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Japan's Longevity Revolution and the Implications for Health Care Finance and Long-term Care

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Contents

Abstract

This paper consists of five related notes on Japanese health care.

Section 1 of the paper proposes a simple model of health care needs in a stationary population where all the sickness is concentrated in the period leading up to death. The main variables determining the burden of health care, such as life expectancy, duration of chronic illness prior to death, etc., are identified. While we are not able to comment (at this time), on trends in the prevalence of chronic conditions in old age, extrapolation of trends in life expectancy presented in Section 2 of the paper suggest that there will be continuing increase in the number of Japanese surviving to extremely old ages. This aging of the population will assuredly put upward pressure on health spending, but this pressure must be put in the context of other factors. Section 3 decomposes increase in Japanese health care spending into portions attributable to overall demographic increase, change in population age structure, and change in a residual "underlying factors" term subsuming changes in technology, health system coverage, etc. The residual dominates total increase in health care spending. In fact, based on historical data and projected demographic trends, the strongest upward pressure from population aging occurred in the period 1980-95, when aging accounted for 1.4 percentage points of 5.6% per annum total health expenditure growth. Health care spending growth attributed to ageing is estimated to be 1.13% per annum in 1995-2020 and only 0.34% per annum in 2020-2050.

Section 4 focuses on home care of the elderly and suggests that there is a substantial ongoing decline in the supply of potential in-family caregivers. Lower fertility is an important determinant of this trend. Section 5 describes the overall profile of the Japanese health care system, noting that it receives relatively high marks in international comparisons but tends to lump together acute care and chronically ill patients. As recognized by the "Gold Plan" policy currently being implemented, there is a severe shortage of nursing home facilities beds as well as services to make home care a more practical option for families. A simple ratio analysis suggests that the number of bedridden chronically ill persons (i.e., the population that would ideally be cared for in a nursing home setting) will reach 1,800,000 by 2020 as opposed to 600,000 today.

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About the Author

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Japan’s Logevity Revolution and the Implications for Health Care Finance and Long-term Care

Les Mayhew

Introduction

For some time there has been considerable academic interest in the remarkable population aging process underway in Japan (Feeney, 1990; Ogawa and Matsukura, 1997; Takahasi et al., 1999; Horlacher, 2000). As older people require more health care, a parallel literature has emerged about reforms to the Japanese health care system, analyzing the basis for the various policy changes over the last 20-30 years (Steslicke, 1989; Ogawa, 1989; Ogawa, 1993; OECD, 1990; Kawai, 1996). IIASA’s work on health care expenditure shows that it is around six times more expensive to treat older than younger people (Mayhew, 2000) so that almost inevitably, as aging proceeds and health care technology advances a significantly greater share of GDP will be absorbed by health care activities. Japan is the most rapidly aging country in the world and so the way it is approaching the aging issue, especially the nature of current reforms to its health care system, is of wider interest.

The purpose of this paper is to examine the long-term impact of Japanese aging on health care provision, especially long-term care. We start with a highly simplified stationary population model which incorporates assumptions based on the observation that much health care expenditure is incurred in the period prior to death (Fuchs, 1984; Seale and Cartwright, 1994). The crucial question both for policy makers and individuals is whether added years of life expectancy are healthy or unhealthy ones. The importance of answering this question is made clear by the following section, which uses historical data to extrapolate impressive increases in the number of Japanese surviving to advanced ages. While the growing number of elderly will challenge the health care system, it is also important to keep the impact of population aging in perspective. A model decomposing health care spending into components due to demographic and non-demographic factors suggests that it is the latter that have dominated in the past and will be even more important in the future.

We conclude that, to date, the Japanese health care system has coped with the enormous changes exceptionally well and that policy responses have been both timely and appropriate. However, we also find that Japanese society is not only aging rapidly but also changing structurally at the level of the family. A decline in the number of potential caregivers, due mostly to increasing elderly dependency ratios at the household level, is bound to lead to pressure to expand long-term care. We conclude the paper with a general discussion that compares Japan's health care system with that of other countries, and find that it is well regarded from an external perspective. However, as policy makers are aware, better policies are needed to cope with the bedridden elderly.

Chronic illness in a stationary population

As a number of writers have pointed out, much health expenditure is incurred to treat chronic illness and conditions in the period before death (Fuchs, 1984). Consider Figure 1, which shows the survival curve FBC for a hypothetical stationary population (i.e., a population that has reached steady state). The vertical axis shows the number of survivors and the horizontal axis age. Imagine that the first instance of chronic illness occurs at age x_1 (point A on the survival curve), a years prior to the onset of mortality at age x_2 (point B), after which a constant number of deaths b = BZ / CZ occur each year up to a maximum age x_4 (point C) after which nobody survives. Note that the period of chronic illness prior to death a is assumed to be independent of age at death and that the maximum age to which anyone survives free of chronic illness is x_3 (point D).

The chronically ill population is given by the area of the parallelogram *ABCD* while the healthy population is given by the area FADO. If x_2 increases but x_4 is unchanged then the survival curve becomes more rectangular, a process sometimes termed the *compression of mortality* (Fries, 1980). If the duration of chronic illness a remains the same, then the result is that chronic illness is compacted into older years. Conversely, if x_2 remains constant and x_4 increases (the *dispersion of mortality*) while a remains the same, then chronic illness is spread over a wider age range. Later we will test whether Japanese mortality is becoming more compacted or dispersed.

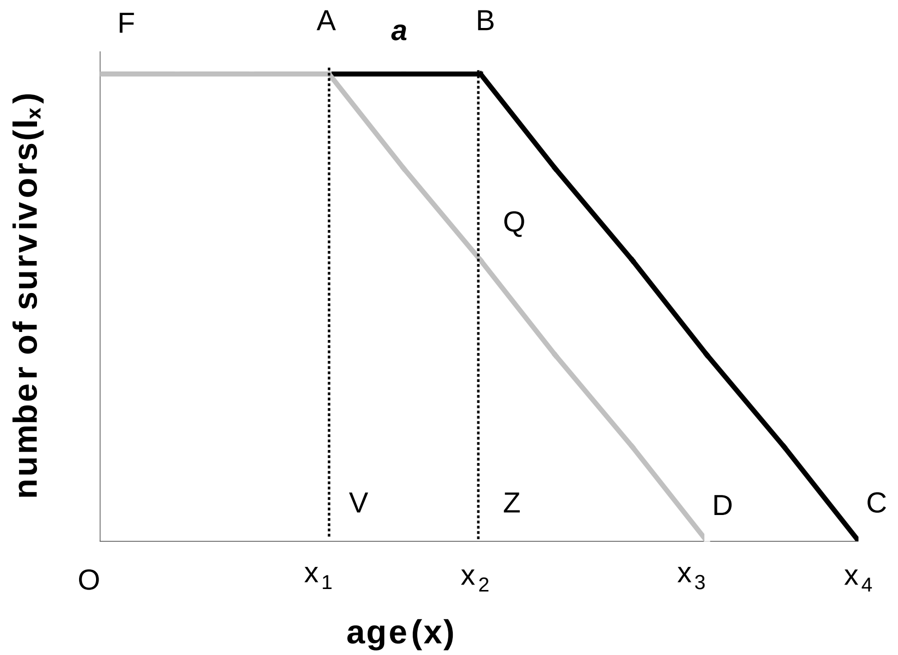

Figure 1: Survival and chronic illness

Table 1 provides selected theoretical relationships based on the simplified model in Figure 1. Table 1, line 1 tells us, for example, that the number of chronically ill people is a constant depending on the population at x_2 and the period of disability a. In a stationary population it means that the number of chronically ill people does not vary from year to year unless the period of chronic illness and disability changes. Another way to look at it is to note that area *ABCD* always equals area *ABZV,* which is a constant.

	Parameter	*Equation*	*Comment*
1	Number of chronically ill (s)	$s = l_{x_2} a$	The population at x_2 multiplied by a (area of parallelogram ABCD)
2	Number of deaths per year (b)	$b = \frac{l_{x_2}}{x_4 - x_2}$	The population at age x_2 divided by x_4 - x_2 (slope of line segment BC)
3	Age specific mortality rate (μ_x)	$\mu_x = \frac{b}{l_x}$	Deaths at age x divided by the population aged x
4	Proportion of population chronically ill (p)	$p = \frac{2a}{x_2 + x_4}$	Area of parallelogram ABCD over area FBCO.
5	Age specific prevalence of chronically ill at age x (δ_x)	$\delta_x = \frac{a}{x_4 - x}$	Length of line segment BQ divided by population aged x.
6	Average age of chronically ill persons $(\bar{x})$	$\bar{x} = \frac{x_1 + x_4}{2}$	Mid-point between onset of chronic illness and death of the last surviving member of the population.
7	Life expectancy at age x	$e_x = \frac{x_4 - x_2}{2} + x_2 - x \quad , x < x_2$ $e_x = \frac{x_4 - x}{2} \quad , x \geq x_2$	
8	Proportion of population chronically ill above age x (p_{x+}).	$p_{x+} = \frac{a}{e_x}$	Expected years of chronic illness divided by expected years of life.
9	Proportion deceased by age x , σ_x	$\sigma_x = \frac{x - x_2}{2e_{x_2}}$	Proportion of population deceased as a function of age x and life expectancy at x_2

Table 1: Some parameters of interest

The cohort death rate and age specific mortality rate are given in Table 1, lines 2 and 3, whilst the proportion of population that is chronically ill is given in line 4. The latter will decline if x_2 or x_4 increase or if the parameter *a* declines, that is, if the age of onset of mortality increases, people live longer or the period of chronic illness prior to death declines. Line 5 gives the age-specific prevalence of chronic illness (the number of chronically ill of a given age divided by the living population of that age). This can be seen to increase with age until it reaches a maximum of one at age x_3.

Since mortality occurs at a constant rate and the period of chronic illness prior to death is invariant, the average age of the chronically ill population (line 6) is given simply by the mid-point between the age at onset of chronic illness and the age at which the last member of the population dies. Given the assumption that everyone survives to x_2 and that BC is a straight line, everyone under age x_2 will, on average, live to an age corresponding to the mid-point of line segment ZC (line 7), while everyone greater than age x_2 will, on average, live to $(x_4 - x) / 2$. The prevalence of chronic illness above age x may be derived from lines 4 and 7; this corresponds also to the proportion of the individual's remaining years of life that he or she may expect to spend in a state of disability and is shown in line 8. We shall use the result in line 9 shortly to test whether Japanese mortality is becoming compacted or dispersed. It shows the relationship between the proportion of the population deceased at age x and life expectancy at age x_2, the onset of mortality and uses the result in line 7.

How do some of these parameters translate into real-world numbers for Japan? Assume the onset of mortality occurs at 65, that there is a 2-year period of chronic illness prior to death and that the maximum age to which anyone survives is 105 years (implying life expectancy at 65 of 20 years). If the population is 119 million and every year 1.4 million persons reach their 65th birthday, then we would expect 2.8 million chronically ill people (2.4% of the population), with an average age of 84 years. Life expectancy at 65 would be 20 years and the prevalence of chronic illness above 65 would be 10%. If 10% of the chronically ill were cared for in an institutional setting in their last year of life, this would indicate a need for 280,000 nursing home beds, as opposed to the roughly 200,000 that are currently available.

As line 4 of Table 1 reminds us, the proportion of the population that is chronically ill will depend on the length of the period of chronic illness prior to death, the age at the onset of mortality, and the maximum survival age. So long as the first of these (*a*) does not increase, policy makers have nothing to fear from improved survival rates, whether these improvements take place at young ages (increasing the proportion of persons reaching age x_2) or at older ages (increasing age x_4). If the duration of chronic illness prior to death is fixed and longevity is increasing, one would expect prevalence rates to fall at the level of the population (lines 4 and 5) and the proportion of remaining life years to be spent in a state of chronic illness to decline at the level of the individual (line 8). It is the possibility that increases in life expectancy will consist of chronically ill life years that has both policy makers and individuals worried (Liu et al., 1990; Bebbington, 1991; Manton and Stallard, 1994, 1996; Freedman and Martin, 1998).

Life expectancy trends and "rectangularization" of the survival curve

While we are in no position to contribute to the debate over whether added life years are healthy ones, we can perform some extrapolations of life expectancy in Japan. Consider the simplified model described above. Figure 2 shows the theoretical relationship predicted by the model between life expectancy at age 50 (vertical axis) and the percentage of people dead at a given age (horizontal axis). Thus, if life expectancy at 50 were 25 years, we would expect to observe half of the population which survived to 50 dying by age 75 (point P), 40% dead by 70, 30% dead by 65, etc. Note that the complement of the cumulative mortality curve is a survival curve; thus, for example, if 40% of the population dies by a given age, 60% survives to at least that age. In Figure 2, we illustrate the range $10 \le e_{50} \le 35$. Based on x_2 = 50 in line 7 of Table 1, this range of variation corresponds to $70 \le x_4 \le 120$. It can be verified from line 9 of Table 1 that the lines in Figure 2 are straight and have slope given $1 / 2\sigma$, where σ is the proportion who are dead. Thus, for example, for $\sigma=0.5$ (the fiftieth percentile line) the gradient is one; for $\sigma=0.4$ (the fortieth percentile line), the gradient is 1 / 0.8, etc.

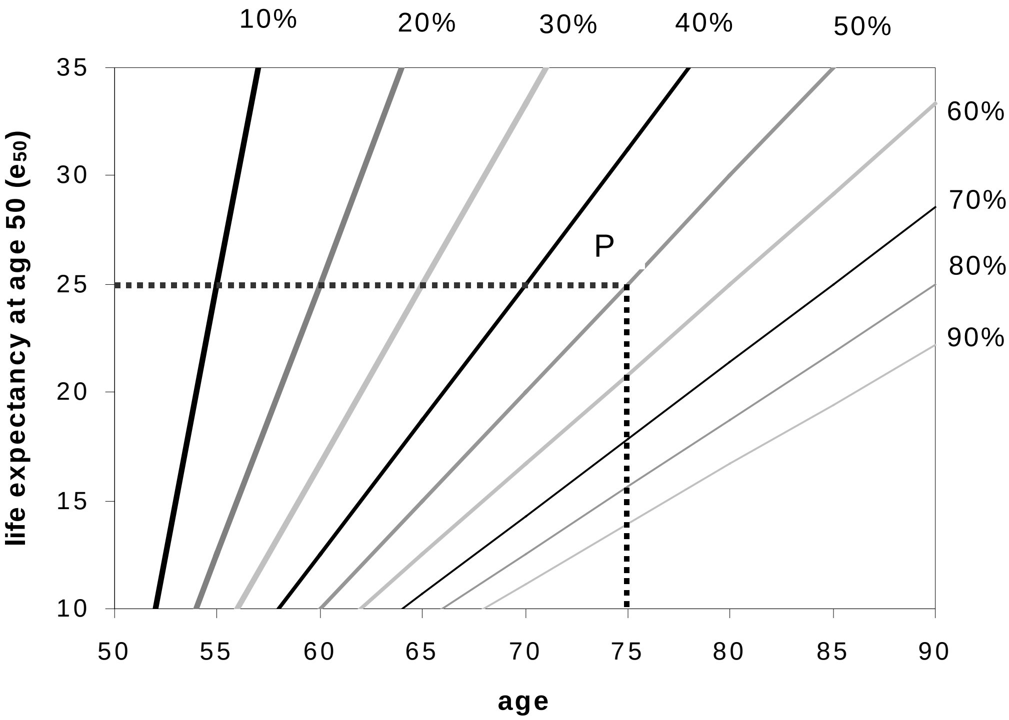

Figure 2: Life expectancy and cumulative mortality

As life expectancy (at 50) increases, the percentile curves fan out. When $e_{50} = 10$ the difference between the 10% and 50% curves is 8 years (from about 52 to 60); when $e_{50} = 25$ the difference is 20 years (from 55 to 75): when $e_{50} = 35$ the difference is "off the chart" but equals 28 years (from 57 to 85). This is consistent with the "dispersion of mortality" hypothesis, because as life expectancy increases, the range over which deaths occur widens.

In order to analyze trends in Japanese mortality, we have used the life tables published by Nanjo and Kobayashi (1985). These cover an extended period from 1891 to 1982 at annual intervals, for both males and females in one-year steps from 0 to 90 years old and therefore have the key advantage of providing a long run of data. The authors present tables for survivors and for life expectancy on both a period and cohort basis although since cohort-based tables are truncated and therefore incomplete we use the period-based tables (B3 and B4, pages 42 to 55). Period-based tables provide a snapshot of survival probabilities at a given period time and so may be, if anything, an underestimate of survival probabilities for cohorts born in the same period.

Figure 3 plots female life expectancy at 50 against the ages of women corresponding to cumulative mortality percentiles as in Figure 2 for the years 1960, 1970, 1975, 1980 and 1982. Least-squares lines are fitted to the data points taken from the life tables. Parallel dotted horizontal lines indicate the period life tables from which observations were drawn (so as not to clutter up the figure, we show the lines for only 1960 and 1982). Thus, taking the 1960 life table as an example, on moving across the chart from left to right we see that 20% of 50 year-old women would expect to die by age 62 (point Q) and 30% by age 68 (point S). According to the 1980 life table, 20% of women surviving to age 50 would expect to die by age 73 (point P) and 30% by age 76 (point R).

Comparing Figure 3, whose cumulative mortality lines were estimated by least-squares from life-table data, with Figure 2, whose lines were derived using the highly simplified stationary population model, a significant difference emerges. Leaving aside the extremes, i.e. the 10^{th} and 90^{th} percentiles, the data in Figure 3 appear more consistent with the compression of mortality hypothesis than the dispersion of mortality hypothesis. In other words, if life expectancy at fifty continued to increase (the graph was extended upwards), eventually we would see the lines converge, implying that everyone would live to a certain age and then die – everyone, that is except the extremely frail, corresponding to the 10^{th} percentile, and the extremely robust, corresponding to the 90th percentile. The slope of the 90^{th} percentile curve suggests that as life expectancy at 50 increases, the longest-surviving members of the population may survive to extremely advanced ages.

A word of caution is required before we use the results of the fitted model to extrapolate survival curves. Life tables are themselves statistical representations of survival processes that are based on data from various sources. The model 'fit' may therefore contain implicit biases depending on the assumptions the producers of the life tables used particularly to estimate survival probabilities in older age groups (for example, the use of an arbitrary upper age limit to facilitate statistical curve fitting). A further problem is that the life tables stop at 90 years, when relatively few people are still alive and so it is not easy to corroborate estimates above these ages.

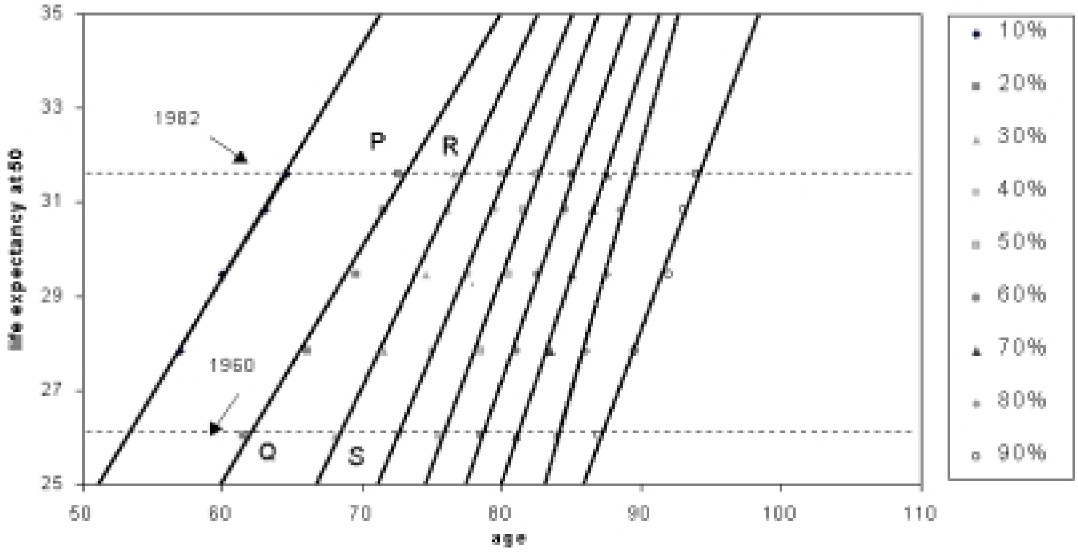

Figure 3: Japanese female life expectancy at 50 plotted against the percentile of women dead at a given age for the years 1960, 1970, 1975, 1980 and 1982. Data points were extracted from the female period-based life tables in Nanjo and Kobayashi (1985) pages 42 to 55.

Figure 4 shows the development of Japanese life expectancy at 50 years of age from 1891 onwards. Note the clear acceleration in the rate of increase – about 1 year of added life expectancy at 50 every 4 years since 1960 as compared with 1 year every 18 years up to 1950 – corresponding to Japan's rapid post-war development. If the post-war trend in Figure 4 continues, in 1998 life expectancy at 50 would have been 35 years, in 2006 it will be 37 years and in 2018 it will be 40 years. In fact, recent figures available from the Ministry of Health and Welfare for 1998 give female life expectancy at 50 to be 35.5 years so the projection appears to be right on track. These extrapolations of life expectancy at 50, "plugged in" to the least-square lines estimated from the historical life tables in Figure 3, give estimates of future cumulative mortality rates. Thus, this is a "double extrapolation" exercise, the first extrapolation being life expectancy at fifty and the second being extrapolation of the historical relation between life expectancy at fifty and cumulative mortality (or survival) curves.

The results, expressed in terms of survival curves, are shown in Figure 5. Counting from the left, the first two survival curves are the 1960 and 1982 complements of the cumulative mortality curves in Figure 3. The next three, corresponding to 1998, 2006, and 2018, result from the extrapolation exercise just described. Consistent with the compression of mortality phenomenon observed in Figure 3, there is a marked "rectangularization" of the survival curve over time. By 2018, according to Figure 5, a woman who survives to 50 (almost all women, because death before 50 is already rather rare) will have a 20% chance of still being alive at 97 years. In 1960, by contrast, she had a 20% chance of still being alive at 84. The 'spur' of extremely aged Japanese women that develops from 1982 onwards reflects the divergent 90% cumulative mortality curve in Figure 3. Unfortunately the model cannot be reliably used for the remaining 10% of survivors and so the survival curves are truncated at this point.

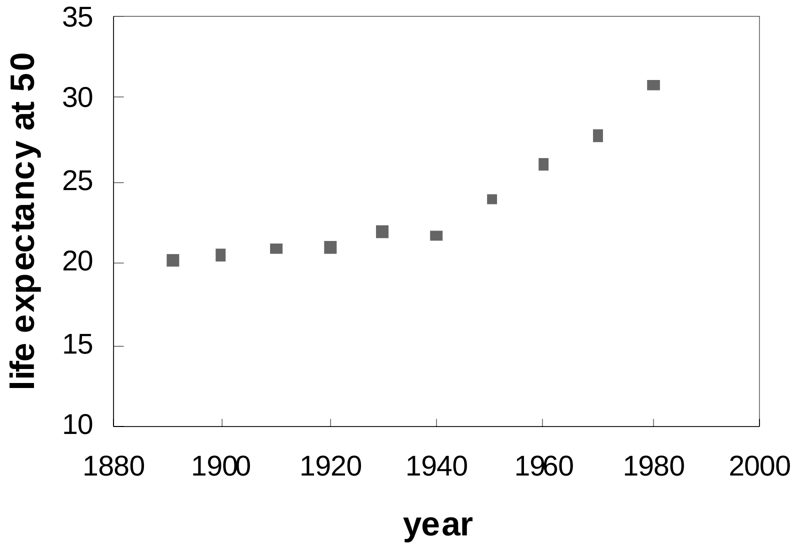

Figure 4: Japanese female life expectancy at 50 from 1891 to 1982.

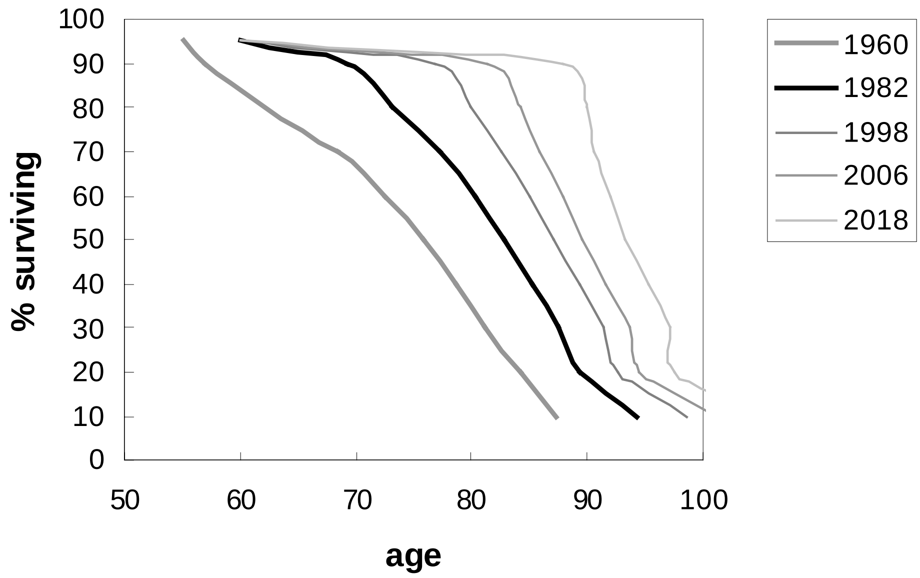

Figure 5: Past and projected survival probabilities for Japanese women based on trends in Figure 4 and least-squares lines fitted to points from historical life tables in Figure 3.

We have said that we are in no position to take a stand on whether years of life expectancy added will be healthy ones or not. Evidence from other countries, where the aging process has not advanced as far as in Japan, is mixed: in the UK, for example, healthy life expectancy is progressing at a slower rate than total life expectancy (Bebbington, 1991; Dunnel and Dix, 2000). We used English Life Table No. 15 for 1990-92 and disability prevalence rates based on the highest severity categories (Martin et al.,1988), to try to estimate the average duration of chronic severe disability prior to death in the UK. Our results showed that persons dying prematurely experienced, on average, 3 to 4 years of severe disability, those dying at very advanced ages averaged less than one year, and those dying in the middle ranges averaged one to two years. Whilst England is not necessarily representative of Japan, it is indicative of the intensity and duration of medical care interventions in this stage of life in a fairly typical industrial country.

Decomposing sources of change in Japanese health care expenditure

Analysis shows that health care expenditure has been growing faster than GDP in industrial countries, at least since 1960 when internationally comparable data started to become available. In that period the health sector has increased its share of GDP from just over 4% in 1960 to around 10% today (Mayhew, 2000). Life expectancy trends described in the previous section, plus the rising proportion of the population in elderly age groups, might be expected to put yet further upward pressure on health care costs, particularly in Japan. Yet once age structure trends are put into perspective, it becomes clear that there is nothing inevitable about rising health care costs.

In order to make this point, we use the projection methodology described in Mayhew (2000). This is based on a simple 'growth factor' method, in which the growth in health expenditure is assumed to be decomposable into a set of independent 'growth rates' which can be estimated from available data. Theoretically, these rates could represent the result of population aging and medical technology, the morbidity or case mix of patients, treatment costs, or sectoral changes in the health care system itself such as the growth of preventative medicine and so forth. The only criterion is they should consist of separable, non-overlapping growth processes. We express the general form of the model as follows:

$$H(t) = H(0)\, e^{t\sum_i r_i}$$

where $H(0)$ is health expenditure in a base period, $H(t)$ is expenditure in time t and r_i is the growth rate of a particular 'growth factor' such as treatment costs. In this section we restrict ourselves to the effects of demographic change, a composite of aggregate population growth and age structure change, and the so-called "underlying" growth rate, estimated as residual. The underlying growth rate captures a myriad of effects, such as technological change (availability of new treatments and procedures, improvements in existing ones), changes in the price of medical care relative to the GDP deflator, changes in take-up rates, etc. The specific form of the model in this case is:

$$H(t) = H(0)\, e^{t(r_U + r_p)}$$

where r_U is the underlying growth rate and r_p reflects demographic change. The parameter r_p is derived by weighting each population age group by the relative per capita cost of providing its members with health care (i.e., relative to some numeraire age group such as the population aged 5-9), summing over age groups and indexing to a base period. Mayhew (2000) describes the mathematical procedure in detail and how the index may be decomposed into a 'volume' effect due to population increase (or decline) and an age structure effect due to shift in the age structure of the population. We based our age-specific cost weighting for Japan on the total cost of medical care per insured person in 1994 (see Cichon et al., 1999, table JPN7, p. 324). The table shows health care costs to be relatively level between ages 4 to 44 but then to increase over six-fold in the over-70 age group, a finding that is consistent with available data from other industrial countries (such as the UK). We assume that the age-specific relative costs are invariant through time, which is not unreasonable based on the evidence, although for reasons given later this assumption could break down in the case of medical care for the chronically ill. Our age-specific population projections are based on UN figures. Once r_p has been calculated, the underlying growth rate r_u is calculated as a residual from the (known) overall growth rate, which can be calculated from historical data.

In Table 2, the time frame is from 1960 to 2050 and is divided in five periods. The Japanese economy grew rapidly between 1960 and 1970 at over 10% per annum before slowing to 4.4% between 1970 and 1980 and 4.6% per annum between 1980 and 1985. Growth in health care expenditure matched economic growth in 1960-70, then continued at 10% per annum as the economy slowed down, outstripping GDP growth by a considerable margin. The period starting just prior to 1960 coincided with at least two crucial policy changes. The first was the 1958 amendment to the 1938 National Health Insurance Law covering rural workers, which extended health insurance to those not already covered under occupational insurance, especially groups such as the old and self-employed. The second was an amendment to the Old-age Welfare Law of 1963 providing free medical cover to the over 70s.

The rate of growth in health care expenditure then slowed between 1980 and 1995 to around 5.6% per annum. Two important policy changes in this period were aimed at cost containment and switching some of the responsibility for elderly care back to families. The first was the introduction (under the 1982 Health and Medical Services for the Aged reforms) of co-payments for elderly patients; the second was the Gold Plan of 1989, which led to the expansion of nursing beds and home help services.

The lesson of both periods -- rapid growth until 1980 and slower growth thereafter -- is that medical expenditure growth reflects the policy environment. Applying the decomposition method just described, it becomes apparent that for each of the three sub-periods analysed, the contribution of the underlying rate of growth exceeded that of demographic factors; in fact, it is only in 1980-95 that demographic factor may be said to have made a very substantial contribution.

	1960-70	***1970-80***	***1980-95***	***1995-2020***	***2020-2050***
GDP: % increase pa	9.9	4.4	4.6	2	2
Health spend: % increase pa	10	10	5.6	4.08	2.79
of which due to					
a. underlying rate	8.14	7.87	3.72	3	3
b. population change	1.03	1.13	0.48	-0.05	-0.55
c. aging	0.18	1	1.4	1.13	0.34
Health spend as share of GDP at end of Period	4.55	6.5	7.18	9.42 (12.09)*	11.48 (18.91)*

** If GDP growth is only 1% pa instead of assumed 2% pa*

Table 2. The development of Japanese health care expenditure and GDP, 1960-2050.

The trend established between 1980 and 1995 is even more sharply distinguishable when we look at the projected situation to 2020 and between 2020 and 2050. We assume economic growth at 2% (comparable but slightly less than that in other industrial countries) per annum and an underlying health expenditure growth rate of 3% per annum. In Mayhew (2000), which looked at developed countries as a whole, we assumed the same growth rate for health expenditure, but our assumption for GDP growth was higher at 3% per annum.

The contribution of aggregate population growth to Japanese health expenditure has declined and will shortly turn negative as the population begins to decline. Aging, however, remains a significant cost driver between 1995 and 2020. What is striking in Table 2, however (and does not depend on the assumptions made regarding the underlying growth rate and the rate of economic growth) is that the peak of age-structure effects on health care spending growth is already past. It corresponded to the period 1980-95. In fact, from 2020-50, the total contribution of demographic trends (aggregate population decline and aging taken together), will be to *reduce,* not increase, the rate of growth of Japanese health care spending compared with the previous period. Plainly, this is a striking result and to check its robustness we performed further sensitivity tests by varying relative health costs for the 70+ age group and increasing the number of elderly. We found that to put the demographic effects on a par with the period 1980-1995 there would need to be significant changes in our base assumptions. For example, we would have to increase relative health costs from 6 to 10 for this group and the number of 70+ by 5m (+20%).

By the 2020, under our assumptions, health care expenditure will have grown to around 9.4 % of GDP and by end 2050 to 11.5 %. This is still some way below the levels currently experienced in the US (14%). Should underlying growth be 3% per annum but the economy grow only 1% per annum, then the projected shares increase to 12.1 % and 18.9%. There are a number of issues, of course, that could blow this prospect off course - either up or down. One, as we have seen, is the assumption that average per-capita health expenditure for different age groups will remain more or less the same in relative terms. For the older ages, this will depend crucially on the mix of institutional versus home-based medical care. We turn to the availability of home medical care in the next section. Another issue is the possibility of age-biased medical technical change (development of more new treatments for the aged than for the young, for instance) or a policy environment that either favoured or discouraged medical consumption of the elderly relative to the young.

The supply of family caregivers

It was long a Japanese tradition for families to live in three-generation households under one roof, thus reducing the demand or need for institutional care. The trend today, however, is away from such arrangements, for three reasons. One is that older couples have independent financial means and are remaining healthier longer. Another is that more Japanese women are in the labor force and have less time for care giving. A third reason is the rise in the elderly dependency ratio, i.e. the fact that there are simply too many old people to be taken care of at home. It is convenient to divide these trends into three periods between 1950 and 2020, and for these purposes we are helped by the analysis of Horlacher (2000).

Between 1950 and 1970, the Japanese population grew from 83-104 million. The median age in 1950 was 19 years or, to put the youthfulness of the population another way, there were only 22 older adults per 100 children (that is people 60+ to children 0-14). In the second phase between 1970 and 1995 the population increased to 125 million, median population age rose to 38 as a result of declining fertility and increased life expectancy, and the number of older adults per 100 children increased to 129. In the third phase, not yet completed, running from 1995 to 2020, the median age is projected to increase to 44 and the adult children ratio to 230, the total population reducing slightly to around 123 million.

Plainly, changes on this scale switch the focus of care in domestic settings from young to old. In order to consider the availability of home care for the infirm elderly, we consider a woman born to a typical Japanese family at two points in time, 1950 and 1970. We arbitrarily assume the woman to be the eldest child in the family, although this is simply a matter of presentation. We used 1950 and 1970 period life tables based on Nanjo and Kobayashi (1985) for each generation to calculate the probability of each member of the family being alive when the woman attains a given age. Note that period life tables are based on a snapshot of survival probabilities at a point in time and therefore may underestimate actual survival where life expectancy is changing rapidly relative to cohort tables. Secondly we constructed a synthetic but typical family, using data in Takahashi et al. (1999) on the mean ages of women at marriage, mean age of their partners, the age at which they have their first, second child, etc.

The values of the parameters are shown in Table 3. For example, for first-born daughters born in 1950, the mother was typically 24 years older, the first sibling 3 years younger and the first child 27.5 years younger. Perhaps the most striking feature in Table 3 is the roughly similar profile of the women born in 1950 and 1970, including the ages at which they had their first child. One important difference, however, is the reduction by one in the number of siblings and the number of children. We then 'age' the woman and potential caregivers, defined to include parents, marriage partner, siblings and children (note that grandchildren are excluded), to ascertain the number of persons on whom the woman could depend if she became ill or infirm. We arbitrarily defined care giving 'eligibility' to be ages between 21 and 80; for example, the woman's child does not become a potential caregiver until age 21. Note that because caregivers are predominantly women, and because not all children live in the same community as their parents, etc., what we are presenting in Table 3 is a clear *over*estimate of the effective supply of caregivers.

Relation	*1950*	*1970*
Mother	24	27.5
Father	26.9	30.2
1st sibling	(3)	(2.5)
2nd sibling	(6)	(5.5)
3rd sibling	(9)	
1st child	(27.5)	(27.5)
2nd child	(30)	
Partner	2.9	2.7
Age at marriage	23	24.2

Table 3: Differences in ages of close relations for a woman born the eldest in a family in 1950 and 1970 (based on Takahashi et al., 1999). Bracketed figures indicate negative age differences.

The results are plotted in Figure 6, where the horizontal axis gives the woman's age and the vertical axis gives the expected number of potential caregivers. The upward peak in the early twenties (A) corresponds to marriage, the upward peak in the late forties (B) corresponds to children reaching 21. The availability of care peaks at age 50, after which it gradually declines as parents and siblings die. Finally, at Point C, there are no own-generation caregivers left (all siblings and the husband are either dead or over 80), only children. Comparing the two plots, it is evident that from about age 30 onwards, the pool of available caregivers is always greater for the woman born in 1950 than the woman born in 1970, the difference being approximately one. At age 80, when a substantial number of women are likely to need some care, the availability of potential caregivers for the woman born in 1970 is estimated to be about one, as opposed to about two for the woman born in 1950. If we figured in changing living arrangements (growing mobility of children) and rising female labor force participation in addition to changing marriage, fertility, and mortality patterns, the decline in potential caregivers would be even more pronounced. While we cannot be precise, it appears certain that between the time that women born in 1950 and women born in 1970 turn 80, there will be a decline of well over 50% in the availability of within-family care.

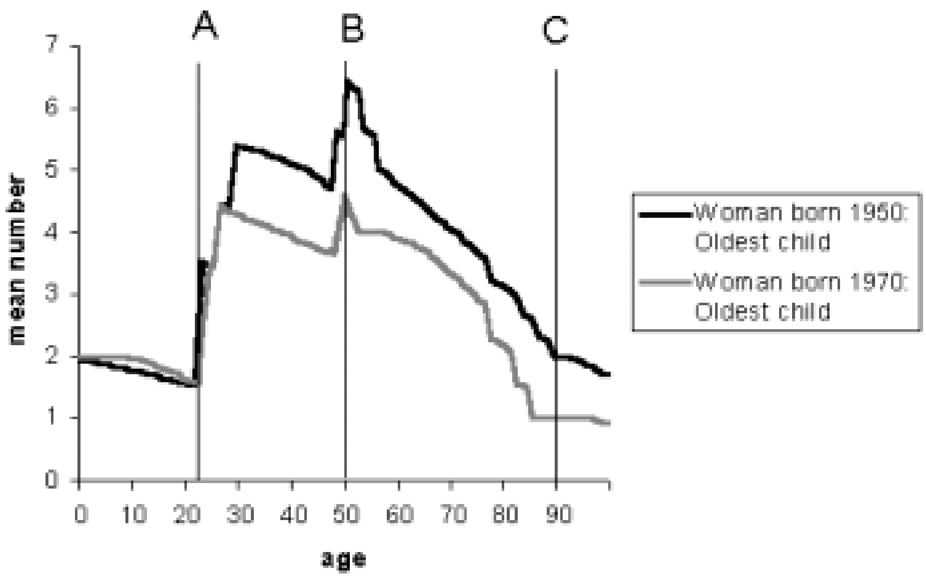

Figure 6: Graph showing the estimated number of caregivers available to a Japanese woman born in 1950 and one born in 1970.

The Japanese health care system: A compromise between the UK and US

How is Japan's health care system organised and financed, and how does it compare with elsewhere? Mackellar and Mayhew (2000) schematise health care systems according to whether they are privately or publicly financed and whether care is privately or publicly provided. Their framework is shown in Figure 7. Japan, with its compulsory universal social health insurance system, falls mainly into the top-right quadrant. The population pays for health care through social insurance premiums and taxes in different proportions, depending on which insurance scheme they belong to. In spite of heavy government regulation including control over prices, over 80% of health care providers operate independently within the private sector.

		Service delivery	
		Public	**Private**
Finance	**Public**	• Block grants direct to providers based on standard assessment formulae or capitation payments or, • Block grants to purchasers to contract with public providers • Small subsidized fixed payments for drugs and defined services (e.g. dental care)	• National Insurance program reimburses provider • Patients make co-payments for services and drugs
	Private	• Private insurer reimburses public provider for treatments dispensed • Patients make co-payments • Patients pay user fee out of pocket	• Private insurer reimburses private provider for treatments dispensed • Patients make co-payments • Patients pay user fee out of pocket

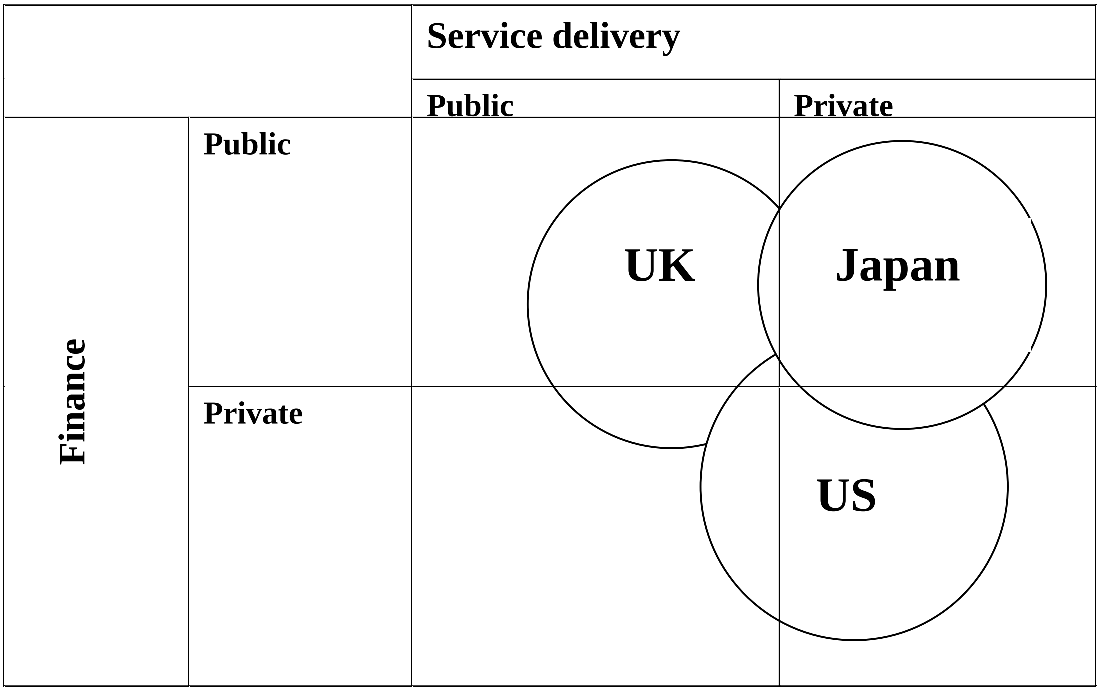

Figure 7: Typology of health care systems showing typical finance mechanisms and different private-public splits.

In addition to reimbursement mechanisms and government subsidies there is a co-payment system in operation for which patients are billed, although in the case of the elderly this is very small (OECD, 1990). Because it costs far more to treat the elderly than other age groups there is explicit cross-subsidization between the schemes using a 'pooling' arrangement. This may be contrasted with, for example, the UK, which has a nationalized health system (top left cell), and which is financed directly out of government revenues and is entirely free at the point of use. Here, cross-subsidization is implicit rather than explicit, the system itself resembling a kind of 'Pay As You Go' pension system. The US system is different again, being essentially privately funded but with substantial free provision for the elderly under the Medicare program and for the impoverished under the Medicaid program, but also with a large population without any insurance at all. Importantly, in Japan the frontiers of free or 'almost' free provision extend further than in the US system and to some degree even further than in the UK system in the case of elderly care services – although this is changing somewhat due to cost pressures.

From an international perspective Japan's health care system is generally well regarded but with certain provisos. It is relatively 'cheap' by international standards, consuming only around 7.2% of GDP as compared with 14% in the US and 10% on average in more developed countries. One reason for its relatively strong record on cost containment is the use of fee lists or tariffs (actually a 'points' system) for reimbursing providers. Unlike cost reimbursement practices in other countries, which bear a close relation to costs, the fees charged in Japan do not necessarily represent the true costs of medical interventions. The system may be used by government to encourage or discourage particular patterns of treatment.

How then does the Japanese health care system shape up overall? The World Health Organization (WHO, 2000) recently published tables of health system attainment in which each country is ranked according to the health of the population, the responsiveness of the health care system, the fairness of financial contribution, and overall expenditure on health care. Not surprisingly the Japanese come first in terms of health attainment due to their leading position in terms of international longevity which has been attributed to their generally healthy lifestyle. In terms of overall ranking WHO puts Japan in 10th position as compared with the UK (18th) and the US (37th). The top country according to WHO at present is France whereas the bottom country in the more developed group is the Russian Federation (130th).

Despite Japan's high ranking on WHO measures, for outsiders some aspects of Japanese health care appear contrary and puzzling, especially if certain trends are compared with other countries. One of the most surprising features is the average length of hospital stay, around 35 days (twice as long for elderly patients), which has remained high while falling elsewhere (to an average of only around 6 days in the UK and US). The reasons have less to do with the quality of care or the methods of treatment, but more with the practice of lumping together acute and chronically ill patients (in large hospitals especially). This, together with financial incentives in the system, tends to encourage the practice of keeping patients in hospital for long periods. Japanese health statistics, for example, do not recognize the concept of 'acute' care beds, as do the statistical systems in other countries (OECD, 1998). Since 1989 Japanese statistics have, however, recognized the category of nursing home beds. These are defined as 'facilities for the elderly which provide medical care as well as living services to bed-ridden people' (OECD, 1998), whom they estimated to number over 600,000. This is two-thirds the annual number of deaths, which would, recalling the simple model introduced at the beginning of this paper, be consistent with a period of eighteen months' incapacity prior to death.

As noted already, the rapid growth of nursing beds is a particular feature of recent years and is the result of the 'Gold Plan'. The aim of this plan is to separate out care for the chronically ill from care for acute patients by creating new long-term care capacity and elderly care services provided direct to homes (Endo and Katayama, 1998). The pattern of growth in nursing home beds since 1989 is shown in Figure 8 and is testimony to the rapid progress achieved over a short period, although long-term care capacity remains low by some international standards.

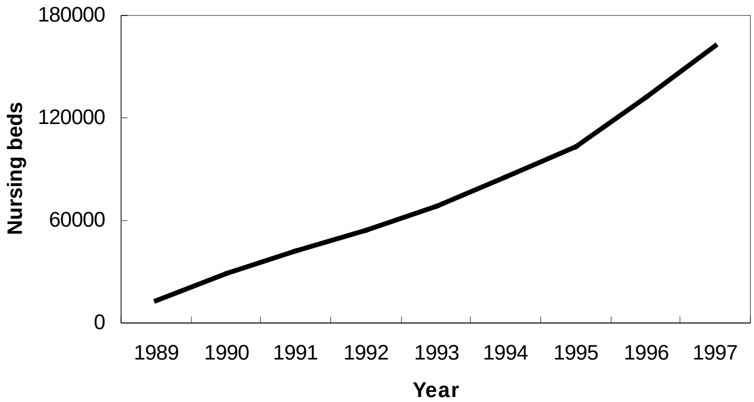

Figure 8: Growth of Japanese nursing beds since 1989.

In Table 4, a simple ratio analysis is used to calculate the nursing home supply gap. In ca. 2000, there were 900,000 deaths, 600,000 bedridden patients and 200,000 nursing home beds. In 2020, according to UN population projections, there will be 1,800,000 deaths. Assuming that the ratio of bedridden chronically ill to deaths remains at 0.67, this would imply 1,200,000 bedridden chronically ill. Even to keep the ratio of nursing home beds to chronically ill bedridden patients constant at its current level of 0.33 will require the availability of 400,000 nursing home beds, twice the current number. Raising it to 0.5 in view of the scarcity of home care noted in the previous section would require 600,000 nursing home beds. Clearly the challenge facing Japanese policy makers in the area of long term care is a considerable one.

Year	2000	2020
Deaths	900,000	800,000
bedridden and chronically ill	600,000	1,200,000
nursing home beds	200,000	600,000
Availability : need	0.33	0.5

Table 4: Nursing home bed availability and need

Discussion (by Landis MacKellar)

It is now broadly recognized that growth in the number of elderly persons is neither necessary nor sufficient for rising health care expenditure. Say, for the sake of simplicity, that medical spending is just the cost of dying; i.e., that health care expenditure is equal to the number of deaths times the price tag on each death. Then health care spending would rise only if the number of persons dying in an average year increased or if deaths were redistributed from age spans over which it is cheap to die to age spans over which it is expensive to die. Regarding the first, if two stationary populations of identical size but with different life expectancies are compared, the population with greater longevity will have a smaller number of deaths per year (because fewer persons will be born each year as well; that is why the two populations are of identical size). Not surprisingly, therefore, according to the stationary population model in Section 1, the crucial variable from the standpoint of health costs is not longevity, but the length of the period of chronic illness before death (the price tag, in our parlance). Regarding the second source of increased heath care spending, some evidence shows that deaths occurring relatively early (in the sixties and seventies) involve greater medical expenditure than deaths occurring relatively late (the eighties and nineties). Seen from this perspective, increases in longevity are an unlikely source of higher health care spending.

Among the more striking conclusions from this paper is that in terms of the demographic contribution to rising health care costs, the worst is already over. The contribution of demographic aging peaked in 1980-1995. The contribution of population growth is now negative.

Not all costs associated with old age are medical. Many older elderly are not chronically ill but are nonetheless to a large degree dependent, requiring non-medical care such as meals-on-wheels, assistance with simple daily tasks, etc. Analysis of longevity trends leaves little doubt that life expectancy in Japan will continue to increase, meaning that survival into the nineties will become commonplace. One of the most striking aspects of the Japanese health care system has been the underdevelopment of both institutional and outreach care of the elderly. Part of the reason has been reliance on the three-generation household as a source of elder care; however, as this paper makes clear, a demographic squeeze is developing in the supply of in-family caregivers. Increased mobility of children and increased attachment of women to the labor force make the demographic squeeze even tighter. Japanese policymakers have recognized the need for expanded elder care facilities and outreach institutions and, with the Gold Plan, have put in place a policy package that will address these needs.

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