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Introduction

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The dictionary definition of demography is "the study of population size, growth, and age structure (fertility, mortality, and immigration) that lead to population change" (American Heritage Dictionary 2006, 483). Of course, by referring to a dictionary, I have already identified myself as not belonging to one of the younger cohorts of Americans, whose members would have looked it up online. The topic of this volume is the interface between demography and the economy. For our purposes, demography includes not only fertility, mortality, and immigration, but also the racial and gender composition of the population, living arrangements, marriage, divorce, the timing of the entry and exit from the workforce, and age-, gender-, and race-specific health and disability. Economic demography is a giant topic and the chapters in this volume, as good as they are, only scratch the surface of the important connections between the two fields.

Attention to the demography-economics boundary is nothing new. Political economist Thomas Malthus is famous for predicting that human societies would inevitably return to subsistence-level conditions due to exponential population growth outpacing the growth in agricultural output. His 1798 *Principle of Population* made this point and led to his conclusion that "the power of population is indefinitely greater than the power in the earth to produce subsistence for man. Population, when unchecked, increases in a geometrical ratio" (13). Malthus was clearly an important economic demographer. His prediction, that societies cannot long remain above subsistence standards of living, has not stood the test of time. While

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there still are perhaps one billion people living at subsistence levels, it is hard to reconcile his model with the fact that roughly five-sixths of the world's population enjoys a much higher standard of living. In the intervening 210 years, output, even agricultural output, has grown faster than population. Malthus can be forgiven for not foreseeing the amazing breakthroughs of electricity, wireless communication, antibiotics, and computers, not to mention chemical fertilizers, engineered seeds, and the whole green revolution. He was right, however, about the important interaction between economics and demography.

Many important economic institutions are based on Malthus' being correct—that fertility would be such that successive cohorts would be more populous. In the United States and many parts of the world, social security was partly based on that premise. The pay-as-you-go systems were based on workers supporting retirees, with workers significantly outnumbering those in retirement. Early in the history of U.S. Social Security, there were approximately nine workers for every retiree. This ratio is now roughly three and by all forecasts, headed to two within the next twenty-five years. Much of this decline is due to the low fertility rates of the past forty years, coupled with dramatically improved age-specific mortality rates. In some European countries and Japan, the ratio of workers to retirees is already two and forecast to approach one. The falling ratio of workers to retirees is placing great strain on both social security and national health insurance systems, including Medicare and Medicaid in the United States. Pay-as-you-go programs that work reasonably well when there are three or four workers per retiree cannot function at all well when the ratio is two or one. Demographics not only affects these income transfer systems, it affects such things as personal and national saving rates, life insurance and annuity markets, the demand for schools, long-term care facilities, the design of houses, and the need for public transportation. Demographics remains a central shaper of economic forces in society.

The two biggest drivers of population growth and population age structure are fertility and mortality. In fact, from a global perspective, they are the only two drivers since immigration has to net to zero. We now recognize that fertility and mortality are not simply statistical or biological constants, but rather they are determined by choices and past investments. The first two chapters of this volume deal with fertility and the orientation of the chapters would be hard for Malthus to get his mind around. In chapter 1, Samuel H. Preston and Caroline Sten Hartnett write about the future of American fertility. Roughly speaking, American fertility, the average number of children that a woman has over her childbearing lifetime, has hovered at or slightly below the zero-population growth level of 2.1 for the past forty years. Malthus would have been surprised that one of the world's richest countries would have a birth rate so low. He would be even more surprised when he learned that the American fertility rate is the one of the

highest among developed economies. All of the advanced economies of Asia and Europe have birth rates well below zero-population growth rates, some amazingly so. For example, Italy, Spain, Germany, Russia, Japan, and South Korea all have fertility rates of less than 1.5. With such fertility rates, their population will shrink by 25 percent or more per generation absent net immigration. The rate of global population growth is now slowing and the world's population is expected to peak sometime in the first half of this century. Malthus would be perplexed.

Preston and Hartnett review the history of American fertility, the connection between fertility and marriage, religion, education, female labor force participation, ethnicity, the relative earnings of women and men, birth control technology, and even the composition of the Supreme Court. They look at differences in fertility across states and find that even the lowest fertility state in the United States (Rhode Island) would rank among the highest fertility countries of Europe. They address the question of whether U.S. fertility might approach the low European levels. They find that the rapid growth in the Hispanic population in the United States will tend to push our fertility rate up slightly, while the continuing trend of more years of education, particularly for women, will tend to push it downwards by a comparable amount. My reading of their chapter is that de Tocqueville's (1839) observation of "American exceptionalism" is likely to continue and that we are likely to remain a relatively high fertility country, even if we are a low fertility country by absolute historical standards.

The second chapter in the volume was written by Larry E. Jones, Alice Schoonbroodt, and Michèle Tertilt. It tries to explain the observed negative relationship between income and fertility within a standard utility maximizing economic model. The observation that richer populations have lower fertility has been repeatedly made, whether the evidence is across countries or within countries. Richer people buy more houses, cars, clothes, and gadgets—why not children? Are children literally an "inferior good?" The authors examine the leading economic models that attempt to explain the negative relationship between income and fertility and they find that the models are fragile and less than convincing. For instance, one idea is that high income people have a higher opportunity cost of time and children take lots of time, therefore they are more expensive and they choose to have fewer of them. The problem with this approach is that richer parents can purchase more and higher quality child care services. Once the possibility of purchased services such as nannies is introduced, the model no longer predicts that those with higher wages would want fewer children. The authors look at models that trade off the quality of children (the amount of time that is invested in children by parents) and the quantity of children, to see whether these models can be made consistent with the observed cross-section results. Several additional models are summarized and a new one is formulated, but I think that it is fair to say that building models that are consistent with

the cross-sectional evidence and that have sensible dynamic specifications is extremely difficult. The authors highlight these difficulties and lay out an agenda for further work on this topic.

The third chapter in this volume was written by Adam Isen and Betsey Stevenson. They examine the trends in marriage, divorce, and fertility among American women. They show that over the past sixty years, marriage rates have fallen, divorce rates have risen, and fertility has fallen, and argue that the fundamental nature of marriage has changed. In his 1981 book, *Treatise on the Family,* Gary Becker proposed an economic theory of families based on "production externalities." The idea was that in a marriage there were gains from trade between the spouses, one specializing in market work and one specializing in work in the home. Clearly, this model of marriage captured the essence of the majority of American marriages for the first sixty years of the twentieth century. This production specialization model of marriage was consistent with the fact that marriage rates were lower for highly educated women (who had more valued market skills) than for less highly educated women. Isen and Stevenson contend that household technology such as dishwashers, automated laundry machines, and microwave ovens is one factor that has led to marriages being more frequently based on "consumption externalities" in recent decades. If marriages are based more on collective consumption of leisure than specialization in production, there is a stronger incentive to marry someone with comparable education and participation in the market. Isen and Stevenson show that this gradual switch in the predominant economic gain from marriage from production to consumption is consistent with the observed marriage trends. For instance, in recent years, the marriage rate for college-educated women has been roughly as high as for those who did not go to college. In addition to marriage and divorce, the authors look at changes in the pattern of remarriage and changes in the timing of childbirth.

The fourth chapter in the volume was written by Gopi Shah Goda and myself. We propose that people of any given age, say seventy, at different times, say 1940 and 2008, are not really the same age. For example, the mortality (the chance of dying within twelve months) of seventy-year-olds in 2008 was about half the mortality of seventy-year-olds in 1940. In fact, the mortality of seventy-year-olds in 2008 was approximately the same as the mortality of sixty-year-olds in 1940. We suggest that years since birth is a flawed way of measuring age and suggest four different ways of moving from nominal age (years since birth) to real age. We draw a parallel to the way that economic statistics and economic policies are often indexed for inflation and stated in terms of real dollars. The four alternative ways that we propose to adjust nominal ages to arrive at real ages are based on (a) remaining life expectancy, (b) mortality risk, (c) percent of life expectancy at birth completed, and (d) percent of life expectancy at age twenty completed.

We look at several key ages in important legislation and show how those

ages would have changed if they had been stated in terms of real ages rather than nominal figures. For example, we show that the equivalent age to sixty-five in 1965 (when sixty-five was made the age of eligibility for Medicare) would have grown to seventy-two, using mortality risk as the method of age indexing. The equivalent of sixty-five in 1935 (when that was set as the age of Social Security retirement) is seventy-four in 2004. What this reflects is that the average seventy-four-year-old American has the same mortality risk in 2004 as did the average sixty-five-year-old in 1935. If men and women were indexed separately, the 2004 equivalent of sixty-five in 1935 would be seventy-five for men and seventy-three for women. The alternative methods of age indexing give somewhat different answers, but all show that there has been very serious age inflation over recent decades. The chapter also looks at how age indexation would differentially affect African Americans and Caucasians. The general result is that mortality improvement has been quite comparable for whites and blacks and therefore the appropriate age adjustments are about the same.

Chapter 5 in this volume, written by Axel Börsch-Supan and Alexander Ludwig, looks at the macroeconomic implications of population aging in Europe. Europe is worth studying—because fertility rates are lower in Europe than in America, mortality rates are slightly lower, and therefore the European age structure is similar to the future American demographic composition. Börsch-Supan and Ludwig model Italy, France, and Germany in particular. The question that they ask is whether the high standard of living in Europe can be maintained with the aging population. This question and the closely related one of whether an aging society can be a high growth economy is relevant to many other countries, ultimately including China and the United States. Börsch-Supan and Ludwig look at a number of European labor and pension market reforms that have the potential to mitigate much of the negative implications of population aging. The authors examine a number of possible reforms and the likely behavioral responses to them. Examples of behavioral responses are that married men may work less if child care is provided to encourage the labor force participation of mothers. Another example is that the demand for part-time work may increase as mandatory retirement ages are raised. The authors look at the impact of labor and pension reforms using a multicountry overlapping generations general equilibrium model of the Auerbach and Kotlikoff (1987) type. The results of the simulation model indicate that the behavioral responses to pension and labor market reforms dampen their ability to keep per capita living standards on a steady growth path despite the aging of these societies. Still, the authors find that the reforms, if correctly designed and coordinated, can have a very significant impact on future living standards in these three European countries.

Chapter 6 in the volume was written by Shripad Tuljapurkar of Stanford University. It examines what the author calls "the final inequality"—the

variance in the age at death. While it is well-known that life expectancy at birth and life expectancy conditional on age ten or age twenty has increased in almost every country of the world, what is less well-known is what has happened to the inequality of the age of death. Tuljapurkar initially studies what happened in Sweden between 1950 and 2000. Over this fifty-year period, life expectancy at birth grew by 12 percent and remaining life expectancy, conditional on reaching age sixty-five, grew by 33 percent. What the author emphasizes, however, is the standard deviation in age of death, conditional on reaching age ten (he also calculates the spread in the age of death conditional on age twenty). The reader will discover two facts: first, the standard deviation in the age of death is quite high, roughly 13.4 years in 1950; and second, death inequality fell in Sweden over this period with the standard deviation in the age of death conditional on reaching age ten falling to about 12.2 by the year 2000. Still, the difference between being one standard deviation lucky and one standard deviation unlucky was approximately twenty-five years of life. He then examines death inequality in a variety of large developed countries (Canada, Denmark, France, United Kingdom, Japan, Sweden, and the United States) and finds that, once again, the United States stands out as exceptional. The United States has the highest level of inequality of the age of death of all of these countries (the standard deviation of the age of death conditional on age ten is between fifteen and fifteen-and-a-half years). Further, the level of inequality in the United States has not fallen over the past forty or fifty years, as it did in Sweden and most of the other countries. The country whose pattern was most like the United States was France. The chapter also includes a brief analysis of life expectancy and inequality for Americans with different levels of education and income. The most notable result is that less educated Americans (those with less than high school graduation) not only have significantly lower life expectancies (by 5.1 years), but also have significantly greater mortality inequality.

Chapter 7 in the volume was written by James M. Poterba, Steven F. Venti, and David A. Wise. It concerns one of the largest asset categories for present and future retirees, namely the equity in their homes. For most people, the big three asset categories in retirement are social security wealth, pension accumulations, and home equity. Poterba, Venti, and Wise have written a number of articles projecting future pension accumulations, particularly 401(k) balances. This chapter does similar cohort analyses for home equity. The authors find that the likelihood of home ownership by age changed very little over the past twenty-five years for married couples, single women, and single men. Roughly 80 percent of couples and 60 percent of singles own their home by the time of retirement. It is well-known that most retirees stay in their home and retain their home equity until late in retirement, when shocks such as the death of a spouse or entry into a nursing home may cause the home to be sold. In a way, the house serves as a "rainy day fund" for potential life changes or expensive developments later in life. This

raises the natural question about whether home equity is a safe store of wealth for the rainy day fund. Even without all of the recent data about the 2006 to 2009 decline in house values, the authors estimate a nontrivial probability of between 10 and 14 percent that the value of the family's home will decline in real value between age fifty-nine and age seventy-nine. The authors caution that their estimate of the riskiness of home equity as a store of value is probably understated. This is because their model uses average home values by state, whereas people own specific individual houses subject to local market risks.

Chapter 8 in the volume was written by Sylvester Schieber, former Chairman of the Social Security Advisory Board. He examines the demographic evolution of several advanced countries and predicts a noticeable slowdown in the growth of per capita gross domestic product (GDP). Pension policies can be viewed as alternative methods for allocating the disappointing output due to the aging of the populations. Schieber's work suggests that switching from pay-as-you-go funding for national Social Security systems to funded systems may not do much in terms of alleviating the disappointing levels of output growth. He reviews the evidence that the United States move to partially prefunding Social Security, which began in 1983 and has resulted in a $2 trillion Social Security trust fund, has not increased national saving rates and has therefore not increased the productive capacity of the United States. Schieber simulates the evolution of retiree dependency ratios for the United States, India, and Italy and shows that the number of people over the age of sixty-five relative to those in their working years rises significantly in all three countries. However, the case of Italy is quite extreme. Their retiree dependency ratio in 2010 is roughly at the level projected for the United States in 2050. The Italian retiree dependency ratio in 2050 is completely unsustainable since it leads to the conclusion that the necessary payroll tax would be approximately 65 percent. Simulations such as these are forcing painful adjustments in retirement ages and the design of national pension systems. Schieber also reviews the literature on the issue of whether demographics alone can lead to a dramatic decline in national saving rates and possibly a decline in asset values.

Chapter 9 of the volume deals with the long-term financing of Medicare in the United States and was written by Orazio Attanasio, Sagiri Kitao, and Giovanni L. Violante. The authors develop an overlapping generations general equilibrium model and contrast the U.S. economy in 2005 with the model's projections for 2080. The model has a changing demographic structure and exogenous increases in health costs. Individuals face risk in terms of their own health status and health determines household productivity, mortality rates, and health expenditure. Their model features employer-provided health insurance, Medicare for the elderly, and Social Security. It is calibrated to match key statistics for the U.S. economy. It has both taxes on capital income and labor income. The baseline forecast of the

model is that the labor tax rate will need to increase from 23 percent to 36 percent by 2080 and that two-thirds of that increase is caused by Medicare. This baseline forecast is for a closed economy where the exogenous price of health care is increasing by 0.63 percent per year over general inflation. The authors look at an alternative specification where the relative price of health care is increasing faster, closer to the Social Security Administration (SSA) projection. In that case, the average labor tax rate that is needed to balance the budget is 39 percent. Probably the best way to think of these tax rate forecasts is that labor taxes will have to be between 57 and 70 percent higher in 2080 than in 2005 and most of the increase is necessitated by Medicare. The authors look at other specifications, including one that models the United States as a small (relative to the world economy) open economy by 2080. While the necessary labor tax rate increase is smaller in the open economy case, it still is very sizable. The authors look at three possible policy reforms and their impact on 2080 tax rates: increases in Medicare premiums, changes in Medicare coverage, and changes in retirement age. Each of them has the potential to lower future labor tax rates, but the demographics and increases in health costs still result in a future of higher taxes.

The final chapter, chapter 10, has the title "Italians are Late: Does it Matter?" and is written by Francesco C. Billari and Guido Tabellini, both of Bocconi University. Italians are a case study in economic demography. Their fertility rate, currently about 1.3, is among the lowest in the world. Italian men study longer, or at least complete college later, they enter the labor force later, and they leave the parental home later than men in any other developed country in the world. It is not unusual for Italian men to live with their parents late into their twenties and sometimes into their thirties. Billari and Tabellini summarize the situation by characterizing Italian men as entering adulthood later than men in other countries. They state, "Italians are late. Not just a little, but a lot. They start all adult activities at a much later age than is common in other countries at comparable levels for development, from working, to living alone, to marrying, to having children." The question they address is, does it matter? They look at whether this lateness reduces the lifetime economic opportunities of individuals or not. They examine survey data for Italians in their mid-thirties. Their key finding is that the age of leaving the parental home is quite important in terms of earnings several years later. Those who leave home later earn considerably less both per year and throughout their career. The age of leaving the parents' home is more important, for instance, than the age at which one begins employment. The authors look at policies that might help with the "lateness problem." These include the possibilities of shortening the duration of higher education and policies that increase the available supply of housing to young men and women. Policies that improve job opportunities for young Italian men would likely increase the probability that they would leave their parents' home and commence the period of adult independence. The basic answer to

Billari and Tabellini's research question is that the lateness of Italians does matter and it depresses their lifetime earnings.

These ten chapters are only a sampling of important topics in economic demography. Here I will attempt to mention just a few of the additional subjects that deserve attention in further work. The size of the populations of India and China, their rapid economic development, and the consequences for the global economy and the global environment are at least partially issues of economic demography. The economic demography of Africa deserves a book by itself. More than any other continent, Malthus would find support for his theory there, with the unfortunate combination of high fertility rates, high mortality rates, and sizable subsistence populations in many countries. Immigration is another important topic that we did not cover in this volume. One question is whether the depopulation of Europe, due to its extremely low fertility rates, will be offset by immigration from elsewhere in the world, perhaps from the Middle East. Then there is the forecasting of future trends in mortality and the economic consequences of very long lifetimes. Can the pace of mortality progress of the twentieth century continue long into the twenty-first? Will the biotech revolution allow the pace of progress to accelerate or will further progress in health and mortality prove slower and more difficult? Many of these issues were tackled in the 2004 Brookings volume, *Coping with Methuselah* (Aaron and Schwartz 2004). The editors of that volume think that there is a good chance that the developed countries of the world will see further substantial increases in life expectancies.

Economic demography issues were important in the twentieth century and they will be equally important in the twenty-first. For instance, all of the extra adult lifetime for men was taken as extra retirement rather than as extra work life. At least in the United States, retirement was essentially a twentieth-century invention. In 1900, men worked until they no longer could work. On average, men died two years after they stopped working. By 2000, the average length of retirement for men was almost twenty years. This allocation of all of the extra lifetime to retirement certainly cannot be maintained in this century. If it were, the length of retirement would begin to approach the length of the work life. The simple saving and pension mathematics will not work for thirty- to thirty-five-year retirements with thirty-year careers. Of course, this is just one of the many adjustments that will be caused by the aging of all major countries and the likely transition from growing populations to stable or even shrinking populations. This transition appears to be already under way in Europe and that is why two of the chapters in this volume concentrated on European countries. Don't get me wrong—improved life expectancies, lower fertility rates, and some indication that the world's population may peak and fall slightly are positive developments worth celebrating, at least in my opinion. The point of many of the chapters in the book, however, is that economic institutions need to adjust to the new demographic realities.

Scientific progress is often most dramatic at the boundary of intellectual disciplines. It is my belief that the boundary between demography and economics is one of the most promising. My hope is that the chapters in this volume will stimulate further research on these topics and on the important topics that we could not cover in one volume.

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