures of life course components of fertility in the projections enables us to construct the projected life course in relation to the relevant life events. I constructed the multistate life tables for the projected life by family status. Those are examined in the next section. The results indicate that less-reproductive and non-familial lives prevail among today's young and future generations, reflecting rapid transformation of partnerships and family formation patterns observed in the current cohorts.

Mortality Assumptions

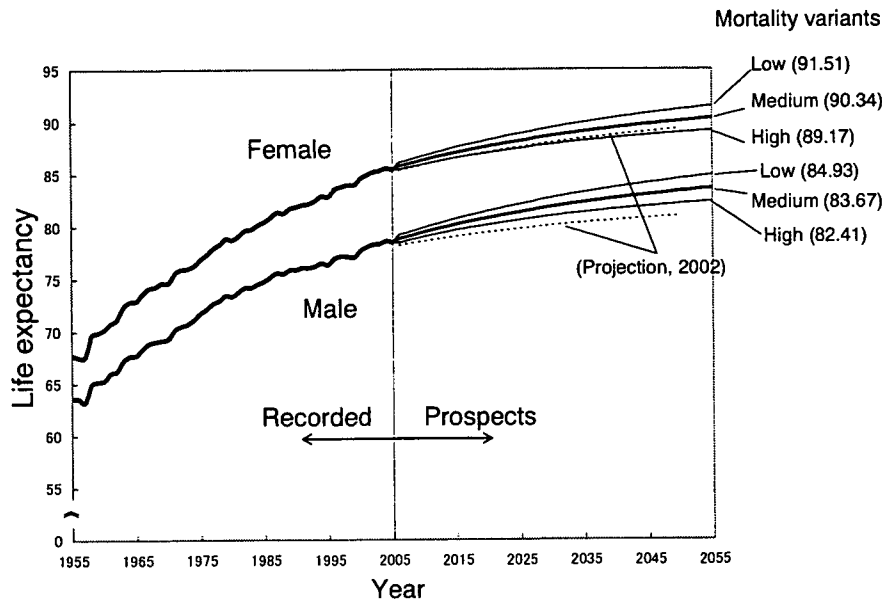
The Lee-Carter model was adopted as a basis to construct future annual life tables. The procedure is, however, modified by introducing a new technique called the shifting logistic model method (Bongaarts 2005), which identifies improvements in the mortality rates as shifts of the aging process toward older ages. This modification is a reflection of the actual mortality trend observed in Japan as a continuing gain of life expectancy especially in old ages. Combining the Lee-Carter model with the shifting logistic model is considered to be a better way of accounting for this trend, and in fact exhibits more sensible age patterns of future mortality than those from the Lee-Carter model alone.

Because of the unpredicted life expectancy gains in recent years of low mortality countries including Japan (Oeppen and Vaupel 2002, Tuljapurkar et al. 2000), a higher degree of uncertainty was anticipated for the future of mortality. This was coped with by making multiple assumptions just like those in fertility. The high and low variants of mortality, however, are derived from the boundaries of the 99 per cent confidence interval of the mortality level parameter of the Lee-Carter model (denoted by k_t in the original formulation).

According to the principal future life tables or the medium variant assumption of mortality, the life expectancy, which in 2005 was 78.53 years for males and 85.49 years for females, is expected to extend to 79.51 years for males and 86.41 years for females by 2010, 81.88 years for males and 88.66 years for females by 2030, and to 83.67 years for males and 90.34 years for females in 2055.

The assumed mortality rate for the high mortality variant will be higher, and consequently the life expectancy will be shorter than for the medium variant. According to this assumption, the life expectancy in 2055 will be 82.41 years for males and 89.17 years for females. Similarly, in the low mortality assumption, the mortality rate will be lower, and therefore the life expectancy will be longer than in the medium variant. The life expectancy by 2055 according to this assumption will be 84.93 years for males and 91.51 years for females. The assumed course of life expectancies is shown in Figure 6.

Figure 6. Trends and Prospects of the Life Expectancy: 1955-2055



Source: Ministry of Health, Labor and Welfare, *the Abridged Life Table*. NIPSSR (2006), *Population Projection for Japan: 2006-2055*.

Life Course Construction

The life-course construction is a characterized approach employed in the projection for Japan since the 1990's. It requires a good deal of quality data and a somewhat complicated model system. Series of the census, vital statistics, and micro data from national representative fertility surveys were brought together into play in the construction of fertility assumptions. It is often the case with population projection that excessive complications do not contribute to accuracy. However, our experience indicates that complexity to some extent would serve, since it provides detailed information on the way life of the future could be. It offers many distinct traces to improve the models through monitoring and contrasting the actual drift of the measures with those projected. In addition, it contributes to fulfilling accountability on preposition of the projections to the public. I briefly discuss the roles, uses, prospects and some limitations of the approach as well.

I attempted to construct the multistate life table for the projected life of Japanese women to obtain their life course measures mainly by ultimate family status. The measures include life time probability of never marrying, childless, having no grandchildren and so on. The probabilities incorporate incidences from women's immature deaths before the events. Average life time spent in each family status such as never married state, childless state, and only-child state, are also examined.

In Table 3, the woman's life time probabilities and distributions by family status are indicated for female birth cohorts born in every five years since 1950 through 1990. The cohorts born in 1950 and 1955 had completed their reproductive life processes by the time of projection, thus their figures are regarded as actually recorded. On the other hand, the cohorts born in 1960 and after have not yet completed the processes, and their figures are all for projected life by the assumption based on the trends of relevant parameters, though length of the projected period varies by cohort to cohort in

relation to their age at projection.

Life time probability of a woman who is eventually marrying, assessed at her birth, is 86.4% for anyone among cohorts born in 1950. The figure gradually decreases from one cohort to the next until 75.7% for a woman born in 1990. These figures are somewhat lower than those calculated from the nuptiality rate among the fertility assumption, since the former includes effects from premature death before marriage.

The probability of never marrying, childlessness and having no grandchildren are 24.3%, 38.1% and 50.2% respectively in cohorts born in 1990 (see also Figure 7). If compared with those in preceding cohorts, these figures indicate rapid prevalence of less-reproductive and non-familial life styles toward an unprecedented level in this society.

Average life times spent in certain family status for female cohorts born in 1950-90 are presented in Table 4, with their proportion in the life expectancies. For instance, the average life time spent in never married status increases to 42.5 years (or 47% of the life expectancy) in cohorts born in 1990 from 25.3 years (31%) in those born in 1950. Figure 8 illustrates that the amount of life spent in never married state will drastically increase for Japanese women of young generations.

The changes in woman's life course cause tectonic movements in population composition as well. In Table 5 and Figure 9, I indicated the composition of female population by family status at three chronological times, year 2005, 2030, and 2055. They give us a manifest view that these life course changes observed above initiate the drastic increase of elderly who do not have any offspring in this society of the near future. 30.9% of women age 65 and higher do not have children in 2055, and 8.0% in 2005. Although only the situations for women are indicated here, the view should be expanded over the whole nation.

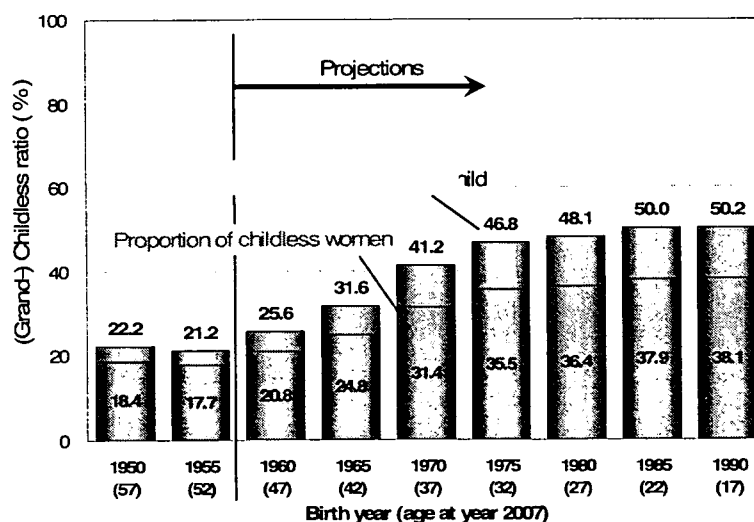
Table 3 Woman's Life Time Probabilities and Distributions by Family Status: Perspectives from the Medium Variant for Cohorts Born in 1950-90

(%)

	Birth year of woman's cohort								
	Recorded		Projected						
	1950	1955	1960	1965	1970	1975	1980	1985	1990
Life time probability of woman ... (at birth)									
Marrying	86.4	88.8	87.1	85.6	82.1	78.3	76.4	75.7	75.7
Having 1st birth	81.6	82.3	79.2	75.2	68.6	64.5	63.6	62.1	61.9
Having 2nd birth	70.4	71.1	65.8	58.6	49.8	45.7	44.8	43.9	43.9
Having 3rd birth	23.6	26.7	24.1	19.1	14.7	12.8	11.7	11.3	11.2
Having 4th and higher birth	4.2	4.7	4.5	3.8	3.2	2.7	2.3	2.0	1.9
Never marrying	13.6	11.2	12.9	14.4	17.9	21.7	23.6	24.3	24.3
Childless	18.4	17.7	20.8	24.8	31.4	35.5	36.4	37.9	38.1
Never having 2nd child	29.6	28.9	34.2	41.4	50.2	54.3	55.2	56.1	56.1
Never having 3rd child	76.4	73.3	75.9	80.9	85.3	87.2	88.3	88.7	88.8
Never having 4th child	95.8	95.3	95.5	96.2	96.8	97.3	97.7	98.0	98.1
Life time distribution of woman by number of child (at birth)									
Childless	18.4	17.7	20.8	24.8	31.4	35.5	36.4	37.9	38.1
Never married	13.6	11.2	12.9	14.4	17.9	21.7	23.6	24.3	24.3
Ever married	4.8	6.5	7.9	10.5	13.5	13.8	12.8	13.6	13.8
Only child	11.2	11.2	13.3	16.5	18.7	18.8	18.8	18.1	18.0
Two children	46.8	44.4	41.8	39.5	35.2	32.9	33.0	32.6	32.8
Three children	19.4	22.0	19.6	15.3	11.5	10.1	9.4	9.3	9.3
Four and more children	4.2	4.7	4.5	3.8	3.2	2.7	2.3	2.0	1.9
Net Reproduction Rate	87.5	90.0	84.5	76.3	66.3	61.2	59.6	58.1	57.9
No grandchild	22.2	21.2	25.6	31.6	41.2	46.8	48.1	50.0	50.2
Life time proportion of woman (without mortality effect = directly derived from fertility assumption)									
Never married	5.0	5.8	9.3	12.0	16.2	20.4	22.6	23.5	23.5
Childless	10.3	12.7	17.5	22.7	30.0	32.8	35.7	37.1	37.4
No grandchild	12.1	15.0	21.3	28.8	39.3	42.9	46.8	48.9	49.4

Source: From the projection 2006, medium-fertility and medium-mortality variant. The life time proportions of woman never married and childless (without mortality effect) are officially provided numbers. Other numbers are calculated by the author from the assumption. The sex ratio at birth for the net reproduction ratio is an officially provided assumption and is 105.4 (fixed value from average over year 2001-05).

Figure 7. Childless and Non-grandchild Ratio among Women by Cohort: The Medium Assumption for Female Cohort born in 1935-1990



Source: From the projection 2006, medium-fertility and medium-mortality variant. Proportions are calculated by the author from the assumption of the projection 2006, medium-fertility and medium-mortality variant.

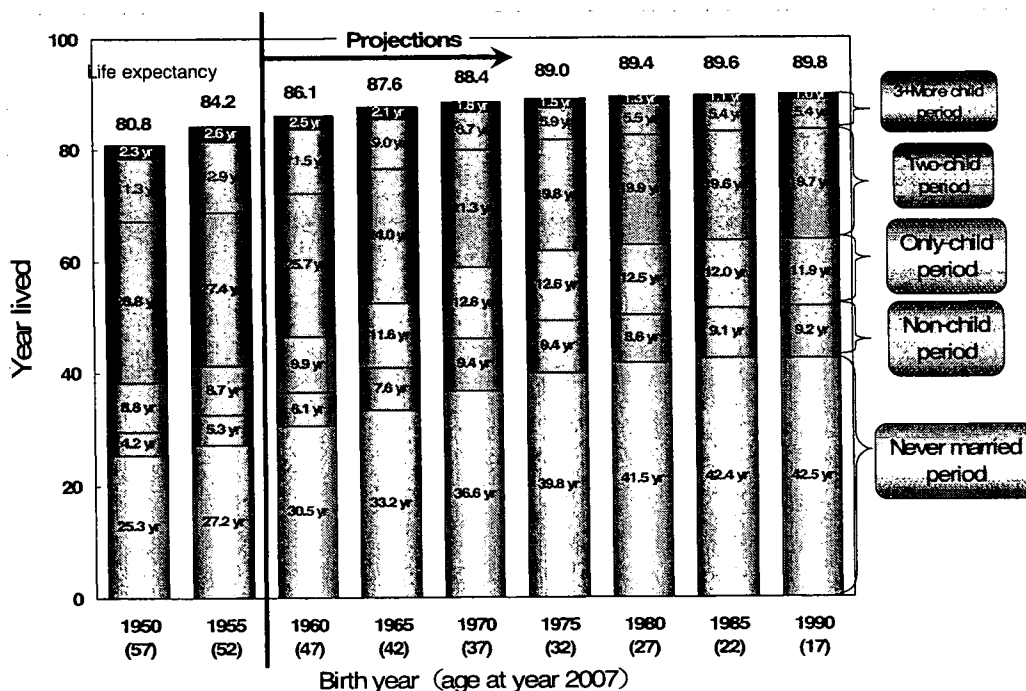
Table 4 Woman's Average Life Time Length of Period Spent in Each Family Status:
Perspectives from the Medium Variant for Cohorts Born in 1950-90

	(year)									
	Birth year of woman's cohort									
	Observed		Projected							
	1950	1955	1960	1965	1970	1975	1980	1985	1990	
Average life time length of period spent in each family status										
Life expectancy	80.8	84.2	86.1	87.6	88.4	89.0	89.4	89.6	89.8	
Never married	25.3	27.2	30.5	33.2	36.6	39.8	41.5	42.4	42.5	
Childless	29.5	32.5	36.5	40.9	46.0	49.2	50.2	51.4	51.7	
Never had 2nd child	38.3	41.2	46.4	52.5	58.7	61.8	62.7	63.5	63.7	
Never had 3rd child	67.1	68.7	72.1	76.5	79.9	81.6	82.6	83.1	83.4	
Never had 4th child	78.5	81.5	83.6	85.5	86.7	87.5	88.1	88.5	88.8	
Ever married	55.4	57.0	55.6	54.3	51.8	49.2	47.8	47.3	47.3	
Having Child(ren)	51.2	51.7	49.6	46.7	42.4	39.8	39.2	38.2	38.1	

	Proportion of life time spent in each family status (%)									
	1950	1955	1960	1965	1970	1975	1980	1985	1990	
Life expectancy	100	100	100	100	100	100	100	100	100	
Never married	31	32	35	38	41	45	46	47	47	
Childless	37	39	42	47	52	55	56	57	58	
Never had 2nd child	47	49	54	60	66	69	70	71	71	
Never had 3rd child	83	82	84	87	90	92	92	93	93	
Never had 4th child	97	97	97	98	98	98	99	99	99	
Ever married	69	68	65	62	59	55	54	53	53	
Having Child(ren)	63	61	58	53	48	45	44	43	42	

Source: From the assumption of the projection 2006, medium-fertility and medium-mortality variant. The life expectancies are officially provided numbers. Other numbers are calculated by the author.

Figure 8. Woman's Average Life Span and Its Composition by Family Status for Birth Cohorts born in 1950-1990



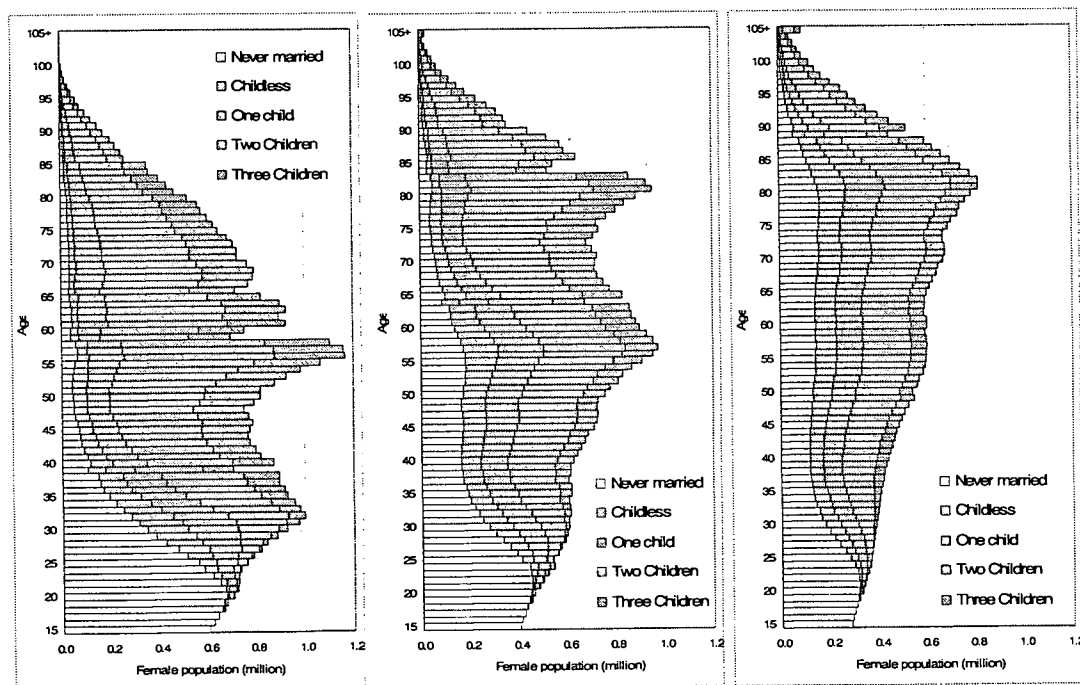
Source: From the projection 2006, medium-fertility and medium-mortality variant. The life expectancies are officially provided numbers. Other numbers are calculated by the author from the assumption.

Table 5 Composition of Woman in Each Age Group by Family Status: Perspectives from the Medium Variant in Year 2005, 2030, and 2055

Age Group	2005			2030			2055		
	Proportion of woman ... (%)								
	Never married	Childless	Less than two children	Never married	Childless	Less than two children	Never married	Childless	Less than two children
15-19	99.2	99.3	99.9	99.2	99.4	99.9	99.2	99.4	99.9
20-24	88.4	91.9	97.9	89.2	92.6	98.1	89.3	92.6	98.1
25-29	57.5	72.4	88.6	62.6	75.2	89.3	62.8	75.3	89.4
30-34	29.3	46.1	68.1	38.5	54.0	73.4	38.5	53.9	73.4
35-39	17.6	30.0	48.5	28.6	41.9	60.3	28.7	41.9	60.3
40-44	11.4	20.7	36.1	25.1	37.9	55.9	25.1	37.9	56.1
45-49	7.3	14.6	27.4	23.3	36.5	55.1	23.9	37.5	55.7
50-54	5.0	11.5	23.3	21.9	35.0	54.1	23.6	37.5	55.7
55-59	5.2	9.6	22.2	17.9	32.2	51.7	23.6	37.5	55.7
60-64	4.6	7.5	20.7	14.3	26.8	44.8	23.5	37.4	55.6
65-69	4.1	7.7	22.4	10.7	20.4	35.8	23.5	37.4	55.6
70-74	4.4	8.1	23.1	7.2	14.6	27.4	22.9	36.5	55.1
75-79	4.4	8.1	23.1	5.0	11.5	23.3	21.9	35.0	54.1
80-84	4.4	8.1	23.1	5.2	9.6	22.2	17.9	32.2	51.7
85-89	4.4	8.1	23.1	4.6	7.5	20.7	14.3	26.9	45.0
90-94	4.4	8.1	23.1	4.1	7.7	22.3	10.8	20.6	36.1
95-99	4.4	8.1	23.1	4.4	8.1	23.1	7.4	14.9	27.9
100+	4.4	8.1	23.1	4.4	8.1	23.1	5.1	11.3	23.2
15+	22.8	29.8	43.6	24.8	34.3	49.4	28.9	41.2	58.1
15-49	41.6	51.4	65.3	48.0	58.9	73.4	48.2	59.0	73.4
65+	4.3	8.0	22.9	6.3	12.2	25.6	18.2	30.9	48.8

Source: From the projection 2006, medium-fertility and medium-mortality variant. Numbers are calculated by the author.

Figure 9. Composition of Female Population by Family Status: Perspectives from the Medium Variant in Year 2005, 2030, and 2055



Source: From the projection 2006, medium-fertility and medium-mortality variant. Numbers are calculated by the author.

Discussion

In this paper, first I described results and methods of the latest Japanese official Population Projections. Besides their unprecedented demographic perspectives on population decline and aging through the world's lowest fertility assumptions with the highest life expectancy, the projections provide some pictures of people's life course changes making use of their life course approaches employed mainly in constructing fertility assumptions. Hence, I attempted to build multistate life tables for the projected life of Japanese women in relation to family status. As a consequence, it is revealed that historically unparalleled increases both in proportion of never married and childless women and in average life time spent in those statuses would be witnessed within the scope of the next few decades. It also sets up an expansion of elderly people who have no offspring or family. These insights in individual aspects of the population projection should rouse public awareness as to the necessity for fundamental alteration in life course related institutions, in addition to reforms of macro socioeconomic organizations such as the labor market or social security system. For example, the society would not be able to rely any more on individual families caring for elderly in the manner used up to today.

The life course approach to making assumptions of vital rates requires significant amount of quality data and sophisticated models. There are arguments that the complexity of models does not necessarily contribute to precision in prediction, especially for systems consisting of many factors. Population projection, in particular, can be carried out with a jump-off population and three assumed vital rates (fertility, mortality, and migration). Incorporation of other components such as marriage makes the model complex, and requires additional assumptions on the future course of the component whose future is often more uncertain than those of the basic three factors. Seeking too much reality in projection models often leads to a morass of technical difficulties with little gain in accuracy. However, to the extent that each rate consists of several behavioral factors which change disjointedly, preparing different assumptions for their future courses is essential for sensible prediction³. Therefore, better policy about the degree of reality to seek in a population projection depends on what kinds of data are available and how confidently we see the future of each component involved, providing the present knowledge and technology. Then, what is the direction we should take to expand "the present knowledge and technology?"

We live in an era of difficulty in forecasting the demographic future of the society due to unpredictable developments in all vital rates. In many countries of the developed world, the traditional cohort component method with naive vital assumptions has continually shown its limitations along with the development of institutional changes called the Second Demographic Transition (Lesthaeghe 1994, Van de Kaa 1987) in the last quarter of the former century⁴⁵. Demographers have increasingly become aware of projection's uncertainty, and some new

³ For example in fertility, coupling and having babies among couples are separate behaviors and their propensities have their own trends.

⁴ The precursors in demographic projection experienced similar difficulties during the first Demographic Transition accompanied with the post-war baby boom.

⁵ The author thinks it reasonable that the shifts in mortality improvement recognized as the fourth stage of the Epidemiologic Transition (the age of delayed degenerative diseases, Olshansky and Ault 1986) being experienced by the most developed countries since the late 1960's should be included in the same stream of the Second Demographic Transition to the extent that they were concurrent phenomena unexpected in the context of the first Demographic Transition.

“paradigms” have emerged as solutions. Among them, the probabilistic population projection is a most pronounced exemplar that enhances projection’s practical applicability explicitly indicating its inherent uncertainty. It bestowed the scientific outline on population projection. Beside techniques that specify uncertainty, however, we should seek frameworks to reduce uncertainty on the other side. The life course approach or statistical life course construction of relevant cohorts should be the basis of the novel framework for that function, since it offers distinct traces by each lifetime behavior to improve the models through monitoring and contrasting the actual drift of the measures for them. The measures are free from annoying disturbances, so called tempo effects, and rarely violently fluctuate.

The present study combined with the above discussion suggests that the life course approach in population projection may deserve all efforts to overcome the difficulties that have been preventing it from working such as unavailability of the data it requires and the model complexities it induces. It provides essential information on people’s life in the upcoming society, and is an effective basis for more reliable demographic prediction tools. The instruments are ample. The event history models, micro-simulation techniques possibly with agent-based design, and decision making theories, for instance, should play central roles in developing such a framework. However, what is most required for the approach to work is cohort data of many aspects. In most cases, an enhancement of the statistical systems and starting a new series of survey may be required. Public consent should be necessary. For that purpose, international cooperation is indispensable, and developing a communal outline for data collection may be effective.

Conclusion

According to the multistate life table constructed from the principal assumptions of the latest official population projections of Japan, the life time probability of childlessness and having no grandchildren among women born in 1990 are respectively 38.1% and 50.2%, while the corresponding proportions are 18.4% and 22.2% in those born in 1950. Similarly, the average life time spent in never married status increases to 42.5 years (or 47% of the life expectancy) in cohorts born in 1990 from 25.3 years (31%) in those born in 1950. These changes set off a drastic increase of elderly who do not have offspring to live with or rely on in this society of the near future.

The life course approach in population projection provides rich information on people’s life in the upcoming society on the one hand, and on the other, it should be a promising basis of a new “paradigm” of the projection in the era of the Second Demographic Transition. The development of the new framework should be accompanied by enhancement of the data collection via upgrading national statistical systems toward demographic formulation of individual life courses.

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