THE FISCAL IMPACT OF POPULATION CHANGE

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Throughout the industrial world and in much of the Third World, populations are aging. This population aging results in part from lower fertility and in part from longer life. Lower fertility reduces the rate of population growth, so that recent generations are smaller than earlier generations, and therefore the relative number of older people is greater. This kind of aging raises the share of the elderly population, but it does not alter their health status, vigor, or remaining life expectancy.

Population aging due to increasing longevity is a different matter. The very processes that lead to longer life may alter the health status of the surviving population, for better or for worse. Fortunately, there is growing evidence that in the United States at least, the years of life added by declining mortality are mostly healthy years, and that at any given age, the health and the functional status of the population are improving (Manton et al. 1997; Crimmins et al. 1997; Freedman and Martin 1999). Apparently, years of healthy life are increasing roughly as fast as total life expectancy.

Population aging due to low fertility reflects a choice made by individuals to raise fewer children. In earlier times, elderly parents were often supported by their adult children, and the desire for old age support was a factor in deciding how many children to raise. Public sector pensions disconnect old age support from individual fertility and

may have played some role in causing low fertility in industrial nations. While lower fertility may go with reduced total parental expenditures on children, it also raises the ratio of elderly to working-age people, other things equal. The rising ratio then leads to societal pressures for later retirement, with no corresponding improvement in health to facilitate such a prolongation of working years. For this reason, population aging due to reduced fertility may well impose important resource costs on the population, regardless of institutional arrangements for support in old age. In a later section, we will discuss the public sector spillover effects of childbearing.

Population aging due to declining mortality, by contrast, will generally be associated with improving health and functional status of the elderly. Higher life expectancy will be accompanied by higher active life expectancy. While such aging may put pressures on pension programs that have rigid retirement ages, in an important sense these are institutional problems, and not real resource problems for society. People may prefer not to work until later ages even though they are physically able, but that is not properly viewed as a resource problem.

Adjustments of patterns of human capital investment, work, and leisure over the life cycle are hampered by our institutional structures and by our accumulated traditions, customs, and expectations about education, work, and leisure. This paper is about the effects of aging on one particular institution: the government and its structure of age-related programs. We will see that population aging will indeed cause serious pressures on these programs as they are currently structured. However, we must keep in mind that this is only one element in the complex set of arrangements for redistributing income across ages. The family is another, and the market is another. By focusing on government programs alone, we are bound to get an exaggerated impression of the adverse effects of population aging. The exaggerated impression is compounded by the common (and often useful) assumption that the benefit structure of programs will remain unchanged.

A study by Roseveare et al. (1996) illustrates this approach. For the public pension systems of twenty OECD nations, they calculated the present value (PV) of projected program expenditures minus tax revenues over the seventy-five-year horizon from 1995 to 2070. Assuming a 3 percent real discount rate and 1 percent per year real productivity growth, seventeen of the twenty countries had PVs greater than a year's GDP, and six of the twenty had PVs greater than two years' GDP. Two countries had shortfalls greater than four times GDP! While early retirement plays a part in these problems for many countries, the main cause of the estimated imbalances is the population aging projected to occur in the future and the failure of policy to confront its consequences. The United States, because of its relatively high fertility, late retirement,

and modest replacement ratios, has one of the lowest imbalances of any of these twenty countries.

Population aging, and changing population age distributions, affect the fiscal situation through multiple channels, including the following:

1. Changing age distributions alter the per worker cost of providing a given age-vector of per capita benefits. For example, population aging will dramatically increase the costs of providing even existing benefits for Social Security and Medicare.
2. As a qualification to point 1, we note that fluctuations in population age distribution, for example, as caused by the baby boom in the United States, and transitional changes in age distribution, for example, as the population ages, add a dimension to the problem. Such changes can be considerably more dramatic than comparisons of steady states. They raise issues of intergenerational equity and risk-sharing.
3. The age distribution of the population alters the relative costliness of providing benefits at different ages. An older age distribution makes it relatively cheaper to provide benefits for a child than for an elderly person. This change may influence decisions about the proportional distribution of benefits by age.
4. The age distribution also affects the relative numbers of voters at each age, and that in turn may affect the proportional allocation of benefits across age. A certain amount of research has been done on this topic, looking at voting behavior in relation to age and family circumstance.

In this paper, we will address points 1 and 2. Points 3 and 4 are complex topics in political economy, and they merit treatment in a separate paper. The first point we will address in a simple analytic model applied to a hybrid situation of steady states and unstable populations. The discussion suggests that changing age distributions condition our policy choices, influencing but not determining them. The second point we can address by projecting the fiscal impact of population change over the next hundred years. These projections can be more realistic in taking account of economic growth, legislated changes in retirement age, projected increases in the costs of Medicare and Medicaid, and so on.

We will also discuss the effects of projected population aging on government budgets in the United States, at both the federal level and the state/local level. The analyses just described will take changing population age distributions as given. However, it is also of interest to seek insight into the nature of the problem by examining the effects of hypothetical demographic events. In particular, we will discuss the fiscal impacts of an incremental birth and an incremental immigrant. In the case of a birth, these fiscal effects are externalities to childbearing; that is, a component of the gap between private and social costs and benefits of

having a child. In the case of immigration, we can also think of the fiscal effects as a component of the externalities to the immigrant's decision to enter the country. These two additional topics will be taken up toward the end of the paper.

THE DEMOGRAPHIC OUTLOOK FOR THE UNITED STATES

Population structure and change depend on fertility, mortality, and net immigration as well as the initial age distribution. The current age distribution of the U.S. population is deeply marked by the baby boom, a period of high fertility and large annual number of births, extending roughly from 1946 through 1965. The leading edge of the baby boom generations will turn 65 in 2011, a decade from now. As it does, the ratio of elderly population, age 65 and over, to the working-age population, ages 20 to 64, will begin to rise rapidly. This old-age dependency ratio, or OADR, will rise from an initial level of 0.21 in 2001 to 0.365 by 2040, according to the projections by the Actuary of the Social Security Administration (henceforth SSA; Board of Trustees OASDI 2001). It is projected to continue to rise thereafter, to 0.42 in 2075 or twice its current value. We will briefly discuss the fertility, mortality, and immigration trends in relation to the corresponding SSA assumptions.

Mortality

The SSA assumes that the rate at which mortality declines at each age will slowly decelerate from the rate of the past twenty years to specified target rates that are about half as rapid over the next twenty-five years or so, and that the rate of mortality decline will remain constant thereafter. Under these assumptions, life expectancy will rise from its current level of about 76.7 years (sexes combined) to 82.6 years in 2075 (Board of Trustees OASDI 2001, Table V.A3).

Elsewhere, one of us has argued that these projections are too low (Lee 2000; Lee and Tuljapurkar 2000), which was also the view of the last two Technical Advisory Panels for the SSA. Many demographers share this view, although not all. If mortality were to continue to decline at the long-run historical rates, then life expectancy would reach about 86 years rather than 82.6 in 2075. International trends in mortality in the populations of the industrial nations support this expectation, since some countries have life expectancies several years higher than the United States and continue to experience rapid mortality declines at the older ages.

Official forecasting agencies in the industrial nations have systematically underpredicted mortality decline over past decades, and consequently they have underpredicted the growth of the elderly population, as revealed by careful analyses of the past forecasting records (Keilman

Figure 1
U.S. Life Expectancy at Birth: Historical Data
and Lee-Carter Forecast

Life Expectancy (Years)

Historical	Lee-Carter median forecast with 95% probability intervals
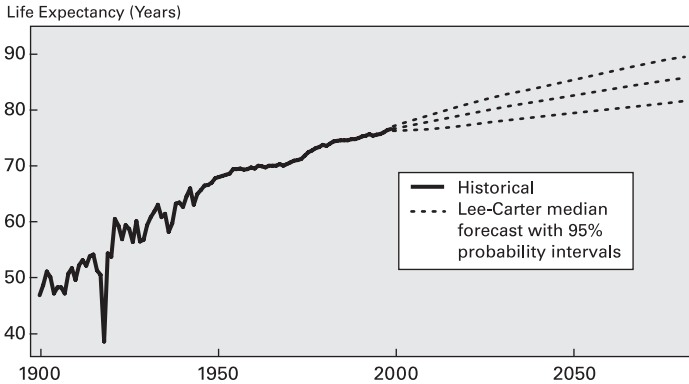
1997). A similar analysis of the forecasting record of the United Nations reveals the same pattern of error. An analysis of the SSA forecasting record for life expectancy since the 1950s finds there as well a tendency to underpredict future life expectancy, except during the decade of the 1980s (Lee and Miller 2000). A recent study by Tuljapurkar et al. (2000) projected life expectancy for the G-7 countries using Lee-Carter methods and concluded that most were substantially underpredicting future gains.

Figure 1 plots life expectancy at birth since 1900 and shows so-called Lee-Carter projections through 2080, with 95 percent probability intervals. For a discussion of the method, see Lee and Carter (1992), Lee (2000), and Lee and Miller (2000). These projections essentially extrapolate long-term historical trends.

Fertility

The United States stands out among the populations of industrial nations for its relatively high fertility rate. While European nations on average have 1.4 births per woman (total fertility rate or TFR) and some have between 1.1 and 1.2 births per woman, the United States has over 2 births per woman. To some degree the higher fertility rate in the United States reflects the moderately high proportion of immigrants in the population, since immigrants on average have higher average fertility, particularly those from Latin America. The fertility of non-Hispanic white women in the United States is 1.8 children per woman, closer to the levels

in Europe. Looking to the future, it is important to realize that fertility in the immigrant-sending countries will continue to fall as they move through the demographic transition. By some official reports, fertility in Mexico is already down to 2.4 children per woman, only a bit higher than that in the United States. We can expect, then, that immigrant women arriving in the future may have fertility little different from the U.S. average and possibly lower than the U.S. average.

Some of the low fertility among women in Europe appears to be due to postponement of childbearing, since the mean age at childbearing has been rising for decades. This might account for about 0.2 births per woman, on average, leaving us with a discrepancy between European and U.S. levels of 1.6 versus 1.8 children per woman, which is not large. Surveys in both the United States and Europe suggest that young women in both places would like to have about two children, on average.

The SSA assumes that the fertility rate in the United States will move to 1.95 children per woman by 2025. This seems to be a reasonable and prudent assumption for the intermediate projection. However, a great deal of uncertainty remains about the future of fertility, and all projections are very sensitive to variations in it.

Immigration

The SSA assumes that the United States will receive 900,000 net immigrants per year, legal and undocumented combined, in each year after 2001 (Board of Trustees OASDI 2001, Table V.A1). The 2000 Census enumerated more people than expected, and some analysts have suggested that the discrepancy is due to a substantially greater number of undocumented immigrants than had been believed. In this case, the estimates of current immigration used by the SSA may have to be revised upward. These issues will no doubt be clarified by research in the next few years, as more details from the 2000 Census are released. An additional problem for projections of immigration comes from the fact that the number of immigrants to the United States has been increasing roughly linearly since 1950, so fixing it at a constant number equal to current rates seems likely to underestimate the future stream. An alternative assumption would be that the rate of net (or gross) immigration per member of the U.S. population remains constant at its current rate of about 0.4 percent per year. This assumption would lead to growing numbers of immigrants, rising to more than 1.3 million net per year, rather than 0.9 million as SSA now assumes.

Population Growth and Age Distribution

These projections for fertility, mortality, and immigration can be combined to produce a population forecast. Of course, there is a great

Figure 2
Old-Age Dependency Ratio
Forecasts for the United States: 1999 to 2080
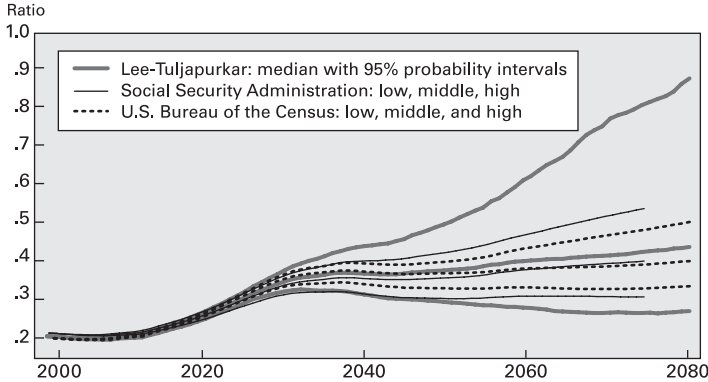
deal of uncertainty about each of these projections, and these uncertainties interact, cumulate, and cancel in complex ways in the population forecast. Some analysts believe that with so much uncertainty in population projections, there is no point in presenting them beyond a horizon of about twenty-five years, or one generation. Our view is that although long-term demographic projections are highly uncertain, they can still be useful if their degree of uncertainty is also estimated and projected. Lee and Tuljapurkar (1994; 2000) have developed a method for making stochastic population forecasts, with probability distributions for all elements of the forecast.

Figure 2 shows Lee-Tuljapurkar-type stochastic forecasts of the old-age dependency ratio for the United States through 2080, together with 95 percent probability intervals. These are based on the Lee-Carter-type mortality forecasts described above, combined with stochastic fertility forecasts with long-run mean fertility constrained to 1.95, consistent with SSA assumptions, but with variability based on time series analysis of the historical series. Immigration is treated deterministically and matches the SSA assumption of 900,000 net immigrants per year. For comparison, the figure also plots the projections by SSA and by the U. S. Census Bureau, along with their high-low ranges.

The old-age dependency ratio (OADR) rises steeply from 2010 to 2030 as the baby boom generations enter old age, then slows as these generations die off and are replaced by aging members of the baby bust generations. After 2050 the OADR resumes its upward trend as mortality

continues to fall, reaching 0.45 in 2075. This trajectory is a bit higher than that of SSA, because it has mortality declining more rapidly than SSA, and it is considerably higher than that of the Census Bureau, because it has lower fertility. The lower 2.5 percent probability bound is fairly similar to the low bound of SSA (no probability is attached to their scenario-based range). The upper 97.5 percent bound, however, exceeds the central forecast by more than twice as much as the SSA high projection. This asymmetry is typical of the log-normally distributed probability bounds for stochastic forecasts. The Census Bureau's high-low range is very narrow, because in their featured projections they bundle high fertility with low mortality, and low with high, which have offsetting effects on the population age distribution. This kind of problem pervades the standard method for assessing the uncertainty of projections by using high and low scenarios (see Lee 1999).

The OADR is the aspect of population change with the greatest fiscal implications over the coming century. Its numerator drives the costs of benefits for the elderly, while its denominator is closely related to the tax base. Roughly speaking, if the OADR more than doubles, from 0.21 to 0.45, then the tax rate to support benefits for the elderly must more than double as well. If the OADR were to quadruple to 0.80, as it has a 2.5 percent chance of doing, then that tax rate would also have to quadruple.

HOW POPULATION AGING AFFECTS THE TRADE-OFF BETWEEN A BENEFIT PACKAGE AND AFTER-TAX INCOME OVER THE LIFE CYCLE

It is possible to view the fiscal impact of population change as a rather mechanical process, in which projected changes in age distributions are applied to fixed or exogenously changing age schedules of benefits and taxes, leading to projections of future expenditures. Population aging, viewed in this way, would be expected to impose heavy costs on future taxpayers, as we shall see later in this paper. However, when analysts have looked at actual historical change in expenditures on benefits, population aging has typically been found to have only a modest explanatory role. Change has been dominated by political decisions about benefit levels in existing programs such as Social Security, or by the introduction of new programs such as Medicare. Gruber and Wise (2001), for example, examine the association of government spending patterns with the proportion of elderly population across OECD nations and over time. They estimate a highly significant 0.5 elasticity of government spending on the elderly with respect to the proportion of elderly in the population. That is, if the number of elderly were to double relative to the size of the population, then spending on the elderly would increase by only 50 percent relative to GDP. The implication is that total spending on the elderly would rise, but spending per elderly person

would fall. It is also noteworthy that total government expenditures are not affected. The increased spending on the elderly has been funded by reducing spending elsewhere in the budget. Clearly, the mechanical approach misses an important part of the story.

Another approach considers the nature and purpose of government transfer programs, in an attempt to understand how they might change in response to changing demography. Some analysts view public sector transfer programs as cumbersome and inefficient substitutes for services that the market could provide better. Population aging then exacerbates these inefficiencies and prompts reform. The leading example is the Social Security program and the drive to privatize it. Other analysts view public sector transfer programs as providing a kind of social insurance that the market cannot provide or can only provide inefficiently, such as insurance against falling into poverty, or annuities that insure against running out of savings if one lives unexpectedly long.

In this section, we will take the second approach and conceptualize government transfers as valuable complements to the market. Demographic change is viewed as altering the constraints and trade-offs governing our policy choices, rather than as dictating increases in expenditures. The analytic approach in this section properly applies only to population aging due to low fertility, as will be discussed toward the end of the section. We will look at these trade-offs from the point of view of an individual, choosing an age profile of benefits to maximize utility over the entire life cycle. We therefore dodge many important but complicated issues surrounding the political choices that people at differing ages, with differing amounts of their lives remaining to be lived, make when they vote for government programs.

Some public sector programs provide benefits that are age-targeted, such as public education, Social Security, or Medicare, or that incidentally happen to be notably associated with age, such as Aid to Families with Dependent Children/Temporary Assistance to Needy Families (AFDC/TANF), Medicaid, or Food Stamps. Let $\beta(x)$ be the total dollar cost of the average benefits provided to an individual at age x in a given reference year, say 2000. Figure 3 plots $\beta(x)$ for 2000, showing the shares in the total at each age of the main categories of programs: public education, Social Security, Medicare, Medicaid, and other. The concentration of benefits in youth and old age is evident. In youth, public education dominates, while in old age, Social Security and Medicare are the main items, with Supplemental Security Income (SSI) and Medicaid for nursing homes also important. The benefits per elderly person are far more costly than those for a child, by a factor of around four.

Let $\tau(x)$ be the sum of the average taxes paid by an individual at age x. Figure 4 plots $\tau(x)$ for the same year, also showing the shares of various kinds of taxes in the total for each age: federal and state income tax, sales tax, property tax, and other. The concentration of taxes in the middle

Figure 3
Federal and State/Local Benefits
by Age of Recipient
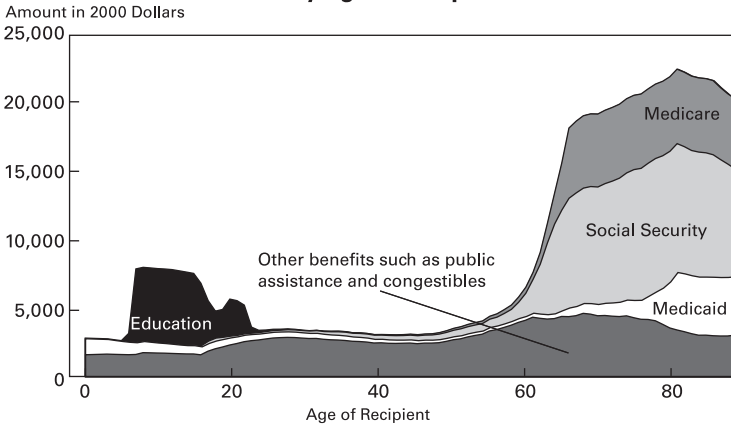
Amount in 2000 Dollars

Source: Based on data from the U.S. Bureau of the Census, March Current Population
Surveys of 1994 and 1995, inflated to 2000 levels.

Figure 4
Federal and State/Local Taxes by Age of Taxpayer
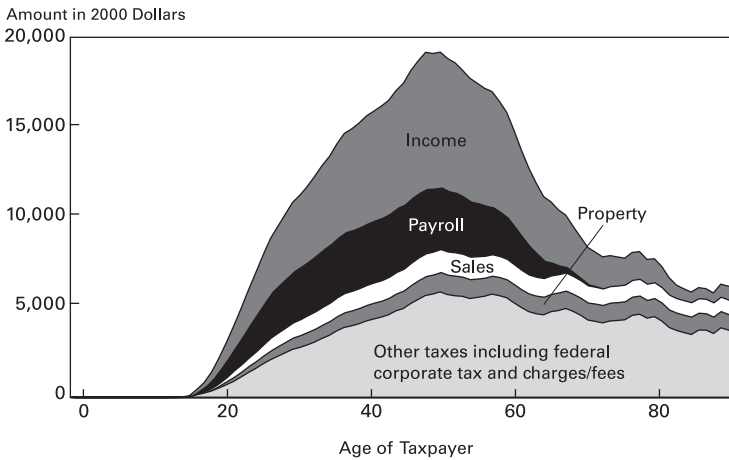
Amount in 2000 Dollars

Source: Based on data from the U.S. Bureau of the Census, March Current Population
Surveys of 1994 and 1995, inflated to 2000 levels.

years between youth and old age is also evident. However, some elderly continue to earn wages, and many receive dividends and interest, so they continue to pay taxes, albeit at a lower level.

In a stationary economy, $\beta(x)$ and $\tau(x)$ would describe the life-cycle benefits that an individual would receive on average, and the average taxes a person would pay over his or her lifetime. These benefits presumably provide utility to the average person. If the goods and services represented by $\beta(x)$ were perfect substitutes for corresponding market items, then we could just express lifetime utility as a function of net income at each age, $y(x) + \beta(x) - \tau(x)$, rather than distinguishing between benefits and after-tax income. However, most of the $\beta(x)$ program benefits are social insurance-type items such as safety nets, annuities, or other insurance policies for which there are no close market substitutes.

If a person receives, on average, income of $y(x)$ (exclusive of public sector transfers), then the net income at each age is $y(x) - \tau(x)$. Life-cycle utility can then be viewed as a function of benefits and after-tax income, or $V[\beta(x),y(x) - \tau(x)]$, where the arguments are age-vectors, and the function V is understood to include the effects of subjective time discounting, survival weighting if appropriate, and the possibilities of shifting income and consumption from one age to another, through borrowing and lending at the market rate.

Suppose that the public sector is subject to a budget constraint such that expenditures on program benefits must be fully paid for out of the corresponding tax revenues each period, with no budget surplus or deficit. The trade-off between consumption of market goods and program benefits over the life cycle is described by a social budget constraint that has a slope determined by the population age distribution. Recall that $\beta(x)$ and $\tau(x)$ were defined for some reference year. More generally, suppose that the actual level of benefits in some given year t is given by a period-specific level, $b(t)$, times the age-vector $\beta(x)$, so that benefits are $b(t)\beta(x)$. Suppose similarly that taxes in year t are $d(t)\tau(x)$. That is, we make the simplifying assumption that as the level of benefits varies from year to year, the shape or proportional distribution of the benefit and tax schedules remains the same.

Now we can draw the social budget constraint showing the trade-off between the levels of the vector of benefits $b(t)$ and the vector of after-tax income, $y(x) - d(t)\tau(x)$, for any given population age distribution. If the population age distribution in year t is $N(x,t)$, then the total cost of benefits, $B(t)$, is given by

$$B(t) = b(t) \sum N(x, t)\beta(x), \tag{1}$$

and the total tax revenue, $T(t)$, is given by

$$T(t) = d(t) \sum N(x, t)\tau(x), \tag{2}$$

Figure 5
Optimal Choice of the Level of Life Cycle
Benefits and After-Tax Income
Before and After Population Aging
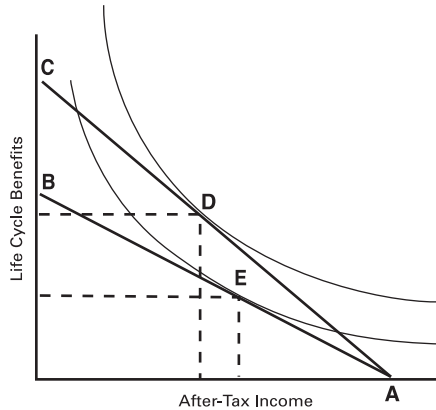
and these must be equal. Bearing in mind this aggregate budget balance condition, we can graph the trade-off between level of benefits, b(t), and after-tax income, which depends on d(t). For each increase in benefits received, indexed by b(t), taxes must be increased, as indexed by d(t), and consequently after-tax income must fall.

Figure 5 plots the initial budget constraint, for the year 2000, as line AC. The slope of the budget constraint is −1.0, by construction (because by assumption, total taxes equal the total cost of benefits in the year 2000). If b is raised by one unit, then d must also be raised by one unit.

Suppose that the population age distribution changes such that budget balance requires that d(t) be greater than b(t). In this case, the slope of the budget line will become less in absolute value, that is, flatter. For concreteness, suppose that population aging occurs, with the effects plotted in Figure 5, where in 2075, aging increases the cost of attaining b=1 by 50 percent. Now benefits cost more in terms of forgone market consumption, because of the unfavorable population age distribution. The new social budget constraint, line AB, strikes the vertical axis at a point one-third of the way toward the origin (1/1.5 = 2/3), while the intersection with the horizontal axis is unchanged.

We could also take into account the deadweight loss that would be associated with higher taxes. This loss would increase in proportion to the square of d(t), which indexes the level of taxes. We could simply draw the budget constraint as a convex curve, reflecting the standard quadratic

deadweight-loss effect. This would make population aging even more expensive in terms of the forgone consumption of market goods necessary to fund a given level of benefits.

Based on the life-cycle utility function, V, we can also draw indifference curves for life cycle benefits versus life-cycle consumption of market goods. Figure 5 shows the point of tangency of an indifference curve to the initial social budget constraint at D, based on the population age distribution for the year 2000. This level of taxes and benefits maximizes individual life-cycle utility.

Figure 5 also shows the indifference curve tangent to the second social budget constraint after population aging, at E. The new optimal choice has substantially lower life-cycle benefits and somewhat lower taxes. The switch to the less advantageous age distribution has a negative income effect, since each person's life-cycle utility will now be less. Consequently, they will tend to choose lower benefits and lower market consumption, and therefore higher taxes. There is also a price effect as a result of the flattening of the budget constraint, which reinforces the decline in benefits and therefore leads to lower taxes. The consequence of population aging, therefore, is unambiguously lower life-cycle benefits, but either an increase or a decrease in taxes would be possible.

Although life-cycle benefits, indexed by b(t), are unambiguously lower, that does not necessarily mean that expenditures on benefits B(t) are reduced, since the older age distribution would have raised expenditures, other things equal. As an example, anticipation of population aging in the United States has led us to reduce life-cycle benefits by raising the normal retirement age for Social Security, but expenditures on Social Security are nonetheless going to rise, because of the increased proportion of elderly. Likewise, the demographic effect on tax revenues, T(t), depends not only on d(t), but also on the age distribution of the population.

Now, more realistically, we consider the effects of population aging due to lower mortality as well as the lower fertility that we just considered. The situation now becomes rather more complicated. Mortality decline will raise the marginal utility of after-tax income, because any given level of income must now be spread over more years. The effect of longer life on the marginal utility of the benefit vector, however, will depend on just how the life-cycle utility function V is specified. If it is based on a survival-weighted sum of an instantaneous sub-utility function, then longer life will raise the marginal utility of the benefit profile, as well. The exact effect of longer life on the indifference curves derived from V is unclear, but in general, population aging due to lower mortality will affect the indifference curves as well as the budget constraint. We can no longer make a clear prediction about the effect of population aging on the choice of tax levels and benefit levels.

It is relatively straightforward to examine the way in which projected

Figure 6
The Trade-off between Life-Cycle Benefits and Taxes

Ratio of Taxes to Benefits
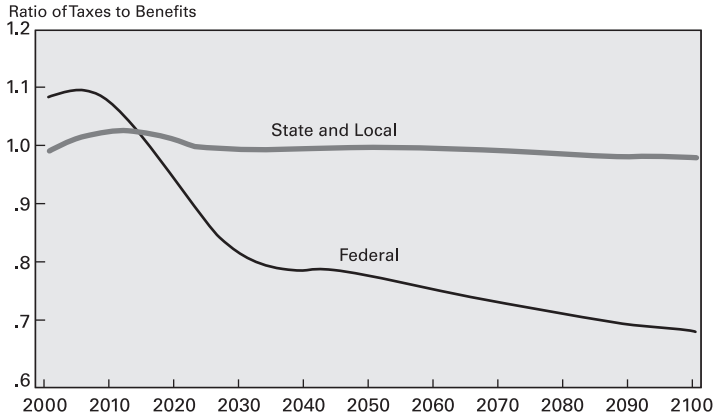
changes in the age distribution over the twenty-first century will influence the trade-off between life-cycle benefits and taxes. By our social budget constraint, we have:

$$b(t) \sum N(x, t)\beta(x) = d(t) \sum N(x, t)\tau(x). \tag{3}$$

Equivalently, we have:

$$b(t) = d(t) \frac{\sum N(x, t)\tau(x)}{\sum N(x, t)\beta(x)}. \tag{4}$$

The ratio on the right gives the slope of the relation between b(t) and d(t), expressing the trade-off between the two under the balanced budget assumption. A rise in the ratio implies that demographic forces are increasing the number of net taxpayers relative to net benefit recipients, while a declining ratio means the opposite.

Figure 6 plots this ratio from 2000 through 2100, for both federal and state/local taxes and benefits.[1] The line for state/local budgets shows that the trade-off between benefits and after-tax income is virtually unchanged over the whole century, according to our central demographic

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[1] The ratios have been normalized so that their initial levels equal total taxes divided by total expenditures, including net interest payments.

projection. However, the line for the federal budget tells a very different story. Once the baby boom generation begins to reach old age in 2010 or so, the ratio begins to fall rapidly, going from 1.1 to 0.8 in about twenty years. Then a lull follows, while the large baby boom generation dies off. Thereafter, the ratio resumes its decrease at a steady rate, reaching 0.75 by 2075, and continuing thereafter. Since our projection assumes that mortality continues to fall and life expectancy continues to rise, population aging continues indefinitely into the future.

This analytic approach helps us understand the way in which changing population age distributions can be expected to affect the choice of tax and benefit levels. Nonetheless, it takes into account only one of four important kinds of demographic influences on fiscal policy, namely, the way demography affects the costliness of achieving a given life-cycle schedule of benefits.

The analysis of steady states in Figure 5 implicitly assumed that the population age distribution was unchanging over time, which is to say that the population is "stable," in the demographer's terminology. Without this assumption, it becomes much more difficult to understand the relationship between the schedule of individual benefits by age over the life cycle and the cross-sectional budget constraint in any given year. The reality, however, is that population age distributions are not stable, but rather are changing from decade to decade in dramatic ways, for example, as the baby boom generation ages and retires.

CONCEPTUALIZING TRANSFERS VIEWED AS SUBSTITUTES FOR MARKET INCOME

Often, tax-and-transfer pension programs are viewed simply as an alternative to funded private sector pensions or individual saving. In this case, they are typically seen as having several disadvantages. First, a mature system in steady state offers a rate of return equal to the growth rate of the labor force plus the growth rate of labor productivity (that is, the growth rate of GDP), and typically this is far below the long-run real rate of return obtainable through investment in risky capital. Second, the transfer wealth created by the system may substitute against funded wealth, and thereby reduce the stock of capital and reduce income.[2] These problems are generally viewed as a legacy of decisions made many decades ago when the system was originally set up in the Pay As You Go (PAYGO) format. They are traced specifically to the gift or windfall gain received by the early generations, which created an implicit debt for

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[2] To these could be added the concern that the payroll tax discourages labor supply, because the future benefits earned are not seen as closely tied to the taxes paid, in contrast to the effects of saving a part of income and investing it in a retirement account.

which subsequent generations must continue to pay interest for as long as the system remains in force, after which the principal must be repaid or the debt defaulted, leaving the elderly impoverished.

This view of the matter is useful in the context of a system in steady state, but it is incomplete and misleading in the context of population aging. On the one hand, to the extent that population aging is caused by declining fertility, it is associated with slower growth rates of the labor force, and therefore lower rates of return to the unfunded system. The implicit rate of return earned by participants in the U.S. Social Security system has dropped dramatically over the course of the century, in part because the growth rate of the labor force has declined and will decline. This decline reflects the secular decline in fertility over the course of the century, to 1.76 or so in the mid 1970s, a decline that has been partially offset by rising female labor force participation rates and by declining mortality. The net effect is small for the United States, but for many European countries, this is a major factor in declining rates of return. On the other hand, population aging creates *new* implicit debt in a PAYGO system. For example, Lee et al. (2000) find that the implicit debt in the U.S. Social Security system will increase by about 70 percent relative to GDP over the next eighty years. This change is due mainly to lower fertility, and it is ushered in by the aging of the huge baby boom generations followed by the smaller generations born thereafter. However, as the earlier Figure 2 shows, the aging is projected to continue throughout this century. It is as if a new PAYGO system were being created as the population ages. We have the policy option to avoid this increase of the implicit debt by pre-funding the new obligations, while leaving the existing implicit debt in place. Many proposed partial privatization plans would accomplish this, although that is not their specific aim.

THE PROJECTED FISCAL IMPACT OF POPULATION AGING

The preceding discussions largely abstracted from the changing population age distribution, and instead focused on comparing steady states with different age distributions—a useful but unrealistic assumption. Here we will carry out a demographically detailed projection of federal and combined state/local budgets, and the separate programs that they comprise. The approach and results in this section draw on previous work in Lee and Miller (1997) and in Lee, Tuljapurkar, and Edwards (1998). While the latter paper presents stochastic projections for government budgets based in part on the stochastic population projections described earlier, here we will confine our discussion to the central deterministic forecast.

Methods and Assumptions

All our projections are based on the assumption that program structures remain as they are now, except for the currently legislated increase in the normal retirement age for receiving Social Security benefits. In this sense they are conditional projections. While we do not believe that the current program structure will persist over the twenty-first century, this assumption seems appropriate for assessing the consequences of population aging.

We divide government programs into four kinds. First are the age-assignable programs like public education, Social Security, Medicare, or AFDC/TANF, where it is reasonably clear which individual (or individual household) receives a particular benefit, making it possible to assign the cost of a benefit to a particular age group, as described by $\beta(x)$, or by sub-functions of this sort for individual programs. Second are public goods like defense. The resulting services can be provided at no additional cost to a larger population, so the marginal cost of providing for new members of the population is zero. At the same time, new members of the population reduce the per capita price of a given level of services, so the actual defense services provided typically increase with population growth. Third are congestible items like roads, police services, fire safety services, sewage systems, public libraries, and airports. The benefits from these do not have an age-assignable cost. We will assume that the costs are simply proportional to the size of the population. The associated capital costs for providing these services are also assigned to population increments. Fourth is publicly held wealth or debt. The per capita amount of this wealth or debt is diluted by additional members of the population, which should be counted as a fiscal impact. For the United States, the dominating item in this category is the national debt. New incremental members of the population share the costs of paying interest on existing debt or of retiring it.

Our approach starts with cross-sectional, age-specific benefit and tax profiles like the $\beta(x)$ and $\tau(x)$ used in an earlier section. Most of the age-assignable program costs that enter into $\beta(x)$ can be estimated from the Current Population Survey (CPS), which provides estimates of cash transfers received.[3] For some programs, such as Medicare and Medicaid, the CPS only ascertains program participation, and the dollar values must be estimated from other sources. Still other programs, such as public education, are not covered by the CPS but can be readily calculated from other government sources. Other program costs for public goods, con-

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[3] These are then adjusted upward so that in combination with the current population age distribution, they imply total program expenditures that match the numbers in the budget. Some program benefits are reported at the household level, in which case it is necessary to impute them to individuals in the household using various assumptions.

gestible goods, and public debt can be calculated in fairly straightforward ways. Further details are given in Lee and Miller (1997) and in Lee et al. (1998).

Most of the benefit schedules are projected forward by assuming that benefits at each age rise at the rate of productivity growth. Some exceptions, however, require special treatment. We follow the Congressional Budget Office (CBO) in assuming that defense spending is a constant share of GDP in the long run. Social Security benefits (OASDI) depend on the earnings history of each generation at the time its members reach age 60, and a special forecasting algorithm modifies the age-specific benefit schedule each year to implement this benefit rule (see Lee and Tuljapurkar 1998). Medicare costs per enrollee are projected separately, following the CBO (2000) long-term projection assumptions, which differ only slightly from the Health Care Financing Administration (HCFA) projection assumptions (Board of Trustees 2001). Both assume that the amount by which the Medicare cost per enrollee grows in excess of productivity growth declines from its current levels to a level of 1 percent per year, which is maintained thereafter. Our projections apply these cost increases to people categorized by health status, where health status is assumed to depend on time until death, which varies from 0 to 10 years. The distribution of the population at any age, in any year, by time until death is generated by our mortality projections. Details are provided in Lee and Miller (2001) and Miller (2001). Similar assumptions are applied to institutional Medicaid health costs, and noninstitutional Medicaid costs are also subject to the per-enrollee-cost growth differential used for Medicare.

Income taxes, payroll taxes, sales taxes, property taxes, and excise taxes are calculated in similar ways, based on the CPS, with an adjustment to the age profiles so that the implied totals match the aggregate budget figures. Property taxes are set each year so as to cover the costs of public education, as derived from the benefit side of the projection.

Labor productivity is assumed to rise at 2.3 percent annually, which is about 1 percentage point per year higher than is assumed by Social Security and is slightly lower than the CBO assumes. Most other assumptions closely match those of HCFA, CBO, and Social Security; only mortality differs.

If we simply assume that all tax receipts at each age, other than property taxes, rise with the rate of productivity growth, and project the budget forward, we find huge deficits and rapidly growing debt as the baby boom generation retires. The ratio of debt to GDP rises above 8 by the end of the 100-year projection window. Such levels are clearly impossible. We believe, and assume, that some sort of budgetary adjustment will take place. In our projections, we assume that the Social Security payroll tax will be adjusted annually so that the Trust Fund, once it begins to fall, will not decline below 100 percent of the next year's costs

of benefits. All other federal taxes will be raised proportionately so as to keep the debt-to-GDP ratio (excluding the Social Security Trust Fund) from rising above 0.8. Thus, in our projections, federal taxes are adjusted to meet the costs of rising expenditures on benefits. Other assumptions are possible, of course, and we have experimented with some.

Taxes at the state/local level are set to maintain the current ratio of state/local debt to GDP, which ultimately comes under pressure only to the extent that Medicaid costs, which are partly covered by the states, continue to grow faster than the economy. Property tax rates are set to cover the projected needs for K–12 education spending, which are driven by the numbers of children of school age.

None of our projections include any behavioral responses to the fiscal impacts of population aging. Labor supply is not reduced as taxes rise, for example, nor do interest rates or wage rates react to changing government debt or to variations in the size of the population of working ages.

At the federal level, we account for all taxes and costs in the federal unified budget. At the state/local level, we ignore some programs, including pre-funded pension or insurance programs such as unemployment insurance and workers compensation. We do not include the payments into such programs as taxes, nor do we count the benefits that accrue under costs. For this reason, our estimates of the current and projected ratios of total taxes to GDP are lower than might be expected.

Projected Expenditures

Figure 7 plots non-interest government expenditures as a share of GDP separately for state/local government and for the federal government, and for the total. We see that total expenditures initially are 25 percent of GDP but are projected to exceed 40 percent of GDP by 2075 and 50 percent by 2100. The timing of the increase clearly reflects the timing of the increase in the OADR, but it is also influenced by rapidly rising health care costs per enrollee. At the state/local level, expenditures are fairly flat relative to GDP. Virtually the entire increase in the total is due to increases at the federal level, which is not surprising given the importance of federal transfers to the elderly. Federal expenses increase from 16 percent of GDP in 2000 to 30 percent in 2075, almost a doubling, and by 2100 they are approaching 40 percent.

It is enlightening to separate the expenditures into three age categories: those for the elderly, those for children, and those that are age-neutral. This separation can be done in two ways. One possibility is to assign each program to one of the three categories, based either on the nature of the program or on some criterion such as the average dollar-weighted age of recipient. Another possibility is to assign that portion of the age-specific benefit schedule for each program that goes to those

Figure 7
Government Expenditures[a] as Shares of GDP


Percent

Total

Federal

State and Local
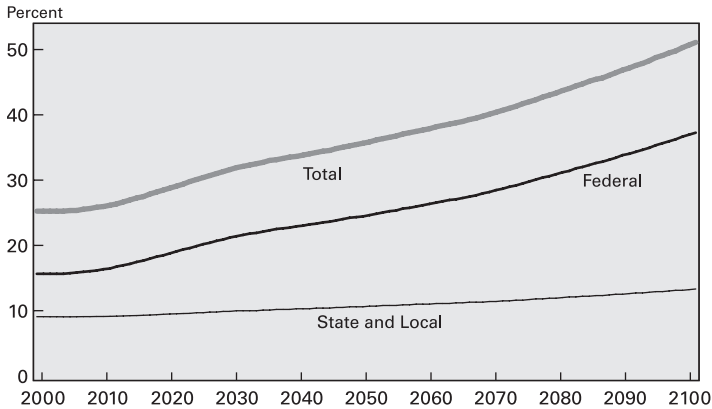
[a]Excluding interest expenditures.

under 18 to children; that portion going to those age 62 or 65 and above to the elderly; and the remainder to the age-neutral category. We have done the decomposition both ways, and found the results to be the same. Here we will report the age division based on program, rather than on explicit age accounting.

Figure 8 shows the result, combining programs at all levels of government. Expenditures on programs for children are flat over the next hundred years. Age-neutral expenditures show some growth, but only to the extent that they include the non-institutional component of Medicaid, which grows faster than GDP because of excess growth in per capita health care costs. The lion's share of the projected increase in government spending over the next seventy-five years and beyond is due to increased expenditures on programs for the elderly. These rise from about 8 percent of GDP in 1999 to 21 percent of GDP in 2075 and more than triple their 1999 share by 2100.

It is also interesting to see which kinds of federal programs are responsible for the projected increases. Figure 9 decomposes the share of federal spending in GDP into retirement programs, health programs for the elderly, other expenditures for the elderly, and expenditures for the non-elderly. The figure confirms that expenditures on children and the working-age population will remain roughly constant relative to GDP, as shown by the constant width of the top section of the graph, labeled "Non-Elderly."

Figure 8
**Government Expenditures[a] by Age Group, as Shares of GDP**
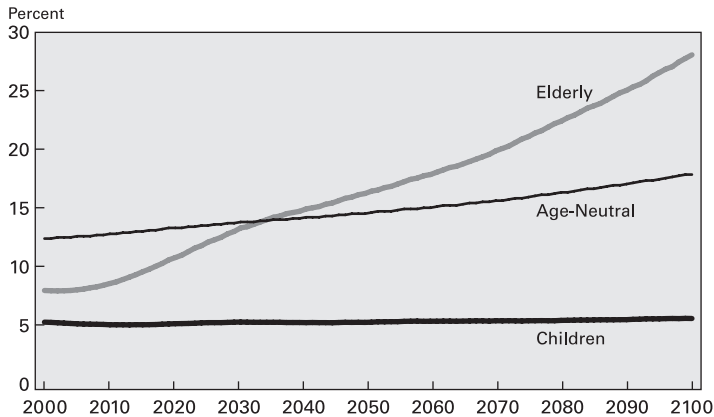
[a]Excluding interest expenditures.

In these projections, Social Security and other federal retirement programs account for only about one-eighth of the projected increase in spending for the elderly, even though Social Security has received most of the public attention in this regard. Instead, health spending is projected to account for the vast majority of the projected spending increase. Of the increase in health spending relative to GDP, roughly half is due to population aging and half to cost increases per beneficiary in excess of productivity growth (Lee and Miller 2001). (We attribute a larger share of the increase in spending on health care to population aging than do most analysts, because we allocate to cost increases per beneficiary only the excess growth relative to productivity.) The new assumptions concerning the rate of increase in health care costs per beneficiary, made by CBO and HCFA and incorporated here, have a large effect on the projections of health costs and, through these costs, on the overall projected expenditures on the elderly.

The figure of one-eighth for the share of retirement programs in the total increase in old-age spending, given in the preceding paragraph, may be far too low. In Lee et al. (1998) the corresponding figure was about one-third. What accounts for the change? There are two main reasons. First, the earlier calculation assumed the same rate of future productivity growth as the SSA, while in this version we have followed the CBO in assuming a rate of 1 percentage point more rapid growth. Based on the latest SSA Trustees Report, this assumption alone would reduce the

Figure 9
Federal Expenditures by Type of Spending,
as Cumulative Shares of GDP
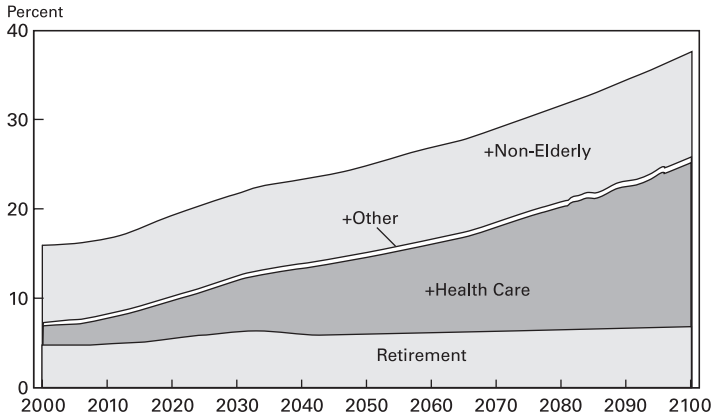
seventy-five-year imbalance from 1.86 percent of the present value of future payroll to only 0.84 percent. We are skeptical about the CBO assumption we have adopted, however. Second, HCFA and CBO assume a trajectory for the gap between the growth rate of per-beneficiary health costs and the growth rate of productivity (or per capita income). Their most recent assumptions foresee a continuation of this gap indefinitely into the future, resulting in greater increases in long-run health costs than in past projections. Furthermore, it is implicit in their assumptions that if productivity growth were more rapid, so would be the growth of health costs. By assumption, therefore, more rapid economic growth can do nothing to make health care more affordable. By contrast, more rapid economic growth would help considerably with the Social Security long-term deficit. For these reasons, we think our figure of one-eighth probably understates the contribution of retirement programs to future increases in government spending on the elderly.

We are actually somewhat more optimistic than CBO regarding the growth of Medicare expenditures per beneficiary, because we expect longer life to be accompanied by better health and reduced need for health care at each age. Nonetheless, because we also project more beneficiaries as a result of more rapidly falling mortality, the net result is very similar to the CBO projections. In general, if mortality declines more rapidly than expected, it will likely be the result of improving health of the elderly population, and costs per elderly person may be lower.

Longer life will impose greater costs on Social Security, but perhaps not on Medicare. For similar reasons, we also expect falling costs per beneficiary at each age for Medicaid-funded long-term care, because of improved functional status of the elderly (Manton et al. 1997; Freedman and Martin 1999; Crimmins et al. 1997).

Uncertainty

We have presented deterministic projections for the next one hundred years. In a sense this is absurd, since uncertainty about the future increases with the forecasting horizon. Our earlier discussion of population aging incorporated uncertainty explicitly. We have also worked extensively on incorporating uncertainty explicitly in budgetary projections, although we do not report that work here. A series of papers develops probabilistic forecasts of the long-term finances of Social Security, including forecasts of the rate of return earned by each generation (Lee and Tuljapurkar 1998 and 2000). Another paper develops probabilistic long-term projections of Medicare expenditures (Lee and Miller 2001). Yet another paper (Lee et al. 1998) develops probabilistic forecasts for government budgets by program and level, and overall. That paper is in the process of being updated, and the deterministic results presented in this section were taken from it.

Although we will not report the probabilistic results, it may be useful if we give some idea of the magnitude of the uncertainty surrounding these forecasts. For federal spending as a percent of GDP, the 95 percent probability interval is fairly tight through 2040, when the forecast is 25 percent ±2 percent. For longer horizons, however, the uncertainty grows more rapidly and becomes more markedly asymmetric. The probability distributions can be shown to tend to a log-normal distribution and therefore to have greater upside uncertainty than downside. For 2075, for example, the point forecast for federal spending as a percent of GDP is 34 percent, and the 95 percent probability interval ranges from 27 percent to 49 percent, twice as great upward as downward relative to the median forecast.

FISCAL EXTERNALITIES OF AN INCREMENTAL BIRTH

Ben Wattenberg (1997) and many others have suggested that the fiscal consequences of population aging be ameliorated by policies to raise the fertility rate or to raise immigration. We will take up these ideas in that order.

Since the main cause of population aging around the world is low fertility, it makes sense to consider pro-natalist policies as an element in a solution. Some analysts view the low fertility in industrial nations as caused in part by the very public transfer programs that low fertility

undermines. The argument is that the contribution of higher fertility to a younger age distribution and hence to old age support is an externality to the parents, leading to a positive externality to childbearing. If people had to rely on their own children to support them in old age and pay for their health care, their fertility would be higher.

Raising fertility in the United States does not seem very appealing because fertility is already at replacement level, and childbearing has negative environmental externalities as well as potentially positive fiscal ones. In many European countries, however, fertility is far below replacement, and pressures sometimes occur to raise fertility for political, military, or cultural reasons independent of the fiscal situation. In this context, fiscal externalities simply add one more reason to adopt pronatalist policies or augment those already in place.

In any event, it is a relatively straightforward matter to utilize the analytic and empirical framework in this paper to assess the possible fiscal externalities to a birth in the United States. Assume that the incremental birth is average in its characteristics and behavior. An incremental birth today can be viewed as a population of one person at age 0. We can then project this population forward based on our assumptions about future fertility and mortality as far into the future as we dare, producing generations of fractional descendants, with the total number either increasing or decreasing exponentially, depending on whether long-term fertility is above or below replacement. In practice, we will do this over a 300-year horizon, although discounting makes the annual contributions negligible well before 300 years is reached.

We can then apply the projected tax and benefit schedules described earlier. These incorporate the assumption that taxes will be adjusted to keep the debt-to-GDP ratio from rising above 0.8. It is this assumption that links the result of the calculation to demographic and economic change during the twenty-first century, since these changes will drive the level of benefits in relation to taxes. In this way, we can generate a future stream of net tax payments by the population descended from this original incremental birth. This future stream will reflect tax payments to help service the debt; the costs of capital expenditures for social infrastructure for the incremental population as well as current expenditures (but not contributions for public goods); and the costs of all age-assignable benefits such as Social Security or public education.

We can summarize the results of this calculation by calculating a net present value of the stream of net taxes. Results are sensitive to the choice of discount rate and the educational level of the parents of the incremental birth. The results, summarized in Table 1, were calculated on the assumption that the budget is adjusted half by raising taxes and half by reducing benefits.

The average educational attainment of reproductive-age adults is slightly more than high school. For simplicity, we will focus here on the

Table 1
Net Present Value of the Fiscal Impact of an Incremental Birth and All Descendants, by Education of the Parents and Real Discount Rate

Education of Parent	Net Present Value in 1000s of 1996$, by Real Discount Rate				
	2%	3%	4%	6%	8%
<High School	362	92	12	−32	−39
High School	495	171	61	−10	−28
>High School	621	245	106	9	−18

Source: Lee and Miller (1997). Empirical intergenerational educational transition matrices are used to project the probability distribution of eventual educational attainment of the original birth and all subsequent descendants. See Lee and Miller (1997, Appendix 7A) for details.

high school case, with a long-run real discount rate of 3 percent; we will call this the central case. Real interest rates earned by the Social Security Trust Fund have averaged 3 percent during the postwar period, and the SSA actuaries assume an ultimate real rate of return of 3 percent in their latest projections (Board of Trustees 2001, Table II.C1). The corresponding cell in the table gives $171,000 as the net present value (NPV) of an incremental birth. At this discount rate, all levels of parental education lead to a substantial positive NPV. At this level of parental education, discount rates of 2 to 5 percent give a positive value, but from 6 to 8 percent the NPV is negative. Higher rates give more weight to the childhood costs of public education relative to later tax payments. Based on these results, we could say that the internal rate of return to an incremental birth, so far as the public sector is concerned, is about 5.5 percent in real terms (that is, at this discount rate the NPV would be zero). Further calculations (not shown in the table) find that if the budget is adjusted entirely by raising taxes, then the NPV for the central case is $214,000, while if it is adjusted entirely by reducing benefits, then the NPV for the central case would be $129,000. Since the externalities arise through "welfare state" programs, scaling these programs back by cutting benefits naturally reduces the externality relative to the effect of adjusting the budget by raising taxes.

Evidently there is a substantial fiscal externality to childbearing. A government could afford to spend a considerable amount on fertility incentives in tax breaks or direct subsidies. To get an idea of the annual impact, abstracting from the timing of the net tax flows, we can multiply the NPV by the discount rate, or 0.03∗$171,000 for the central case, showing an income stream of about $5,000 per year as the result of an incremental birth. At 4 percent it would be about half this, and at 2 percent it would be about twice this. In any case, the net contribution is substantial. It should be kept in mind, however, that most of the fiscal costs of an incremental birth are borne at the state/local level, while most of the fiscal benefits are reaped at the federal level.

FISCAL IMPACTS OF IMMIGRATION

We can build on similar principles to estimate the fiscal impact of an immigrant, including all descendants of the immigrant who are born in the United States. In addition to the methods used for the incremental birth, we must now consider differing ages of arrival and possibly country of origin (although we will not do so here). We must also take into account the considerable possibility that the immigrant returns to the country of origin, a probability that is about 30 percent and distributed across durations of residence in the United States. We estimate tax and benefit schedules for immigrants by age and by duration of stay, so that we can distinguish, for example, between a 70-year-old immigrant who arrived within the past ten years and therefore did not qualify for Social Security benefits and is likely to be receiving SSI, and one who arrived more than fifteen years earlier, who therefore might well have qualified for Social Security and is less likely to be receiving SSI. Tax payments also depend on duration in the United States as well as age, since the process of earnings convergence increases with duration. We estimate separate tax and benefit schedules for the U.S.-born children of immigrants, or "second-generation" immigrants, as well as for the rest of the population, the "third-plus generations" of immigrants who make up about 80 percent of the U.S. population.

Table 2 summarizes the NPV estimated in this way. (See Lee and Miller 1997 or Smith and Edmonston 1997 for details of method and for further results and sensitivity tests.) We see that immigrants arriving at younger ages have large positive NPVs, and that NPVs are higher for those with more education. We can also see that immigrants who arrive later in life can be very expensive. Averaging across education categories, immigrants who arrive after age 40 are increasingly costly, with arrivals between ages 60 and 70 apparently imposing costs over $150,000. One reason for the high costs of these older immigrants is that they do not

Table 2

Net Present Value of the Fiscal Impact of an Incremental Immigrant and All Descendants, by Education and Age at Arrival in the United States

Education of Immigrant or Parent	Net Present Value in 1000s of 1996$, by Age at Arrival (r=3%)			
	0	20	40	70
<High School	60	33	−141	−166
High School	92	146	−32	−255
>High School	117	288	132	−149

Source: Lee and Miller (1997). For children, the educational attainment is that of their parents. Empirical intergenerational educational transition matrices are used to project the probability distribution of eventual educational attainment of the original birth and all subsequent descendants. See Lee and Miller (1997: Appendix 7A) for details.

contribute births in the United States, nor do they contribute much in the way of taxes. However, it is possible that some of these immigrants who apparently arrived later in life have actually worked here before, but have given their most recent entry to the United States rather than their first entry, in response to the Current Population Survey. In this case, they have qualified for Social Security benefits and borne children in the United States. This is a likely source of distortion in these estimates of costs for older immigrants. It affects the estimated costs by age at arrival, but not the overall age profiles of costs and taxes of immigrants that abstract from age at arrival.

Drawing on estimates like those in Table 2, but for single years of age at arrival, and using the distribution of recent immigrants by age at arrival and by education, we can estimate an overall weighted average of their NPVs. This yields a figure of $80,000 (in 1996$) for the average immigrant. Calculating this separately for state/local and the federal levels of government, we find −$25,000 and +$105,000. Immigrants are on net costly at the state/local level, because this level provides education for children and a small portion of the benefits for the elderly. At the federal level immigrants are a large net benefit, because they help share the burden of supporting the costs of Social Security and Medicare in an aging population. This would also be true of incremental births, as noted earlier.

These estimates are based on projections very far into the future, which some may find too fragile a basis for drawing useful conclusions. An alternative approach projects year by year the fiscal implications of an incremental immigrant, or of a flow of incremental immigrants. As a concrete example, suppose that the flow of immigrants increased by 100,000 per year, starting now and continuing indefinitely, with the incremental immigrants having the same distribution of characteristics as the recent immigrant stream. In this case, the effect would initially be to raise taxes per average U.S. resident by about $8 per year, but increasingly after twenty years taxes would be reduced, so that after fifty years, taxes would be $60 less per resident, and increasingly so thereafter. This calculation does not rely on projections past the year in question.

Our analysis takes a partial equilibrium approach, in which incremental people have only fiscal effects and do not alter the trajectories of wages or interest rates. Storesletten (2000) takes a general equilibrium approach, incorporating the effects of immigrants on wages and interest rates in a dynamic, perfect foresight setting. However, he includes less demographic detail and does not include public goods.[4] Auerbach and

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[4] In Storesletten (2000), capital, factor prices, and labor supply are endogenous. The general equilibrium feedbacks reduce the impact of immigration by about 20 percent. He finds the NPV of a legal immigrant is $7,400, substantially lower than the $99,000 we find

Oreopoulos (1999) use a generational accounting framework. Although the results from these three studies may appear to differ, once comparable assumptions are made they are all roughly consistent.

The fiscal impact of an individual immigrant is found to be a large positive amount. However, these calculations of the effect of immigration on the average taxpayer give a rather different impression. While the effect is still positive, it is much smaller. Suppose we were to try to balance the long-run finances of the Social Security system by raising immigration, in the sense of making the seventy-five-year actuarial balance be 0 instead of −1.86 percent as it now is. This would require an additional 5 million immigrants per year, every year (Lee and Miller 2000). Demographic simulations also indicate that the effect of varying rates of immigration on the old-age dependency ratio is relatively minor. To have a substantial effect, it is necessary to have an exponentially rising stream of immigrants.

The bottom line is that although long-run fiscal impacts are important when measured per immigrant, only massive and accelerating increases in the volume of immigration would have an important aggregate fiscal effect, given the current composition of the immigrant stream. A policy of selectively increasing the stream of more educated immigrants, as Storesletten (2000) suggests, could have a larger effect. However, in our view, immigration is only a weak policy instrument for reducing the fiscal consequences of population aging.

Summary and Conclusions

Population aging is a natural and inevitable stage in the process of the demographic transition, a transition that has been unfolding in the United States over the past 200 years. Because the United States has, and may continue to have, fertility close to the replacement level of two children per woman, as compared to the substantially lower fertility throughout much of the industrial world, population aging here is expected to be relatively mild. Nonetheless, the ratio of those ages 65 and above to those ages 20 to 64 is expected to double, and could rise higher, over the next seventy-five years.

It is a feature of modern industrial government programs that they provide more costly benefits per elderly person than they do per child. The greater part of the cost of rearing children is left to the private family.

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here. However, his number does not reflect public goods; adding them raises the NPV to $26,000 (Storesletten 1999, p. 16). The discount rate is endogenous and varies; results are closer to ours when 4 percent is used in place of the endogenous discount rate. He assumes substantially higher fertility and lower life expectancy than we do, implying a lower old-age dependency ratio than is projected by the Social Security actuaries, which would further reduce the NPV. His estimates are therefore fairly consistent with ours after taking these identifiable differences in assumptions into account.

Consequently, population aging alters the costs per taxpayer of maintaining the current benefit structure in the future. We calculated earlier that for the United States, population aging will raise the tax costs of our current benefit package by about 50 percent, even with no changes in the per-recipient costs of programs. Industrial nations must face head-on the question of how to respond to this change in the price of our current collection of benefits. Options include raising taxes, reducing benefits, or radically restructuring the programs while maintaining benefits, for example, through a move to pre-funding and investment in equities. This last step probably does nothing to solve the problem on a risk-adjusted basis, however, and it might well raise the costs that current generations must pay.

We have also projected over a 100-year horizon the likely tax increases needed to maintain an acceptable debt-to-GDP ratio, given the legislated changes in the normal retirement age for Social Security and projected increases in relative costs of health care per enrollee. We find that the total share of GDP going for federal expenditures excluding interest on the debt would have to double, from about 16 percent now to about 30 percent in 2075. Expenditures on children and the working-age population would remain roughly constant relative to GDP, while expenditures on the elderly would almost triple over the next seventy-five years, from 8 percent now to 21 percent in 2075. It is expenditures on the elderly that are responsible for the long-term budgetary pressures.

Of these increased expenditures on the elderly, we find that Social Security and other federal retirement programs account for a surprisingly small portion. Health spending accounts for the majority of the increase. However, we have some doubts about the assumed rate of future productivity growth and the form of the health cost assumption that we have adopted from HCFA and CBO. We suspect that increased costs of public pension programs will play a larger role than our results indicate. Of the increase in health spending relative to GDP, roughly half is due to population aging and half to cost increases per beneficiary in excess of productivity growth.

We showed that both incremental births and additional immigrants would help ease the long-run fiscal situation. However, U.S. fertility is already high among industrial nations, and high fertility has many other implications besides the fiscal ones. We do not find a pro-natalist approach to easing the fiscal crisis appealing. For other industrial countries, the situation may be different. As for increased immigration, we have shown that it would have a relatively modest budgetary impact, with the possible exception of a policy that targeted highly educated immigrants.

Longer life and smaller families are fiscally costly. Major changes in taxes, benefits, or program funding structures are necessary. Policymakers and the public must be educated to these new realities, and difficult decisions must be made.

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