

Low Fertility and Population Aging in Germany and Japan:

Prospects and Policies

Warren Sanderson

May 2, 2008

1. Introduction

Almost all developed countries currently have below replacement fertility (United Nations (2007)), a situation in which the average woman of reproductive age does produce enough offspring to replace herself with one daughter of reproductive age in the next generation. Indeed, a number of these countries are in a group characterized as having the lowest-low fertility. This normally means that, on average, 100 women of reproductive age replace themselves with less than 75 daughters. In the long-run, when age structure effects of baby booms and the like are washed out, that rate of reproduction would lead to population shrinkage of around 0.95 percent per year. This pace of population shrinkage would cause a population of 100 million people to be reduced to 38 million over the course of a century. If, on average, 100 women of reproductive age produced 70 daughters, in the long run a population of 100 million would have 30 million descendants a century later. If they had 65 daughters, the population would shrink to only 24 million after 100 years. All of these figures assume that there are no changes in mortality conditions and no immigration. These rates of reproduction are not hypothetical. Countries with the lowest-low fertility are experiencing them now and are taking actions to raise their fertility rates. But what, if anything, should be done about those low fertility rates and why should it be done? These are the questions addressed in this paper.

It only takes a moment's thought to realize that the lowest-low fertility is a very peculiar phenomenon. No other species of animal, with ample food and the other essentials of life, fails to reproduce itself. In long-run, this is a strategy that is likely to lead to extinction. Part of the visceral dislike that some people feel about population shrinkage comes from the association of population shrinkage with wars, famine, disease, and massive out-migration. When we think about population shrinkage, these ingrained associations color our attitudes. Today, we are dealing with a new situation, one of voluntary population shrinkage in an environment of high living standards. People are choosing to have few children not because of deprivation, but even as they have wealth that was hardly imaginable a century earlier. While the aggregation of individual actions does not always lead to a socially preferred outcome, economists like to understand why it does not before they recommend policies designed to make people change

their behavior. Indeed, it is argued here that such an understanding is crucial to the formulation of appropriate future policies regarding fertility.

The very peculiarity of voluntary population shrinkage in an environment of high living standards suggests a useful perspective on policy formation. The voluntary shrinkage of rich national populations is a very recent phenomenon. For all of its existence humans had two strong forces that sustained childbearing, the sex drive and the need to have children to support their aging parents. With modern contraceptives and modern finance, these two props have disappeared. Given the variety of cultures, policies and socio-economic institutions among rich countries today, it is not surprising that, in some places, no socio-economic arrangements have emerged yet to sustain fertility.

From a longer-term perspective, the voluntary population shrinkage of wealthy countries could be a transitory phenomenon. Humans respond to their living conditions and a transitory period of shrinkage could be just what is needed to alter older ways of doing business to newer ones that support fertility. We can learn some lessons here from the earlier debate on family planning. Advocates of family planning scared many people with their computations of how many people would be on Earth if past growth rates continued for centuries. Of course, these growth rates did not continue. Advocates of pro-fertility policies can now scare people with computations of how few people would live in certain countries if low fertility persisted for centuries. But these low fertility rates may also not persist. We discuss reasons why current low levels of fertility may not continue in Section 6 below.

In nature, species that cannot adjust to changes in their environments die out. In our own genus, *Homo erectus*, *Homo habilis*, and *Homo ergaster*, among others, are no longer with us. Closer to home, many cultures, such as those of the ancient Egyptians and the ancient Mayans, have died out. But we have no evidence, at least as of yet, of rich populations simply breeding themselves out of existence.

Of course, if we believed strongly that fertility would rebound on its own, the case for policies to increase fertility would weaken. On this score, we can learn another lesson from the earlier debate on family planning. We can also learn that adjustments to the environment are imperfect. Economic development and family planning programs helped reduce fertility in many countries around the world. Still, there are a number of countries, especially in Sub-Saharan Africa, where rapid population growth is one cause of lowering standards of living and in which fertility remains high. There is no reason to argue that countervailing forces will automatically emerge that will raise fertility back to replacement level in all countries. In some countries, weaker versions of those forces could be present and good policies would identify and strengthen them.

Thus, there are two intellectual traps for us to avoid, the Scylla and Charybdis of these sorts of population discussions. The first is that because fertility is low now, it must remain low forever in the absence of new policies. The second is that no new policies are needed because of automatic homeostatic forces. We must steer clear of both of these if we are to arrive safely at some understanding of appropriate responses to the challenge of very low fertility.

Once we allow ourselves to consider the possibility, but not the necessity, of new policies two observations immediately constrain our choices. First, in general, fertility policies are costly. Policies of providing subsidized childcare or mandating minimum paid parental childbearing leaves cost money. Sometimes the money comes from the government and has to be raised through taxes. Sometimes it is a levy on businesses. In addition to monetary costs, there are also political adjustment costs. The costs and benefits of fertility policies are not borne uniformly. There are always gainers and losers. The distributional consequences of these policies always have to be considered. Some fertility policies would benefit members of younger generations at the expense of older populations. These policies may become more difficult to enact as electorates age. Fertility policies always have opportunity costs.

The second observation is that higher fertility is not a goal in itself. Economists normally assume that improving human well-being is the goal toward which policies should be directed. Perhaps many of the goals of fertility policies would be better met by improving the skills and capabilities of the people who would be in the country in any case. Perhaps spending more money on schooling would have more of a positive impact on the well-being of citizens than spending the money on having more people. Fertility policies need to be evaluated not just on whether they would produce more births, but in the broader context of whether they improve well-being more than alternative policies.

Policy formulation and evaluation need to be dynamic. Fertility policies need to be designed to be evaluated and adjusted. Here we can run into two sorts of problems. The first is a sort of policy hubris. Policies are put in place and their effects on fertility are measured in their first years of operation. But many other things could have influenced fertility in those years. To evaluate and adjust a policy requires some knowledge of how it works. There is a literature in fertility analysis on the effects of social interactions (see Kohler (2001), for example). The literature suggests that fertility behavior is influenced, in part, by the actions of other people. A policy may appear to have little effect in its first few years of implementation, but could have a much larger effect over time because of its indirect effects through social interactions. In order to understand how fertility policies work, we need to establish a much deeper scientific grasp of fertility determinants than we currently have. A major hindrance to a better scientific understanding of how fertility policies work is the lack of appropriate data. We need, at a minimum, data on birth rates by age, birth order, and year and preferably age- and birth order-specific birth probabilities. Supplementing these with information about the education level of

the mother and her location would be a great boon. Without the needed information, the development and evaluation of fertility policies will remain a shot in the dark.

In order to consider fertility policy in a more concrete setting, we look at two countries here, Germany and Japan. Both are very wealthy and both are experiencing very low fertility. In 2006, 100 German women, on average, had a number of babies that would result in 65 daughters replacing them in the next generation. In Japan, the comparable number was 64 daughters. They are hardly the only rich countries to have the lowest-low fertility, but they provide good representative cases for study.

2. The Quantitative Effect of Fertility Policies

Before we begin discussing fertility policies it is useful to have in mind what such policies are likely to achieve. The easiest way to do this is to look at some of the population projection variants produced by the United Nations (United Nations (2007)). These variants differ only in terms of their assumptions concerning fertility and so they are exactly what we need for our purposes. Figures 1a and 1b show the UN fertility assumptions for four of their variants for Germany and Japan respectively. They are graphed in terms of the average number of daughters born to 100 women of reproductive age in the indicated period, who would survive to become reproductive age women in the next generation. A figure of 100 would indicate that women were exactly reproducing themselves. For short, we refer to these numbers as “daughters per 100 women”.

The four variants are the medium variant, which is the best guess as to what the future is likely to be, a constant fertility variant, and two variants, a high one and a low one, that bracket the medium variant. Fertility in the medium variant, for both Germany and Japan is expected to rise. In Germany it increases by 29 percent over the period 2000-05 to 2045-50, from 65 daughters per 100 women to 84 daughters per 100 women. In Japan the increase over the same period is 24 percent, from 62 daughters per 100 women to 77 daughters per 100 women. The high and low variants are quite unlikely. The high variant for Germany has the number of daughters per 100 women rising from 65 in 2000-05 to 108 in 2045-50. In Japan, the rise during that interval is from 62 daughters per 100 women to 102. In the high variant, fertility is above replacement level in both countries by mid-century. The low variants show precipitous falls in fertility in both countries after 2000-05 followed by an increase that leaves fertility even lower in 2045-50 than it was in 2000-05.

There are two main reasons for the UN’s assumption that fertility would increase in its medium variant. The first is a technical issue. The figures on the number of daughters per 100 women

are influenced both by the average number of children women have over their reproductive lifetimes and the ages at which they have those children. Increases in the average age at childbearing, which have been occurring in both Germany and Japan, depress the figures on the number of daughters per 100 women relative to what they would be if that average age were constant. Because the average age at childbearing cannot increase indefinitely, if the average number of children women have over their reproductive lifetimes remains constant, the number of daughters per 100 women must rise. The second reason is that the UN assumes that Germany and Japan will introduce additional policy measures that will increase fertility.

Thus, comparing population sizes assuming constant fertility and the UN medium variant provides a rough estimate of the combined effects of the two causes. Tables 1a and 1b show those combined effects. If fertility remains constant, the UN forecasts the German population to be 69.7 million in 2050, down from 82.7 million in 2005. If fertility follows the path of the medium variant, German population would be 74.1 million in 2050, or 4.4 million people higher. In Japan, the situation is similar. With constant fertility, the UN forecasts that Japan's population would be 99.3 million in 2050, down from 127.9 million in 2005. If fertility followed the medium variant Japan's population in 2050 would be 102.5 million, 3.2 million people more than it would have had under the constant fertility scenario.

These are strikingly small effects especially when we remember that not all of them can be attributed to expected new population policies. Would the welfare of Germans in 2050 really be that much higher if the German population were 4.4 million people larger? Would the addition of 3.2 million Japanese in 2050 markedly improve the welfare of the Japanese people?

Under the constant fertility scenario, Germany's 2050 population would be roughly what it was in 1954 and Japan's 2050 population would be roughly what it was in 1966. If Germany's population size was acceptable in 1954 and Japan's was acceptable in 1966, then, to make an argument in favor of increasing fertility, we would need to know why they would be unacceptable in 2050.

Another way of looking at the data in Figures 1a and b and Tables 1a and b, is to look at the difference between the medium variant and the high variant. We can do a thought experiment in which the medium variant is what would happen in the absence of additional policies that increased fertility and the high scenario is what would happen if we had wildly successful fertility policies. We characterize the high scenario as being wildly successful because it assumes that by 2015-20, fertility is increased by around 24 daughters per 100 women compared to what it would be in the medium scenario and that this difference remains through 2045-50. There is no suggestion in the literature that such a large effect of is even possible. So by comparing the UN high variant with its medium variant, we get an upper bound on the effects of any plausible fertility policy. In Germany, this upper bound is an increase in the population in

2050 by 11.4 million people, from 74.1 million to 85.6 million. Instead of decreasing by 8.6 million people, as it would under the medium variant, it would increase by 2.9 million. In Japan, the upper bound on the population increase would be 15.8 million people. Instead of decreasing by 25.4 million people, Japan's population would decrease by 9.6 million. Of course, the likely effects of a fertility policy would be much smaller.

An objection to this analysis could be that we should not stop at 2050. This is the Scylla of population size discussions and it is dangerous to go there. Things do not stay the same. Making long term forecasts on the basis of constant fertility is misleading. This essay was written in 2008. Think back to 1958. A discussion that forecasted the fertility situation that we now observe would have been considered ludicrous. Nevertheless, we are now living in it. Fertility in 2050 is not likely to be easier to forecast than today's fertility was half a century ago.

The effects on population size of any plausible fertility policy are not expected to be large by 2050. In order to understand if the magnitudes of the gains will offset the costs, we need a clearer picture of the goals that fertility policies are supposed to achieve.

3. Why Do We Need Any Fertility Policy?

In this section, we deal with the major arguments in favor of pronatalist policies.

3.1 Arguments based on population size

Here we discuss arguments in favor of policies to increase fertility based on population size alone. We defer consideration of arguments based on age structure effects to a later sub-section. Two types of arguments occur often. The first is based on ethnic identity. There is sometimes a fear that if the numbers of people with a certain culture and heritage falls too low, then that culture and heritage will get lost. This argument is surely true, but it hardly applies to either Germany or Japan. Sweden's population was 9.0 million in 2005 (United Nations (2007)). It still has a viable culture and is able to maintain its traditions and historical heritage. The argument that we need fertility policies in Germany and Japan to maintain culture, traditions, and heritage must, therefore, be rejected.

Another argument for policies to increase fertility is that international power and prestige are related to population size. This may be true, but international power and prestige is based on many other factors as well. Nevertheless, having a few million more people by 2050 is hardly likely, by itself, to have much influence on a country's international power and prestige. Even if it did, people may not wish to pay much for it. After all, would the citizens of Switzerland or

Sweden, for example, wish to double their population sizes simply because of the additional prestige that could possibly come along with it? Probably not.

If our view only goes up to 2050, it is difficult to imagine that fertility policies would have anything other than a trivial effect on the ability of Germany and Japan to maintain their cultural traditions or on their relative international power and prestige. Recall again, that here we are addressing only population size not population age structure. Arguments concerning population size have the most power when they are applied to the long-run. But here we have to be careful about assuming that current conditions will remain constant into the future. Arguments concerning population size suggest that appropriate policies need to be designed for the long-haul and that they need to be flexible enough to take changing conditions into account. They do not suggest that we need to implement strong fertility-increasing policies right away.

3.2 Arguments based on population growth

It could be argued that we need more babies because population shrinkage reduces the rate of per capita income growth. This argument is somewhat ironic given the large literature arguing the rapid population growth decreases the rate of per capita income growth, but nevertheless deserves mention here. Empirical evidence suggests that changes in the rate of population growth, holding age structure constant, has only a very weak effect on the rate of per capita economic growth (Kelley and Schmidt (2005)). Most of the ill-effects of low fertility on the economy, such as difficulties in sustaining national pension commitments arise because of the age structure effects that we discuss below.

Population growth is not free, even if population policies to promote fertility were costless. Children are an investment. They cost money to raise, to educate, and to keep healthy before they become productive in the labor force. There is no evidence to suggest that investing in more children is more efficient than in investing more in the children that would be there in any case.

Arguments based on population size and growth do not, in themselves, provide a strong basis for advocating policies to increase fertility immediately. In the long-run, countries need to find a way to maintain their populations. Whether this could happen automatically, even in the absence of fertility policies, is addressed in Section 4below.

3.3 Arguments based on fertility levels

When we study complex dynamic processes like population growth, it is often useful to distinguish conditions that lead to negative feedbacks from those that lead to positive feedbacks. Negative feedbacks are stabilizing and positive ones are destabilizing. If the lowest-low fertility was part of a negative feedback system, then it would generate forces within the system to bring fertility back up. If it were part of a positive feedback system, then the lowest-low fertility would generate forces that tend to keep fertility low or perhaps even drive it lower.

Recently, Lutz and Skibekk (2005) proposed a hypothesis that is a variant of the positive feedback conceptualization. They suggested the possibility that when fertility fell below 75 daughters per 100 women social changes would begin that would make increases in fertility more difficult to achieve. The low level fertility trap hypothesis is plausible enough, but its application to Germany and Japan is not immediately clear. Both countries are below the trap threshold and have been there for some years now. A potential elaboration of the low level fertility trap hypothesis might be that the difficulty of escaping from the trap increases with the number of years in which fertility is below the threshold level. It is important to emphasize here that the feedback mechanism envisioned in the low level fertility trap hypothesis works off of the level of fertility itself, not on population size or population growth. Fertility is treated as a social phenomenon with past levels of fertility positively influencing current levels through changes in the socio-economic environment in which people live. Long periods of the lowest-low fertility could allow adaptations to take place that make the lowest-low fertility the normal state of affairs and make changing it harder. If this were the case, then it argues for strong fertility-increasing policies now, because to achieve the same effects later would be more costly and more difficult.

One intriguing feature of the low level fertility trap hypothesis is that it links the long-run and the short-run. It suggests the possibility that we might not be able to solve the long-term problem of population shrinkage if we do not take actions soon, not because population size will quickly get too small, but rather because of the cost of raising fertility will become so large that even in the long-run it would be extremely difficult to do it.

The implications of the low level fertility trap hypothesis for the development of fertility policies are as unique as the hypothesis itself. Policies that are just addressed to the issue of numbers would emphasize long-run policies that increased the average number of children ever born to women. Demographers call these “quantum” policies. If we were basing policies on correctness of the low level fertility trap hypothesis, we could, in addition, employ policies that had only transitory effects. Policies that affect only the timing of births and not the average number of births are called “tempo” policies. Their effects are inherently temporary, but even temporary effects could be very powerful according to the low level fertility trap hypothesis. A temporary increase in fertility would enhance the effects of other policies, thus potentially propelling a country out of the trap. An interesting tempo policy suggested in Lutz and Skibekk (2005) is to

get students through college and into jobs more quickly and there are many others that could be considered.

3.4. Arguments based on Aging and the Economy

There are three related arguments for fertility policy that come from considerations of the age structure, the influence of age structure on economic growth, the sustainability of public pension systems, and externalities generated by pay-as-you-go public pension and health care provision. We deal with each of these in turn.

3.4.1 Age structure and economic growth

Age structure affects economic growth. Kelley and Schmidt (2005) delineate two sorts of effects. There is an accounting effect. When the working age population grows more rapidly (slowly) than the population as a whole, the increasing (decreasing) ratio of workers per capita raises (lowers) the rate of growth of GDP per person. Even after the accounting effects is taken into consideration, there is also what Kelley and Schmidt call a productivity effect in which per capita economic growth and the ratio of the working age population to the total population are positively related. Increases in fertility initially lower the ratio of the working age population to the total population and hence lower the rate of economic growth through the productivity effect. This reduction in the rate of growth is partially reversed when the additional young people enter the labor force. Increases in fertility initially also lower the ratio of workers to the total population further decreasing the rate of growth of GDP per capita.

3.4.2 Pensions

The Kelley and Schmidt (2005) analysis is based on countries observed from 1960 through 1995. The effects of aging on pension systems were far less pronounced in that period than they will subsequently become. It could be argued that having more children helps keep national pension systems more sustainable by providing more people over whom the spread the burden of supporting the elderly. This is certainly true, but the argument is not fully persuasive. If a policy to increase fertility was begun immediately, we would have to pay for the cost of the program and then the cost of raising the additional children until they reach the age when they can make consequential contributions to national pension systems. This may take 30 years or so. Most current pensioners would be dead by the time the program began to pay a positive dividend and even more future pensioners would be dead by the time a break-even date was reached.

In both Germany and Japan, there are tools at hand to make public pension systems both sustainable and more intergenerationally equitable. In March 2007 the German Bundestag passed legislation increasing the normal pension age gradually from age 65 to age 67 over a

period of 18 years beginning in 2012. During the first 12 years, the normal pension age is to increase by one month per year. During the next six years, it is to increase by two months per year. Japan has a two-tiered pension system, with a national pension covering everyone in the country and a separate tier based on a person's type of employment. The normal pension age in the national system is 65. Reforms in 2004 stipulate that the normal pension age for an employee's pension is to rise gradually from 60 to 65 by 2025 for men and by 2030 for women. In addition, pensions in Japan are indexed for life expectancy change and other demographic characteristics (Takayama (2004), Sakamoto (2005) and Foreign Press Center (nd)). Both the German and Japanese pension reforms are important steps in creating sustainable pension systems and are certainly cheaper than supporting pension systems through having more children.

3.4.3 Externalities

Externalities are the bread and butter of economic arguments for government intervention. Pay-as-you go public pension systems and other publicly provided services, such as health care, when combined with the age structures typical in more developed countries generate a positive externality to population growth. This is because the net flow of wealth transfers in these systems is upward, on net from younger to older people. Having more working age adults diminishes the burden on each one of them to support the older generation. Lee and Miller (1990) found that the externality in the United States in 1985 due to intergenerational transfers was roughly 50 percent higher than per capita GNP in that year. Werding and Hoffmann (2005) found a similar sort of externality in Germany in 2000 to be 77 thousand euros (over two generations).

Wealth flows through public programs are not unidirectional. In general, wealth flows from working age adults downward to support children and upward to support the elderly. The direction of the net flow depends on the number of children and elderly as well as the support that each group receives. A policy to increase fertility initially increases the burden on the working age adult population because it has to provide for the care, education, and health of the young. It is only as these young eventually become working age adults themselves that they reduce the burden of supporting the elderly.

Fertility policies do not immediately and costlessly resolve the externality issue. Rather fertility policies are more like a costly investment, whose payoff over time is related to the externality to childbearing. It is not clear that this investment has a competitive rate of return. Therefore, before we can argue that externalities to childbearing provide a strong reason to implement fertility policies, we need to do the analysis in a dynamic setting and estimate its rate of return.

3.4.4 Investing in skills and health rather than numbers

An alternative approach to dealing with an aging population is to invest more in the population that would exist even in the absence of fertility policy. The scope for such investments is substantial ranging from improving early childhood education to training people for second careers later in life. A persuasive argument in favor of policies to increase fertility because of its effects on the economy would need to show that it would be more efficient than a policy of investing in the skills and health of the existing population.

The evidence is not strong that the age structure effects associated with faster population growth would increase per capita income growth. There is also not a strong argument to be made that faster population growth is needed for a sustainable public pension system. In order to make this case, we would have to argue that policies to have more children would be more welfare enhancing than policies that directly affect pensions, such as changing some of the characteristics of the pension system. While pay-as-you-go pension systems combined with the age structure in today's richer countries generates a positive externality to childbearing, it does not follow that an investment in a fertility increasing program will yield a competitive rate of return. This is because of two reasons. First, the additional children require substantial investments in areas such as schooling and health care. Second, the payoff to additional children only happens after the children enter the labor force. In seeking a stronger argument for fertility policies, we must look beyond the traditional claims. We do this in the next two sections.

3.5. Aging and Politics

In a provocative article Sinn and Uebelmesser (2002) argue that there is not much time for Germany to carry out pension system reforms (see also Uebelmesser (2004) and Bergstrom and Hartman (2005) for similar calculations for other countries). Younger people benefit from those reforms and older people lose from them. As the German electorate grows older the ratio of losers to winners decreases and eventually becomes greater than one. They write:

“An impending demographic crisis in Germany calls for fundamental reforms of the pension system. In a democracy, however, reforms require the support of the majority of the electorate. To determine whether the majority is in favour of reforms of the pension system, we calculate for each year the “indifference age” as the age of the cohort that is not affected by the reform and the “median age” as the age of the politically decisive cohort. Until 2016, a reform can be democratically enforced. After 2016, Germany will be a gerontocracy.” (Sinn and Uebelmesser (2002))

The 2016 date was computed before the recent changes in German pension law that increased the age in the future at which a full pension could be received. Now the comparable date would be

somewhat later. Nevertheless, any fertility policy is unlikely to have much effect on the computed date of the onset of gerontocracy.

Focusing on the precise date of the onset of gerontocracy, however it is defined, interprets the Sinn and Uebelmesser argument too narrowly. It is not simply pension reform that is at issue. As populations age, there is an impact on democratic processes. There are a large number of ways, some intentional and some not, in which resources can be reallocated from the young to the old. After a while, fertility policy can influence the age composition of the electorate and perhaps keep some of those reallocations from happening. The scenario that as populations age, the democratic process shifts resources to older people, making younger ones relatively worse off and possibly decreasing their fertility is a positive feedback effect in which aging produces even more rapid aging (see McDonald and Budge (2005), for a discussion of the relationship between age structure and government spending)).

Table 2 contains some information about the future age composition of the voting age populations (VAPs) of Germany and Japan. In 2000, the median age of members of Germany's VAP was 46.2. By 2025, it was expected to rise to 54.2 and to 57.7 by 2050. Japan's VAP is older. Its median age was 49.2 in 2000 and was expected to increase to 55.5 in 2025 and 62.6 in 2100. Certainly at first glance the forecasted median ages seem quite high. If 65 remains the normal age at a full pension in Japan, then by 2050, a majority of the Japanese VAP will be supported by public pensions, once disability pensions and spouses supported by their older partners' pensions are taken into account. A situation where a majority of the voters have incomes that depend on public policies upon which they can vote is uncharted territory. Germany is not far behind. The median age of the VAP is around 5 years less than Japan's in 2050, but Germans typically retire earlier than Japanese and so the difference in terms of voting is likely to be less. In both countries, an understanding of the political effects of aging is important for the formulation of appropriate policies.

One fear that emerges when discussing the implications of older electorates is that the time horizon of the median voter will become much shorter and this will lead to a great emphasis on policies with shorter term payoffs. We have discussed the fact that population policies have their main payoffs in the long-run. On this ground, older electorates may be less interested in them. Column 2 in Table 2 addresses this issue. Life expectancies are likely to be increasing at the same time as VAPs will be aging. The data in that column show that when this is taken into account, we can see that the time horizon of the median aged voter will not change by very much during the first half of the century. Because of life expectancy increases older electorates will still be motivated to seek policies that will sustain their pensions (see Sanderson and Scherbov (2007) for a more detailed explanation).

Voting is one area in which investment in skills cannot compensate for numbers.

3.6. Helping People Achieve Their Desired Fertility

One reason to support fertility increasing policies is the gap between fertility levels that people say that they desire and the number of children that they eventually have. In both Germany and Japan, the levels of fertility that people say they would like are well above what is attained in practice. Table 3 shows the ideal number of children, the intended number of children, and the actual number of children of once-married Japanese women who were married for 10-14 years. By 10-14 years of marriage couples have almost all the children that they are going to have. The highest series is always the ideal number of children. The intended number of children is lower because it reflects more constraints. In the surveys, reasons given for having a lower intended number of children include things like the high cost of children and an unwillingness to have children at a more advanced age (Kaneko et al. 2008a). The lowest series is always the actual number of children. German data on desired fertility are also well above actual fertility (Heiland et al forthcoming). In passing, we should note that the declines seen in Table 3 in ideal fertility and actual fertility from 1992 to 2005 are consistent with the fertility trap hypothesis.

We see something similar in Japan when it comes to marriage. In surveys unmarried Japanese women continue to say that they would like to get married some day (Kaneko et al. 2008b), but the proportion of 35-39 year old women who have never married rose for decades up to 2000, the last date at which I could find data. Rather amazingly, that proportion increased from 7.5 percent to 13.8 percent from 1990 to 2000 (National Institute of Population and Social Security Research 2006).

If policies reduce people's utilities by keeping them either from marrying or having the children that they want, then changing those policies or adopting counteracting policies would result in an immediate welfare gain that could potentially outweigh the costs of the policies. This is potentially a stronger argument that those depending on population age structure because of the timing of its effects. Policies to affect age structures take decades to become effective. Policies to help people attain what they desire would have an impact right away.

The problem with this argument is that it does not seem so sensible when we view it in the context of other things. For example, someone could ask people about their ideal number of luxury automobiles, such as Mercedes-Benz or Lexus. Their average number of such vehicles would always be smaller than the ideal number. We would certainly make some people better off by subsidizing luxury cars, but would this be appropriate public policy? Certainly not. To make the argument that costly policies that make some people better off should be undertaken, we would have to pay close attention to the distribution of costs and benefits of those policies.

In summary then, arguments in favor of fertility policies based on population size alone are not very compelling. Arguments based on age structure are not very strong either. For example, it is likely to be much more efficient to make public pension systems sustainable by changing the characteristics of those programs than to support them through having more children. Two sorts of arguments potentially have the most power. The first is an adaption of the long-term fertility trap hypothesis. If the difficulty of a country extricating itself from the trap depends on the length of time in it, then quick action to increase fertility could be an appropriate policy. The second has to do with reducing constraints on people's nuptiality and fertility behavior. An even stronger argument can be made by combining these two arguments with those concerning voting.

Even so, we are not left in the end with a clear-cut case in favor of fertility policy. The long-term fertility trap hypothesis remains a hypothesis. It may be possible to produce a Pareto optimal improvement in welfare in ways that also increase fertility, but this is far from certain. Because we are not compelled by logic or data to adopt pronatalist policies, it is natural to ask what might happen in their absence.

4. What Might Happen in the Absence of Additional Fertility-Increasing Policies

Regardless of the fact that the arguments in favor of pronatalist policies require additional evidence to be economically convincing, Germany and Japan have been implementing these policies for at least two decades now. These policies include child allowances, paid time off for parental leave and tax reductions. Germany's history is more complex than Japan's because reunification in 1990 significantly reduced the support for fertility in the East. Current policies have not been obviously successful, since Germany and Japan continue to have quite low fertility. Nevertheless, it is possible that without these policies fertility could even have been lower. So the question naturally arises about what would happen in the absence of additional policy interventions.

The standard computation of the number of daughters who would replace women of childbearing age in the next generation produces a figure that depends both on the number of children women have over their reproductive lives and on changes in the ages at which they have those births. This is a technical matter, but it is well-established in the demographic literature (Bongaarts and Feeney (1998)). In the absence of other changes, fertility is expected to rise as the speed at which births are postponed to older ages slows. The order of magnitude of this effect for Germany and Japan may well be in the neighborhood of 10 to 20 daughters per 100 women. Without further policies, births, therefore, could go up from around 65 daughters per 100 women in Germany and Japan now to somewhere around 75 to 85 daughters per 100 women. If additional fertility

policies were introduced, politicians could well take credit for this increase, but it could come in any case. This phenomenon suggests caution in the development of fertility policies. They simply may not be needed.

Of course there will be many other changes (Lutz, Sanderson and Scherbov (2001) and 2008)). There are two interesting polar scenarios to consider. The negative feedback loop scenario sees low fertility endogenously generating forces that increase fertility. There are various possible ways of envisioning how this scenario might come to pass. Low fertility reduces the share of young people in the population. As these people become relatively scarce, they get higher wages as businesses compete for them. Not only do they get higher wages but early lifecycle economic uncertainty is reduced as well. The increased well-being of the young allow them to leave their parental homes earlier, get married earlier, and begin childbearing earlier.

A negative feedback loop could also be generated because of heterogeneity. In every national population, there are subpopulations with higher than average fertility and those with lower than average fertility. Very low fertility could eventually lower the proportion of the population in the lowest fertility subgroups and raise the proportion in the higher fertility ones. Heterogeneity is also important on the level of individual couples. Couples who have children in an environment of very low fertility are different from those that do not. The couples with children have been able to cope with the obstacles to childbearing. Perhaps their children, having grown up in families that have been able to overcome those obstacles, would be better prepared to overcome them themselves.

We could put this last argument in a Japanese context. Fertility is low today in part because so many Japanese women remain childless. One reason that is often cited for this is that Japanese men work long hours and contribute little to childrearing, leaving Japanese women with little scope for mixing work and family. But Japan is changing. Couples with children may be ones where the conflict in gender roles is likely to have been resolved to some degree. A greater fraction of children, therefore, could be brought up in such households bringing slow social change to the expectations about gender roles in the future. Still, this formulation is highly speculative. Japan is more culturally homogeneous than Germany and so negative feedback loops based on heterogeneity are likely to be weaker there.

These economic and social arguments suggest the possibility that fertility could increase, even in the absence of further policies. If fertility would rise because of the slowing of postponement of births and these negative feedback effects were strong enough, then no additional fertility policies would be needed.

The positive feedback scenario goes something like this. The postponement of fertility slows bringing upward pressure on fertility, but this is offset by an increase in childlessness and a

decrease in the number of children parents want. Very low fertility causes a reallocation of resources from the young to the old, in part, perhaps, through an increase in taxes to pay for pensions, healthcare, and other forms of old age support. To keep pension systems healthy older workers are encouraged to retire later. The pattern of making the young pay for economic adaptations to changing market conditions is reinforced through a democratic process that is increasing dominated by the votes of the ever more elderly electorate. This increases economic stresses on the young leading them to have even lower fertility. The young could migrate to cities where a concentration of young people still provides the kind of life style that they enjoy leaving parts of the country to age even more quickly or perhaps to migrate to other countries where opportunities are better.

Parts of this scenario are already visible in Germany and Japan. In July, 2006, the news magazine *der Spiegel* had a cover story about Germany's "Generation Praktikum", which roughly translates into the internship generation or more figuratively the eternal internship generation. This is the generation of young Germans who go from one (usually unpaid or low paid) internship to another for years without being able to find a long-term job. In Japan, the proportion of working poor in the labor market has been increasing (Economist (2008a)) and the prospects of a young person finding long-term job security are also decreasing. Japanese have various expressions for the increasing number of young people who are not in full-time employment. "Freeters" are akin to the "Generation Praktikum." "Freeters" usually have low paying temporary jobs and often move between employment and unemployment. The term "NEET" originally comes from the UK, but is also now used in Japan. It stands for those not in employment, education or training. The number of "freeters" and "NEETS" has increased in Japan. Young people without permanent jobs in Germany and Japan often do not have the financial resources to start families and find getting on a stable career path later in life more difficult. The effects of an older population on the intergenerational redistribution of income can already be seen in Japan. In 1996, the age group that had the highest per capita income after taking government redistribution programs into account were those 80+ years old (Takayama (2005, Figure 2)). In both countries migration has caused certain places to age dramatically, potentially reducing support services for young families.

Still, where does all this leave us? It could be that we do need fertility policies or it could be that we do not. It could be that we have plenty of time to formulate appropriate policies or it might be that we should act quickly. Why at this late date are we still so uncertain? The answer is in part political and in part academic. Politicians have not seen to the production of the data necessary to understand the dynamics of low fertility and academics have not prodded them by providing many hypotheses that would frame how those data should be collected and analyzed. We discuss this more in Section 6 below. We stand here now, ready to go on to a section on

possible policies, knowing full well that the data and the intellectual frameworks needed to support one policy over another are lacking. It is a sad state of affairs.

5. Possible Policies

Because of the uncertainties involved, we are not in a position to make serious policy recommendations. What we can do is to sketch out the elements of a policy-making environment. There are a number of rules that should be followed here. The first is to recognize the uncertainty of the situation and to design policies that are flexible. The second is to begin with win-win policies. These are policies that are cheap and which we would want to implement in any case. The third is to base policies explicitly on arguments that can later, at least in principle, be tested.

There are, broadly speaking, two classes of policies to consider. The first is the set of policies designed to reduce the cost of childbearing. A number of these policies are already implemented in Germany and Japan. They include income supplements for parents who have children, subsidies in the costs of childcare, and various labor market regulations relating to leave time for parents of young children, job retention, and the like. Some countries, such as Singapore, provide housing subsidies to families with children as well. Potential policies such as linking public pension payments to fertility would fall into this category too. These policies are addressed to couples and are aimed at inducing them to have more children than they otherwise would have. A variety of these policies are already implemented, not only in Germany and Japan, but in many other countries as well, and the general consensus is that they have a small positive effect on fertility. (Gauthier (2007)) The very continuation of very low fertility in Germany and Japan and the continuation of the discussion about what to do about it immediately suggests that, up to now, these policies have not been conspicuously successful.

There is, however, another approach to fertility policy that has received much less attention. It is bolstered by the existence of Generation Praktikum and “freeters”. Young people in Germany and Japan have been finding it harder and harder to get good stable well-paying jobs. They bounce around trying to find their place in the economy. Even when they succeed in finding a stable well-paying employment, they often experience an initial period of long work hours as they establish themselves. As a result, people do not feel that they have the resources or time to form families and have children. Some never do and some wait so long that low fertility is ensured.

If this view is correct, then fertility policy formation is much more difficult. The needed policies would be ones that supported the economic well-being of young people. Fertility policy, in this

view, would not be aimed directly at the production of children, but indirectly at this goal by enabling couples to marry and have children earlier. This is not as simple as subsidizing childcare. Young people need expeditious training for the kind of jobs that exist and there needs to be enough good jobs to employ them. Labor market reforms need to address not only the need for international competitiveness, but the need for young to have good enough incomes before they are too old to have children.

There is no sense in suggesting specific policies to support the younger generation, but several sorts of comments are in order here. First, there can be a tension between policies aimed at supporting the older generation and those supporting the younger generation. Policies that support the older generation at the expense of the younger one are likely to encourage low fertility.

Government policies are mediated through the electoral process and as electorates age, policies can become more tilted in favor of the old. One way to mitigate this is through Demeny voting (Demeny (1986) (*Kinderwahlrecht* in German), where parents vote as proxies for their not yet enfranchised children (see Deutscher Bundestag (2004) for a parliamentary discussion of this idea). This system has the advantage that it is more likely to balance the interests of the younger and older generations are electorates age.

The extent to which Demeny voting can reduce the shift in political power toward the older generation can be seen in Table 4. The proportion of the German VAP 65+ years old in 2000 was 20.1 percent. In Japan it was 21.7 percent. Without voting age reform that percentage is forecasted to rise to 38.6 percent in Germany by 2050 and to 46.4 percent in Japan by that date. If parents were given the right to vote as proxies for their underage children, then 33.1 percent of the adjusted voting age population would be 65 or older in 2050 and 39.8 percent of the adjusted voting age population in Japan would be 65 or above in that year. Thus, nearly 40 percent of the Japanese electorate would be of pension age in 2050, even adjusting allowing for parents to vote on behalf of their young children. Clearly, while Demeny voting or any lowering of the voting age can help in balancing political power between generations, it cannot be the full answer.

Finally, Germany and Japan are well integrated into the global economy. A major change in the global economy in the last few decades has been the massive increase in the global labor force involved in international trade, especially with economic policy reforms China and India. According to the IMF, the global labor force has increased more than 4-fold since 1980 (Economist (2008b)). The world is still adapting to the effects of this gigantic increase in the labor force. But within decades China's population will begin to shrink. Aging will continue everywhere and the shock of the massive increase in the labor force is likely to wane. This will likely have effects on well-being of young people and on fertility. Exactly how this will play out is not yet known.

6. The Need for Science

It might be said that developing fertility policy is a bit like shooting at a target in a pitch black room. Actually, this metaphor is too optimistic. Developing fertility policy is like trying to hit a target while standing in a pitch black room without even knowing whether the target is there. The first bit of policy advice, naturally, is to turn on the lights. The most important data needed to develop fertility policy and to evaluate it as it proceeds are age- and parity-specific birth probabilities. It would be even better if those birth probabilities were cross-classified by education and location. Unfortunately these data are lacking. Germany has only recently begun collecting data by birth order and none of these data have been published yet. In the case of Japan, the underlying data seem to exist, but they are not made easily available to researchers. The first recommendation for fertility policy is to collect and disseminate the needed data. This is reasonably cheap and can be done relatively quickly. We can, of course, continue to shoot at our policy objectives in the dark, but the results might not be what we would desire.

The situation, though, is more complex than just shooting in the dark. We do not know that the target is even in the room. There needs to be a much deeper analysis of the problem of low fertility in order to do something about it. We need some more science. Germany and Japan have been engaging in policy formation without the appropriate data and without a modicum of understanding of what we are doing, but why should we support this approach? We are not in a crisis where, if strong fertility-increasing policies are not implemented by 2009, Germany and Japan will cease to exist. Both Germany and Japan have already implemented a number of policies, designed in the dark, to increase fertility. The results so far have not been overly successful. Why not try a different tack? Why not, take a little time to gather the needed data and to do some analyses?

What kind of framework might be used? Our preferences would be to begin with one that explicitly incorporates the relative well-being of young people (for example Easterlin (1966)) and integrates it with consideration of the value of time (for example Macunovich (1996)). Germany and Japan both have young generations who have difficulty of setting up independent households early in their adult lives. We conjecture that for fertility policies to be successful they must address the circumstances that are experienced by younger generations.

7. Conclusions

If 100 women of reproductive age continually produced 101 daughters who themselves survived to reproductive age, in the absence of immigration and changes in survival rates, the population would eventually grow to be more numerous than all the stars in the heavens. Under the same conditions, if they continually produce 99 daughters who themselves survived to reproductive age, the population would eventually go extinct. Whenever population growth rates are above replacement, some people worry about a population explosion. Whenever they are below replacement, others worry about a population implosion. Neither approach is very thoughtful. Populations can have periods of growth and periods of shrinkage. There is nothing necessarily abnormal about this. Neither population growth nor population shrinkage provides, in itself, *prima facie* evidence that fertility policy is needed. This is made more formal in Lutz and Sanderson (2005), where we developed the concept of population balance. We show, using a simple simulation model, that very rapid population growth and very rapid population shrinkage are both bad for welfare. In between, there is a wide range of rates of slow population growth and slow rates of population decline in which welfare remains high.

Population shrinkage in Germany and Japan is not a crisis. It might not even be a problem. It is possible that the slowing of the process of birth postponement brings fertility up to a level where it is no longer a major concern. Germany and Japan could, even without any additional fertility policies, reach the soft solution, where fertility is just a bit below replacement, life expectancy continues to increase, and the countries allow in a modest amount of migrants. The three together could keep populations roughly stable for a long time. Still, it is not even clear that a rough stability should be a goal. Japan is a crowded country with extremely high housing prices. Perhaps a somewhat smaller population, like Japan had in the 1960s, would not be a bad thing.

The case in favor of pronatalist policies is not a strong one. Many of the goals achieved by having more people can also be achieved by having a more educated and better trained population. Nevertheless, we cannot rule out the possibility that fertility-increasing policies could be needed. The low level fertility trap hypothesis could be correct and getting out of the trap sooner rather than later would be a good thing. An aging electorate could make decisions that burden young people and cause a further reduction in fertility. But before we decide whether or not any of this is the case, we need appropriate data, better ideas about what is going on, testable hypotheses and relevant analyses. The combination of these is not yet strong enough to guide us confidently to better fertility policies.

It is a joke that academics always end their papers by saying that more research is needed. In the case of pronatalist policies, action has preceded analysis. Germany and Japan have already implemented policies aimed at increasing fertility, but fertility remains stubbornly low. There is little point in engaging in more trial-and-error policy formation. Why not try some science? It cannot do much worse.

References:

- Bergstrom, Ted C. and John Hartman. 2005. *Demographics and the Political Stability of Pay-as-you-go Social Security.* <<Available at <<http://repositories.cdlib.org/ucsbecon/2005b>>>.
- Bongaarts, John and Griffith Feeney. 1998. "On the Quantum and Tempo of Fertility," *Population and Development Review* 24(2):271-291.
- Demeny, Paul. 1986. "Pronatalist Policies in Low-Fertility Countries: Patterns Performance and Prospects," *Population and Development Review* 12 (Supplement):335-358.
- Deutscher Bundestag. 2004. *Stenografischer Bericht*, 102 Sitzung. (Plenarprotokoll 15/102): 9269-9280. Available at <<<http://dip.bundestag.de/btp/15/15102.pdf>>>.
- Easterlin, Richard A. 1966. "On the Relation of Economic Forces to Recent and Projected Fertility Changes," *Demography*. 3:131-153.
- Economist. 2008a. "Briefing: Employment in Japan," *The Economist*. 386(8561) (January 5-11):68-70.
- Economist. 2008b. "Open Up: A Special Report on Migration," *The Economist*. 386(8561) (January 5):3-16.
- Foreign Press Center Japan. (nd). *Japan: A Web Guide*. Available at <<http://www.fpcj.jp/e/mres/publication/jp/society/social_main.html>>.
- Gauthier, Anne H. 2007. "The Impact of Family Policies on Fertility in Industrial Countries: A Review of the Literature," *Population Research and Policy Review* 26(3): 323-46.
- Heiland, Frank, Alexia Prskawetz, and Warren Sanderson. Forthcoming. "Are Desired Family Sizes Stable? Evidence from West German Panel Data," *European Journal of Population*. Available at <<<http://mailer.fsu.edu/~heiland/research.htm>>>
- Holtzmann, Robert and Edward Palmer. 2006. *Pension Reform: Issues and Prospects for Non-Financial Defined Contribution (NDC) Schemes*. Washington, D.C.:The World Bank.
- Kaneka, Ryuichi, Tsukasa Sasai, Saori Kamano, Miho Iwasawa, Fusami Mita and Rie Moriizumi. 2008a. "Marriage Process and Fertility of Japanese Couples: Overview of the Results of the Thirteenth Japanese National Fertility Survey, Married Couples," *The Japanese Journal of Population* 6(1):24-50.
- Kaneka, Ryuichi, Tsukasa Sasai, Saori Kamano, Miho Iwasawa, Fusami Mita and Rie Moriizumi. 2008b. "Marriage Process and Fertility of Japanese Couples: Overview of the Results of the Thirteenth Japanese National Fertility Survey, Singles," *The Japanese Journal of Population* 6(1):51-75.
- Kelley, Allen C. and Robert M. Schmidt. 2005. "Evolution of Recent Demographic-Economic Modeling: A Synthesis," *Journal of Population Economics* 18(2): 275-300.

- Kohler, Hans-Peter. 2001. *Fertility and Social Interaction: An Economic Perspective*. Oxford: Oxford University Press.
- Lee, Ronald and Timothy Miller. 1990. "Population Policy and Externalities to Childbearing," *The Annals of the American Academy of Political and Social Science* 510(4):17-32.
- Lutz, Wolfgang and Warren Sanderson. Hans-Peter. 2005. Toward a concept of population balance considering age-structure, human capital, and intergenerational equity," in S. Tuljapurkar, I. Pool, V. Prachubmoah, eds., *Riding the Age Waves: Population, Resources and Development*. Springer (May 2005, 3 volumes).
- Lutz, Wolfgang, Warren C. Sanderson, and Sergei Scherbov. 2001. "The End of World Population Growth," *Nature* 412:543-545.
- Lutz, Wolfgang, Warren C. Sanderson, and Sergei Scherbov. 2008. "The Coming Acceleration of Global Population Ageing," *Nature* Advance Online Publication DOI 10.1038/nature06516 on 20, January.
- Lutz, Wolfgang and Vegard Skirbekk. 2005. "Policies Addressing the Tempo-Effect in Low Fertility Countries," *Population and Development Review* 31(4): 699-720.
- Lutz, Wolfgang, Vegard Skirbekk, and Maria Rita Testa. 2006. "The Low-Fertility Trap Hypothesis: Forces That May Lead to Further Postponement and Fewer Births in Europe," *Vienna Yearbook of Population Research*. 167-192.
- Macunovich, Diane. 1996. "Relative Income and Price of Time: Exploring Their Effects On U.S. Fertility and Female Labor Force Participation, 1963-93," In *Fertility in the United States: New Patterns, New Theories*. Population and Development Review (Supplement) 22: 223-257.
- McDonald Michael D. and Ian Budge. 2005. Elections, Parties, Democracy – Conferring the Median Mandate. Oxford:Oxford University Press.
- National Institute of Population and Social Security Research. 2006. *Population Statistics of Japan 2006*.
- Preston, Samuel. 1984. "Children and the Elderly: Divergent Paths for America's Dependents," *Demography* 21(4):435-457.
- Sanderson Warren C, and Sergei Scherbov. 2005. "Average Remaining Lifetimes Can Increase as Human Populations Age," *Nature* 435:811-813.
- _____. 2007a. "A New Prospective on Population Aging," *Demographic Research* 16(2):27-58.
- _____. 2007b. "A Near Electoral Majority of Pensioners," *Population and Development Review* 33(3):543-554.
- Sakamoto, Junico. 2005. Japan's Pension Reform. SP Discussion Paper 0541. Washington,

DC : The World Bank. «<http://unpan1.un.org/intradoc/groups/public/documents/APC-ITY/UNPAN024379.pdf>>».

Sinn, Hans-Werner and Silke Uebelmesser 2003, “Pensions and the Path to Gerontocracy in Germany,” *European Journal of Political Economy* 19(1):153-158.

Suzuki, Toru. 2006. “Fertility Decline and Policy Development in Japan,” *The Japanese Journal of Population* 4(1):1-32.

Takayama, Noriyiki . 2004. “Changes in the Pension System,” *Japan Echo* 31(5).

Uebelmesser, Silke 2004. “Political Feasibility of Pension Reforms,” *Topics in Economic Analysis & Policy* 4(1), Article 20. Available at <<<http://www.bepress.com/bejeap/topics/vol4/iss1/art20>>>.

United Nations. 2007. *World Population Prospects: The 2006 Revision, Population Database*. Available at <<<http://esa.un.org/unpp>>>.

Weimann, Mike. 2002. *Wahlrecht für Kinder: Eine Streitschrift* Weinheim:Beltz.

Werding, Martin and Herbert Hofmann. 2005. *Die fiskalische Bilanz eines Kindes im deutschen Steuer- und Sozialsystem : Studie im Auftrag der Robert Bosch Stiftung*, ifo Forschungsberichte, 27, München:ifo Institut für Wirtschaftsforschung. *der Robert Bosch Stiftung*, ifo Forschungsberichte, 27, München:ifo Institut für Wirtschaftsforschung.

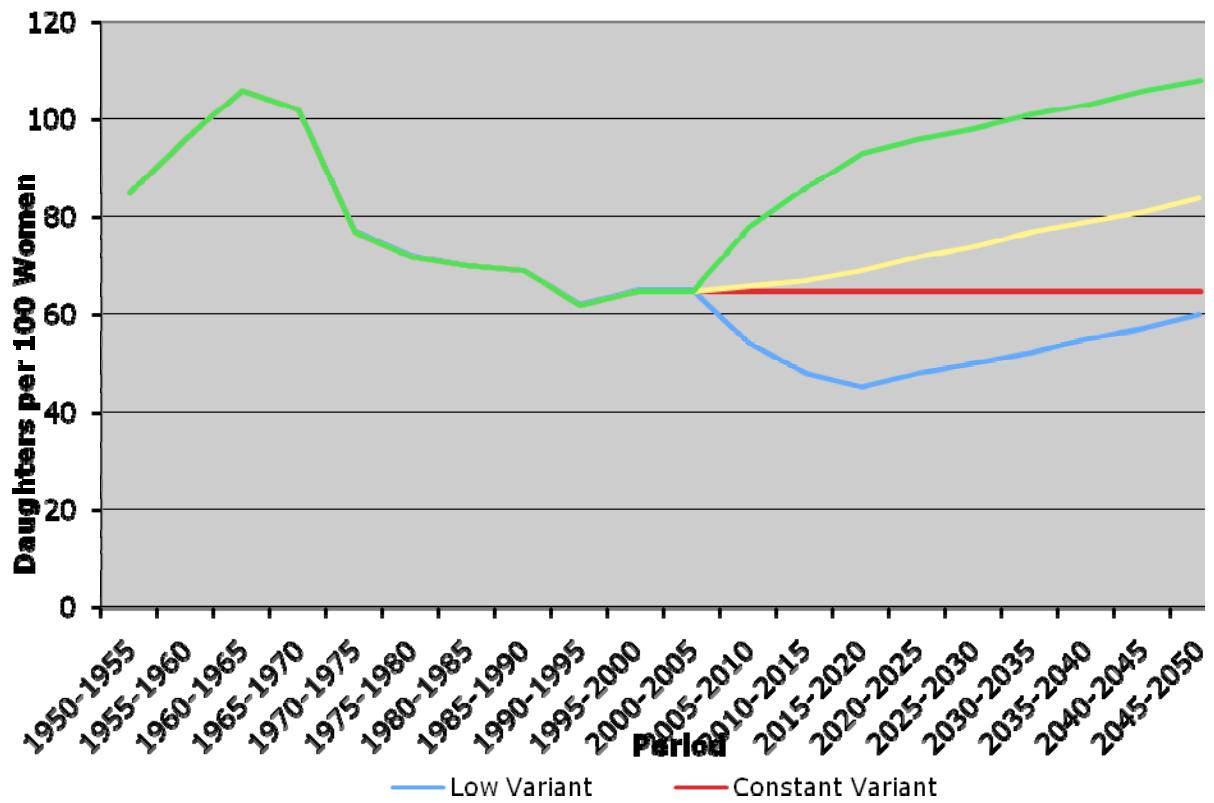


Figure 1a: United Nations fertility estimates and projections for Germany, 1950-55 to 2045-50.

Source: United Nations (2007)

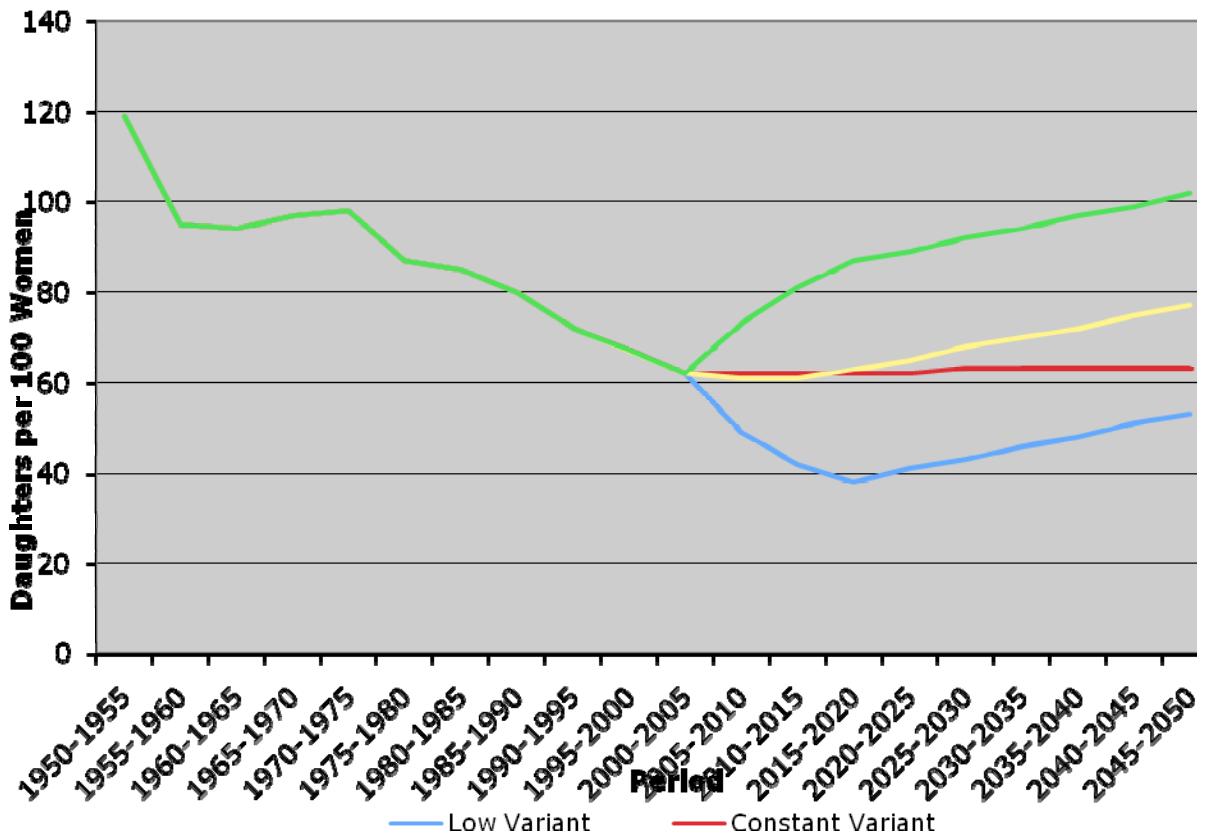


Figure 1b: United Nations fertility estimates and projections for Japan, 1950-55 to 2045-50.

Source: United Nations (2007)

Year	Low Variant	Constant Variant	Medium Variant	High Variant
1950	68376	68376	68376	68376
1955	70326	70326	70326	70326
1960	72815	72815	72815	72815
1965	75964	75964	75964	75964
1970	78169	78169	78169	78169
1975	78674	78674	78674	78674
1980	78289	78289	78289	78289
1985	77685	77685	77685	77685
1990	79433	79433	79433	79433
1995	81661	81661	81661	81661
2000	82309	82309	82309	82309
2005	82652	82652	82652	82652
2010	81767	82317	82365	82960
2015	80267	81670	81825	83377
2020	78416	80751	81161	83888
2025	76461	79528	80341	84177
2030	74395	78015	79348	84254
2035	72150	76246	78171	84264
2040	69652	74255	76852	84437
2045	66895	72077	75466	84897
2050	63971	69736	74088	85599

Table 1a: United Nations population estimates and projections for Germany, four variants, 1950 to 2050

Source: United Nations (2007)

Year	Low Variant	Constant Variant	Medium Variant	High Variant
1950	83625	83625	83625	83625
1955	89815	89815	89815	89815
1960	94096	94096	94096	94096
1965	98881	98881	98881	98881
1970	104331	104331	104331	104331
1975	111524	111524	111524	111524
1980	116807	116807	116807	116807
1985	120837	120837	120837	120837
1990	123537	123537	123537	123537
1995	125472	125472	125472	125472
2000	127034	127034	127034	127034
2005	127897	127897	127897	127897
2010	126736	127824	127758	128766
2015	124118	126693	126607	129042
2020	120349	124494	124489	128530
2025	115943	121397	121614	127157
2030	111101	117684	118252	125301
2035	105923	113522	114569	123309
2040	100405	109007	110651	121443
2045	94589	104242	106590	119777
2050	88645	99349	102511	118267

Table 1b: United Nations population estimates and projections for Japan, four variants, 1950 to 2050

Source: United Nations (2007)

	1977	1982	1987	1992	1997	2002	2005
Women in their first marriages, married 5-9 years							
Ideal number of children	2.56	2.63	2.65	2.61	2.47	2.48	2.41
Intended number of children	2.17	2.21	2.25	2.18	2.10	2.07	2.05
Average number of children	1.93	1.95	1.97	1.84	1.75	1.71	1.63
Women in their first marriages, married 10-14 years							
Ideal number of children	2.68	2.67	2.73	2.76	2.58	2.60	2.51
Intended number of children	2.30	2.21	2.24	2.18	2.19	2.28	2.30
Average number of children	2.17	2.16	2.16	2.19	2.10	2.04	1.98

Source: Kaneko et al. (2008a) Table 2-3 (p. 28) and Tables 3-1 and 3-2 (p. 30).

YEAR	MEDIAN AGE OF THE VAP (1)	AGE OF A PERSON IN 2000 WHO WOULD HAVE THE SAME TIME HORIZON AS A PERSON AT THE MEDIAN AGE OF THE VAP (2)
GERMANY		
2000	46.2	46.2
2010	48.8 (48.6-49.0)	46.8 (45.9-47.7)
2020	52.5 (52.0-53.1)	48.6 (46.9-50.5)
2025	54.2 (53.2-55.2)	49.3 (47.1-51.7)
2030	54.9 (53.3-56.6)	49.0 (46.5-51.7)
2040	56.1 (53.9-58.5)	48.5 (44.9-52.0)
2050	57.7 (54.5-60.9)	48.2 (43.7-52.8)
JAPAN		
2000	49.2	49.2
2010	51.8 (51.7-51.9)	49.9 (49.1-50.8)
2020	54.2 (53.8-54.6)	50.5 (48.9-52.2)
2025	55.5 (54.9-56.1)	51.0 (48.9-53.2)
2030	57.2 (56.5-57.9)	51.8 (49.3-54.3)
2040	60.5 (59.0-62.0)	53.5 (50.2-56.4)
2050	62.6 (60.1-65.1)	53.7 (49.9-57.6)

Table 3. Median Age of VAP and Age of a Person in 2000 Who Would Have the Same Time Horizon as a Person at the Median Age in the Specified Year, Germany, Japan, 10 Year Intervals 2000 to 2050

Source: Sanderson and Scherbov (2007). Figures are median values computed over 1,000 probabilistic forecasts. Figures in parentheses are 95 percent prediction intervals. We use the term “time horizon” to refer to expected remaining years of life.

Year	Germany	Japan
2000	20.1	21.7
2010	20.4	22.4
2020	22.6	28.4
2030	27.8	31.1
2040	31.7	36.0
2050	33.1	39.8

Table 4: Percentages of Total Populations Above Normal Pension Age, 2010 to 2050, and Percentage of the VAPs Above Normal Pension Age in 2000.

Source: Sanderson and Scherbov (2007).

Data are from the mean scenario in Sanderson and Scherbov (2005).

Figures for 2000 do not take Demeny voting into account.

Calculation treats the total population as if it were the Demeny VAP. This is a close approximation, but it does produce a slight downward bias in the percentages, especially for Japan under Option 1. This is consistent with our interpretation of the Demeny voting results as showing the maximum possible effect of a voting age reform.