S. HRG. 98-359

TRENDS IN U.S. LIFE EXPECTANCY

HEARING

BEFORE THE

SUBCOMMITTEE ON SAVINGS, PENSIONS, AND INVESTMENT POLICY

OF THE

COMMITTEE ON FINANCE
UNITED STATES SENATE

NINETY-EIGHTH CONGRESS

FIRST SESSION

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TRENDS IN U.S. LIFE EXPECTANCY

FRIDAY, JULY 15, 1983

U.S. SENATE,
COMMITTEE ON FINANCE SUBCOMMITTEE ON SAVINGS,
PENSIONS AND INVESTMENT POLICY,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:35 a.m., in room SD-215, Dirksen Senate Office Building, Hon. John H. Chafee (chairman of the subcommittee) presiding.

[The committee press release announcing the hearing and the opening statements of Senators Chafee and Dole follow:]

FINANCE SUBCOMMITTEE ON SAVINGS, PENSIONS, AND INVESTMENT POLICY SETS HEARING ON TRENDS IN U.S. LIFE EXPECTANCY

Senator John H. Chafee (R., R.I.), Chairman of the Subcommittee on Savings, Pensions, and Investment Policy of the Senate Committee on Finance, announced today that on Friday, July 15, 1983, the Subcommittee will hold a hearing on trends in the projected life expectancy of U.S. citizens and the potential effect of these trends on retirement planning and other economic and social policies.

The hearing will begin at 9:30 a.m. in Room SD-215 of the Dirksen Senate Office Building.

In announcing the hearing, Senator Chafee stated that, "Our first area of interest is to identify whether current life expectancy projections are accurate, or whether Government policymakers and other projections underestimate the number of people who will live well beyond 65.

"Another intriguing question is the likely limit on the human life span in the 21st century," the Senator added. "Advances in science and medicine, especially in the treatment of major diseases such as heart disease may have increased life expectancy to its current level, but the extent to which these advances can continue to promote increased longevity is unclear."

Senator Chafee also noted that the answers to the question of increased longevity would have a significant impact on retirement policies, economic planning, and individual lifestyles. He added that while the Subcommittee cannot expect to examine these issues in detail at this hearing, he hoped that the Subcommittee could begin to identify the issues that should be considered in light of a projected increase in U.S. life expectancy.

"The prospect of increased U.S. life expectancy presents an opportunity and a challenge," the Senator concluded. "It is exciting to consider that advancements in science may have added years to the lives of U.S. citizens. But it is important that the Government and the private sector act now to understand the impact of these additional years. Employers, employees and their representatives must have this information in order to plan for the future. In this way the quality, as well as the length, of our lives can be improved."

Senator Chafee stated that testimony at this hearing would be received from invited witnesses only. A list of witnesses will be announced at a later date.

REMARKS OF SENATOR JOHN H. CHAFEE

We live in exciting times, but demographically, these may be the most exciting times in our history. Unprecedented gains have been made in life expectancy and these gains will likely continue, possibly even accelerate. At the same time we are

expanding our understanding of the processes of aging in ways that may lead to the extension of life span itself.

These developments hold both great opportunity and great challenge.

The opportunity is, of course, that many of us can expect to live longer, fuller lives. The challenge for us as individuals is whether we can enjoy these additional years as vital, productive members of society. The challenge for society is whether we can adapt family structures, social and government institutions to the fact that so many of us will be old. And ultimately, we must ask, how will we be able to afford the support of an elderly population numbering as many as one-fifth of the total population.

These concerns can quickly be demonstrated by numbers which illustrate the advance of life expectency. In 1900, 3.1 million people, or 4.1 percent of the population lived to be 65 and over. In 1980, 26 million, or 11.3 percent of the population, reached this age. By 2000, 36 million people or 13 percent, and by 2025, 58 million or 20 percent of the population is projected to live to be 65 and over.

The startling fact is that these huge increases in Americans' life expectancy will be accomplished even without our having found cures for the major chronic diseases.

The increase in life expectancy is only one aspect of the issue. Life span extension must now also be considered. Man has never is his history lived much beyond 110. (The oldest verified individual lived to be 114.) But this age-old fact is now being challenged. As one of our witnesses, Dr. Walford, has suggested, life span could be increased by 40 or more years. Such speculation might be dismissed out of hand. Yet we really cannot afford to blind ourselves foolishly to the fiscal and societal effects of such a leap of scientific knowledge.

The combination both of continued increases in life expectancy and the possibility of increases in life span are simply staggering from the standpoint of public policy.

Very clearly, the assumptions that government and private actuaries make about mortality rates are critical in projecting future federal outlays. For example, the total federal benefits that would have been paid to people had they not died in 1978 of heart diseases, cancer, car accidents and homicides would have exceeed the potential taxes the survivors could have been expected to pay by $15 billion. In other words, cures of these killers would have resulted in a net drain of $15 billion, in 1978 dollars.

Facts like these only begin to illustrate the need to have the most accurate possible estimates of mortality. There are 51 federal retirement programs encompassed in 38 separate retirement systems. In 1978 the General Accounting Office expressed its concern that these programs operated separately in the absence of federal guidelines, without uniform practices governing their financing. That concern is as real today as then. As of 1981 only one of the federal retirement systems, the Civil Service Retirement System, assumed that mortality rates would improve in the future. The Federal Reserve uses annuity tables from 1951 when life expectancy for people over 65 was 15 percent less than now.

The Social Security system, the major source of financial security for so many millions of Americans, is of course of special importance. While not strictly speaking a federal retirement program because it insures mainly private citizens, the federal stake in it is enormous.

The Social Security Administration has rather recently adopted a set of three assumptions about mortality—high, intermediate and low. All of them project mortality improvements at rates less than the historical average for the first 80 years of this century. If the low (or optimistic) mortality forecast were accurate, there could be 15 percent more Social Security beneficiaries by 2020 than the intermediate estimate would indicate.

The Social Security Administration's intermediate projection assumes an improvement in mortality of 37 percent over the next 80 year period, whereas it improved 67 percent over the previous 80 years.

We are all, I am sure, interested, even fascinated by the possibilities that exist for increased life expectancy and life span. But the central issue of concern today is whether or not federal and private retirement systems—and other programs based on actuarial estimates of mortality—are taking into account these possibilities. Projections of mortality based solely on historical date are in danger of being wrong. It is quite sensible to expect that medical science will continue to make substantial progress against the major causes of death. Retirement systems that are based on mortality estimates that do not attempt to encompass these possibilities are, in my view, potentially at risk.

I hope that today we will shed light on these issues.

THE "RECTANGULARIZATION" OF LONGEVITY

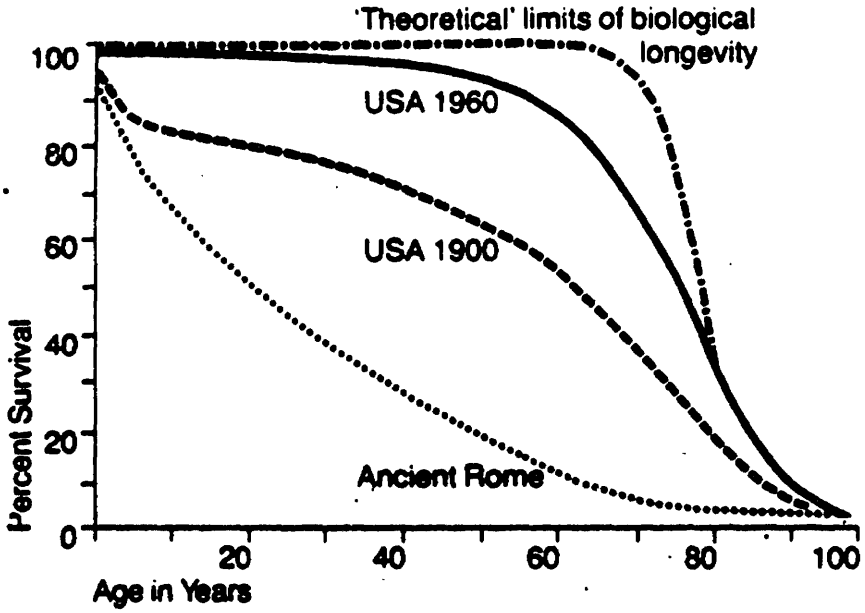

TABLE 1

	1900	1940	1975	1980
Percent of the population age 65+ and 80+; United States:				
Total 65+	4.1	6.9	10.5	11.3
Total 80+	0.6	0.9	2.1	2.3
Percent of deaths age 65+ and 80+; United States:				
Total 65+	24.3	45.8	64.3	67.2
Total 80+	7.3	14.1	27.8	30.6

Source: National Center for Health Statistics.

STATEMENT OF SENATOR DOLE

I am pleased to welcome you to these hearings on life expectancy trends in the United States.

I do not believe there is any disagreement with the projection that the population over age 65 will increase dramatically in the next 50 years. This trend is of great interest to us as lawmakers and as members of the Finance Committee, since we must work to insure that our political and economic system prepares for an increase in the proportion of older Americans. We must also anticipate necessary social and attitudinal changes with respect to the role of older individuals in our society.

But before concrete planning can begin, it is necessary to focus on the magnitude of the changes that are being forecast. Both lawmakers and policy planners in the private sector have come to depend on a number of institutions to provide statistics and information that, quite frankly, we sometimes don't fully understand and are tempted to accept at face value. It is sometimes necessary to take a close, hard look at the numbers, percentages, and charts we receive, and to reflect on the assumptions underlying those numbers and the policy implications of interpretating those numbers in a particular manner. I hope that these hearings will provide us with information to make these evaluations.

Finally, I would like to emphasize that these projected trends in life expectancy should not be seen as a message of impending economic or social doom. Rather, it is

exciting to contemplate that advances in medical technology and health planning have resulted in an increase in life expectancy, and I look forward to learning about what trends may be in store for us in the future.

Senator CHAFEE. Good morning.

This morning we are going to have a hearing on trends in U.S. life expectancy, and I look forward to hearing the witnesses. We have some fine ones appearing before us today, on a subject that I think is of tremendous importance to our Nation.

We are living in exciting times, but demographically these may be the most exciting times in our history. Unprecedented gains have been made in life expectancy, and these gains will likely continue, possibly even accelerate. At the same time, we are expanding our understanding of the processes of aging in ways that may lead to the extension of lifespan itself.

These developments hold both great opportunity and great challenge for our country. The opportunity is, of course, that many Americans can expect to live longer, fuller lives. The challenge for the United States and Americans as individuals is whether we can enjoy additional years as vital, productive members of society. The challenge for society itself is whether we can adapt and restructure social and governmental institutions to the fact that so many Americans will be old. And ultimately, we must ask ourselves how we will be able to afford to support an elderly population numbering as much as one-fifth of the total population.

These concerns can easily be demonstrated by numbers which illustrate the advance of life expectancy. In 1900, three million people, or four percent of the population of the United States lived to be over 65. By 1980, 26 million people or 11 percent reached this age. By the year 2,000, 36 million people or 13 percent of the population will live beyond 65, and by the year 2,025—and that is not so far away—58 million or 20 percent of the population is projected to live to be over 65.

These huge increases in the life expectancy of Americans will be accomplished even without our having found cures for the major chronic diseases.

The increase in life expectancy is only one aspect of the issue. Lifespan extension must also be considered. Man has never in history lived much beyond 110 years of age, but this fact is now being challenged. One of our witnesses, Dr. Walford, has suggested that lifespan could be increased by 40 or more years.

Yet we really cannot afford, to blind ourselves foolishly to the fiscal and societal effects of leaps in scientific knowledge. The result both of increases in life expectancy and the possibility of increases in lifespan could be simply staggering from the standpoint of public policy. Very clearly, the assumptions that Government and private actuaries make about mortality rates are critical in projecting the future Federal outlays.

For example, the total Federal benefits that would have been paid to people had they not died in 1978 of heart disease, cancer, automobile accidents and homicides would have exceeded the potential taxes the survivors could have been expected to pay by $15 billion. In other words, cures of these causes of death would have resulted in an added cost of $15 billion in 1978 dollars.

Facts like these only begin to illustrate the need to have the most accurate possible estimates of mortality. There are 51 separate Federal retirement programs encompassed in 38 separate retirement systems. I became aware of this when a judge of the U.S. Court of Tax Appeals, came to see me. He wanted some changes in the Tax Court's pension fund. And mind you, they have a separate pension fund for the Tax Court as well as a separate pension fund for all kinds of organizations in the Federal Government.

These programs operate separately, in the absence of Federal guidelines, without uniform practices governing their finances. But of course, the major program that we are concerned with is the social security system, which is the major source of financial security for so many millions of Americans.

While not strictly speaking a Federal retirement program, because it insures mainly private citizens, the Federal stake in the social security system is enormous.

The Social Security Administration has rather recently adopted a set of three assumptions about mortality: High, intermediate, and low. All of them project mortality improvements at rates less than the historical average for the first 80 years of this century.

If the optimistic mortality forecast were accurate, there could be 15 percent more social security beneficiaries by the year 2020 than the intermediate estimate would indicate. The Social Security Administration's intermediate projection assumes an improvement in mortality by 37 percent over the next 80-year period, whereas mortality improved 67 percent over the previous 80 years.

We are all fascinated, by the possibilities that exist for increased life expectancy and lifespan. But the central issue of concern today is whether or not Federal and private retirement systems and other programs based on actuarial estimates of mortality are adequately taking into account these possibilities.

Projections of mortality based solely on historical data are in danger of being wrong. It is quite sensible to expect that medical science will continue to make substantial progress concerning the major causes of death. Retirement systems that are based on mortality estimates that do not attempt to encompass these possibilities are in my view potentially at risk.

I would like to add a personal footnote to this. How did I get into this? Why are we holding these hearings? We are holding them because I personally began to notice that a lot of Americans were living longer. I do not know what the statistics will show, and we are going to have testimony on that, but this issue reminds me of the question that was asked of the southerner: Do you believe in infant baptism? And he said: Believe in it? Heck, I have seen it.

And I have seen, just by looking around, the increased life expectancy of Americans. I think it behooves us to spend some time considering the implications in light of the host of functions of the Federal Government, especially, of course, the social security system.

We spent, earlier this year, many hours on deciding what to do about the social security system because it was in dire trouble. As I look around I see witnesses who have appeared before us in connection with that. As a result, of the problems with the social security system, a Commission was formed which itself devoted over a year

to the study of the problem. They came forward with recommendations which are supposed to take care of the problem to the year 2000.

I am not so sure. I do not want to sound any alarm bells. I hope everything is fine. But I have a nagging suspicion that we are not taking into account adequately the increased life expectancy of Americans in our projection of the costs of social security.

And with that sober note, we welcome our first witness, Mr. Bayo, who is the Deputy Chief Actuary for Long-Range Projections of the Social Security Administration. Mr. Bayo, you have with you, I understand, Mr. Wilkin.

Now, all the witnesses' statements will go in the record and we have them, so do not worry about that. That is a given. We have seven witnesses. I would ask that each witness limit his or her presentation to 10 minutes. If you want to extrapolate from your testimony or present it any way you wish, but at the end of 10 minutes we will have to bring you to a halt.

So go to it, Mr. Bayo, and we welcome you here.

STATEMENT OF FRANCISCO R. BAYO, DEPUTY CHIEF ACTUARY FOR LONG-RANGE PROJECTIONS, OFFICE OF THE ACTUARY, SOCIAL SECURITY ADMINISTRATION, ACCOMPANIED BY JOHN C. WILKIN, SUPERVISORY ACTUARY FOR DEMOGRAPHIC AND ECONOMIC ANALYSIS

Mr. BAYO. Good morning, Mr. Chairman.

Mr. Wilkin and myself appreciate this opportunity to appear before you to discuss the mortality projections that underlie the long-range cost estimates of the social security program. I am submitting a written statement for the record and at this time I would like to present an oral summary.

There is a significant interest in mortality among different groups. Health planners are interested because they want to know how changes in the mortality pattern will affect life expectancy and longevity, so they can offer better services. Industrial and sales planners are interested in mortality because they would like to know the age and sex distribution of the population in order to better plan their production and marketing. Actuaries also like to know mortality patterns in order to better fund insurance policies and private pension plans. In the Social Security Administration, we believe that mortality is an important element in the planning of the program and in the planning of the financing of that program.

Before describing the projections we use in social security, let me make a few remarks about actuarial assumptions in general and about mortality projections in particular. First, I would say that nobody knows accurately what will happen in the future, particularly when we project 75 years into the future. There are bound to be differences among the different experts. As a matter of fact, there are bound to be conflicting differences among the different experts.

This I think is a normal situation and, I would add, it is a healthy situation because it will convey directly the idea that there is uncertainty about the future. In fact, the Office of the Actuary

in presenting its cost estimates to the Congress has used three different projections, one of high level of mortality, intermediate level of mortality, and low level of mortality.

Mortality assumptions are just one of many assumptions that enter into the preparation of the social security program cost estimates. The various assumptions could be classified broadly into three categories. I will name them: Economic assumptions, programmatic assumptions, and demographic assumptions.

The economic assumptions include the gross national product, productivity, price increases, and unemployment. Generally these are variables that have a significant amount of volatility. That is, they change significantly from year to year, sometimes even from month to month. All these variables affect significantly the cost of social security.

Then second I will mention the programmatic assumptions. These are assumptions that are related to the program itself. For example, the retirement rate or the rate of coverage of working people. These are assumptions that have a lower level of variability and they are subject to slower changes.

Third, I will mention the demographic assumptions. Among them we can include fertility, migration, mortality. These are more stable assumptions. They change slower through time and their swings are narrower.

Among these three demographic assumptions, mortality is the most stable of the three assumptions. So I would say that generally there is no need to rush into changing the program just because there are indications that the trend may be changing. There is ample time in which to look at the possible trend and include it in the projections and recognize it in the program planning.

There is an example of this happening, and it is very important. For the last several years the report has indicated to the Congress that mortality has been increasing faster than previously projected. The Congress did not rush into modification of the program, but instead waited until the 1983 amendments. Then Congress fully recognized the deficit that was being projected and eliminated it through those amendments.

So I would say there is no need to be unduly alarmed now. Recent fast declines in mortality have been analyzed by our office. The results have been incorporated into the cost estimates, and the Congress has been using those cost estimates.

If in the future there should be deviations from our projections, new cost estimates will be prepared and conveyed to the Congress through the Board of Trustees, and ample time will be available, in my opinion, to consider possible modification either in the financing of the program or in the structure of benefits in the program.

Let me now turn to how we develop our mortality assumptions. For close to half a century, the Office of the Actuary has been analyzing mortality data. Since 1938 we have been periodically projecting mortality and population as needed for our cost estimates. Since the mid-1970's, we have been preparing annual reviews of the mortality projections, and if needed, revising those projections. Those projections are incorporated into the annual report to the Board of Trustees.

In addition, the Board of Trustees also shows three projections, as I indicated before. Besides that, we also indicate the sensitivity of the cost estimates to variations in mortality.

The data that we have back to the turn of the century shows that mortality declines have varied and that we should therefore, in my opinion, expect that in the future there will be variations in the rate of decline. I would mention four different periods of decline:

From 1900 to around 1937, the decline was about 0.9 percent per year, slightly less than 1 percent per year. This period was a period of wide variation in mortality because of different epidemics.

The second period is 1937 to 1954. Mortality decreased faster in that period, about 2.3 percent per year. It was a steady decline, mostly due to new antibiotics and better public health services.

Then there came a period, from 1954 to 1968, in which mortality remained almost flat. It declined by only 0.1 percent per year. In reality, the death rate for males actually went up. During that period it was felt that future declines in mortality would be difficult to achieve because most of the controllable diseases were already controlled and the remaining diseases generally referred to as the degenerative diseases, were very difficult to control.

However, recent declines since 1968 have shown that improvement can be made in that area, too. Since 1968, we have been having declines of about 1.8 percent per year. This has been a decline related in large part to diseases of the heart and of the blood vessels.

These recent changes, have affected the cost of the social security program. It is easy to understand that as mortality at the older ages decreases significantly, then the cost of the program goes up because there are more older people to whom you have to pay benefits. If the declines were at the younger ages, the effect would be the reverse that is, one of reduction in the cost of the program because we would have realtively more workers.

If mortality changes at all ages uniformly, then the results on the costs of the program are mixed. It could be a slight increase or it could be a slight decrease in costs.

I would say that analysis of past experience is not enough for making the projections. We also need to factor in our views on future developments regarding possible new diagnoses, new surgical techniques, environmental pollutants, exercise and nutritional practices of our population, smoking and drug abuse, including the abuse of alcohol. These are factors that need to be included.

It is very difficult to take these factors into account, particularly since future declines in mortality will be different from those that occurred in the past. For example, the improvements in mortality that we had from the 1930's to the early 1950's due to the control of the communicable diseases cannot be obtained a second time in the future. We have to make progress in other types of causes of death.

For the near future, in establishing our assumptions we can be guided by the near past, and we do that. But the long-range future is mostly unknown, and so we really have to use our imagination as to what are the possible improvements that could be made.

In the midst of all of this uncertainty about future mortality, what we do in our office is postulate ultimate rates of decline and accept that other experts could come up with different postulated rates of improvement. However, we believe that the mechanical extrapolation of recent trends is not an acceptable way of projecting mortality.

Let me discuss now our current assumptions. These are assumptions that, as I said before, the Congress has been using in determining the future of this program. They were used in the deliberations on the 1983 amendments.

The recent trend in decline in mortality is assumed to continue in the near future and then to slowly decelerate until about the year 2007, after which it will be at the rates that we postulated, which are significantly lower than the recent rates of decline.

For the three major causes of death we project that heart diseases will decrease ultimately at a rate of seven-tenths of 1 percent per year; vascular diseases, nine-tenths of 1 percent per year; and cancer, which has been going up recently, will decrease by a quarter of a percent per year.

The effect of mortality assumptions on our cost estimate is something that we consider very carefully. Our mortality projections are not theoretical projections. They are values that are needed and that are essential in the preparation of cost estimates, and we have to come up with values that are reasonable. They are important elements of all of our cost estimates.

In these estimates——

Senator CHAFEE. Let me see if I understand your terms here. On page 14 you are talking about optimistic and pessimistic "optimistic" to me would mean people living longer. I take it that "optimistic" to you is the contrary. You look at it strictly from a cash point of view, don't you? "Optimistic" to you means that they will be dying earlier? I do not mean to be harsh, but is that about the way it is?

Mr. BAYO. That is correct, Mr. Chairman. The labeling is done according to——

Senator CHAFEE. That is a little ghoulish. "Optimistic" means people will die at a very satisfactory rate, is that right?

Mr. BAYO. Yes.

Senator CHAFEE. And pessimism comes over your organization when you find people living longer, is that right?

Mr. BAYO. The set of assumptions that results in the highest cost to the social security program is labeled "pessimistic" and includes the highest rate of increase in mortality, because people living longer and receiving benefits longer will increase the cost of the program.

Senator CHAFEE. Well, in my presentation, I reverse your terms. I think we want to say that it is optimistic when people live longer, but you are looking at it strictly from a cash point of view.

Mr. BAYO. From the point of view of the cost of the program.

Senator CHAFEE. I see. All right.

Mr. BAYO. For example, the cost of the program under the intermediate assumption is now estimated at 12.84 percent of taxable payroll. If we use optimistic assumptions, that is people dying sooner, the costs will decrease by about two-thirds of 1 percent, ac-

tually, 0.66 percent of taxable payroll. If we use pessimistic assumptions, that is, people living longer, then the costs will go up by about 1 percent of payroll, actually 0.97 percent.

What I wanted to emphasize is that the increase or decrease in cost is not as large as we would imagine at first sight, and that there is ample time in which to make those adjustments, because mortality doesn't change that quickly; 2 or 3 percent per year would be a significant change in mortality.

For my final remarks, I would like to say that we have analyzed the recent trends in mortality and incorporated these trends in our cost projections. The Congress used those projections in the 1983 amendments. I see no need to make further changes in the program at this time. There will be ample time to consider new changes if our current projections turn out not to be accurate.

I thank you, Mr. Chairman. Mr. Wilkin and myself are available for questions.

[The prepared statement of Francisco R. Bayo follows:]

DEPARTMENT OF HEALTH & HUMAN SERVICES
Social Security Administration
Refer to:
Baltimore MD 21235

FOR RELEASE ONLY UPON DELIVERY

STATEMENT

ON TRENDS IN LIFE EXPECTANCY

BY

FRANCISCO R. BAYO

DEPUTY CHIEF ACTUARY

SOCIAL SECURITY ADMINISTRATION

BEFORE THE

SUBCOMMITTEE ON SAVINGS, PENSIONS AND INVESTMENT POLICY

COMMITTEE ON FINANCE

U.S. SENATE

FRIDAY, JULY 15, 1983

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE, I APPRECIATE THIS OPPORTUNITY TO APPEAR BEFORE YOU TODAY TO DISCUSS THE MORTALITY PROJECTIONS THAT UNDERLIE THE LONG-RANGE COST ESTIMATES FOR THE SOCIAL SECURITY PROGRAM.

INTRODUCTION

AS MEMBERS OF THIS SUBCOMMITTEE ARE AWARE, MANY PEOPLE ARE INTERESTED IN KNOWING HOW CHANGES IN MORTALITY AFFECT OUR NATION. HEALTH CARE PLANNERS WANT TO KNOW HOW CHANGES IN MORTALITY WILL AFFECT LONGEVITY SO THAT THEY CAN DEVELOP AND PROVIDE SERVICES EFFECTIVELY. INDUSTRIAL AND SALES PLANNERS WANT TO KNOW HOW CHANGES IN MORTALITY WILL AFFECT THE SIZE AND THE AGE-SEX DISTRIBUTION OF THE POPULATION SO THAT THEY CAN MAKE PRUDENT DECISIONS ABOUT PRODUCTION AND MARKETING. ACTUARIES WANT TO STAY ABREAST OF CHANGES IN MORTALITY TO BE SURE THAT INSURANCE PREMIUMS ARE PROPERLY SET AND THAT PENSION PLANS ARE PROPERLY FUNDED. AT THE SOCIAL SECURITY ADMINISTRATION WE HAVE SIGNIFICANT INTEREST IN MORTALITY PROJECTIONS BECAUSE MORTALITY IS AN IMPORTANT ELEMENT TO

BE TAKEN INTO ACCOUNT IN THE PLANNING OF THE SOCIAL SECURITY PROGRAM AND OF ITS FINANCING.

BEFORE DESCRIBING THE PROJECTIONS THAT WE ARE CURRENTLY USING AND HOW WE DEVELOPED THEM, LET ME MAKE A FEW REMARKS ABOUT ACTUARIAL ASSUMPTIONS IN GENERAL AND MORTALITY PROJECTIONS IN PARTICULAR. NEEDLESS TO SAY, NOBODY KNOWS EXACTLY WHAT WILL HAPPEN IN THE FUTURE, ESPECIALLY A DISTANT FUTURE OF 75 YEARS SUCH AS WE PROJECT FOR SOCIAL SECURITY COST ESTIMATES. THEREFORE, THERE ARE BOUND TO BE MANY DIFFERENT AND SOMETIMES CONFLICTING VIEWS AMONG THE EXPERTS. THESE DIFFERENCES ARE NOT ONLY NORMAL, BUT I WOULD ADD THAT THEY LEAD TO A HEALTHY SITUATION--ONE IN WHICH WE MORE DIRECTLY RECOGNIZE THAT THERE IS SOME UNCERTAINTY ABOUT THE FUTURE. IN FACT, IN ORDER TO MORE PROPERLY CONVEY TO THE CONGRESS THE SENSE OF UNCERTAINTY, WE PRESENT OUR SOCIAL SECURITY COST PROJECTIONS ON THE BASIS OF THREE DIFFERENT SETS OF

25-518 O—83——2

MORTALITY PROJECTIONS: LOW, INTERMEDIATE, AND HIGH MORTALITY IMPROVEMENTS.

THE ASSUMPTIONS NEEDED TO MAKE SOCIAL SECURITY COST ESTIMATES CAN BE GROUPED INTO THREE MAJOR CATEGORIES: ECONOMIC, PROGRAMMATIC, AND DEMOGRAPHIC ASSUMPTIONS. THE FIRST CATEGORY INCLUDES THE MAJOR PARAMETERS THAT ARE USED TO BROADLY DESCRIBE THE OPERATIONS OF THE NATIONAL ECONOMY. AMONG THEM IT WOULD BE WELL TO MENTION THE GROSS NATIONAL PRODUCT, PRODUCTIVITY, PRICE INFLATION, AND UNEMPLOYMENT. THESE VARIABLES ARE SUBJECT TO A RELATIVELY HIGH LEVEL OF VOLATILITY, AND CHANGES IN THEM AFFECT THE LONG-RANGE COST OF THE SOCIAL SECURITY PROGRAM.

THE SECOND CATEGORY OF ASSUMPTIONS COVERS ACTUARIAL PARAMETERS INHERENT TO THE STRUCTURE OF THE PROGRAM'S BENEFITS AND TO THEIR ADMINISTRATION. AMONG THEM WE COULD MENTION THE DISABILITY RATES, THE RETIREMENT RATES, AND THE COVERAGE RATES. AS COMPARED TO THE ECONOMIC ASSUMPTIONS, THE PROGRAMMATIC

ASSUMPTIONS ARE LESS VOLATILE. THEY ARE NOT SUBJECT TO SUCH WIDE SWINGS AND THEY DO NOT CHANGE AS FAST THROUGH TIME.

THE THIRD CATEGORY OF ASSUMPTIONS INCLUDES ELEMENTS RELATED TO THE POPULATION RESIDING IN OUR COUNTRY. AMONG THEM ARE THE FERTILITY RATES, THE MIGRATION RATES, AND THE MORTALITY RATES. THESE RATES ARE RELATIVELY STABLE, WITH NARROWER SWINGS AND SLOWER CHANGES THROUGH TIME THAN THE FIRST TWO CATEGORIES. OF THESE THREE POPULATION-RELATED VARIABLES, THE MORTALITY RATES ARE GENERALLY THE MOST STABLE. THEIR ANNUAL CHANGES ARE RARELY MORE THAN TWO OR THREE PERCENTAGE POINTS. THIS RELATIVE STABILITY AND SLOW MOVEMENT IN THE MORTALITY RATES GENERALLY GIVES PROGRAM PLANNERS CONSIDERABLE TIME IN WHICH TO ANALYZE AND CONFIRM TRENDS BEFORE RECOMMENDING PROGRAM CHANGES.

AT THIS TIME I SEE NO NEED TO BE ALARMED BECAUSE OF THE RECENT FAST IMPROVEMENT IN MORTALITY AT THE OLDER AGES. ANALYSES HAVE BEEN MADE OF THIS FACT AND THE RESULTS OF THESE ANALYSES

INCORPORATED INTO THE COST ESTIMATES THAT THE CONGRESS HAS BEEN USING. IF FUTURE EXPERIENCE SHOULD DEPART GREATLY FROM OUR PROJECTIONS, THIS TOO WILL BE INCORPORATED IN THE REPORTS OF THE BOARD OF TRUSTEES OF THE SOCIAL SECURITY TRUST FUNDS, AND NEW COST ESTIMATES PROVIDED TO THE CONGRESS. BECAUSE OF THE SLOWNESS WITH WHICH CHANGES IN MORTALITY AFFECT SOCIAL SECURITY PROGRAM COSTS, AMPLE TIME WILL BE AVAILABLE IN WHICH TO CONSIDER WHETHER PROGRAM CHANGES SHOULD BE MADE IN RESPONSE TO THE MORTALITY CHANGES.

How Mortality Assumptions are Developed

LET ME USE THIS OPPORTUNITY TO GIVE YOU A BRIEF DESCRIPTION OF THE WORK WE DO IN THE SSA'S OFFICE OF THE ACTUARY REGARDING MORTALITY PROJECTIONS.

A FUNDAMENTAL ELEMENT IN GAUGING THE EFFECTS OF MORTALITY IS THE KNOWLEDGE OF WHAT MORTALITY LEVELS HAVE BEEN, WHAT THEY ARE NOW, AND WHAT THEY MAY BE IN THE FUTURE. IN THE OFFICE OF THE ACTUARY WE HAVE COLLECTED, ANALYZED, AND PROJECTED MORTALITY DATA

FOR CLOSE TO HALF A CENTURY. PROJECTED IMPROVEMENTS IN MORTALITY HAVE BEEN USED FOR COST ESTIMATING PURPOSES SINCE THE PROGRAM STARTED IN 1937. IN THE MID-1970'S WE ACCELERATED OUR SCHEDULE FOR MAKING MORTALITY PROJECTIONS AND CURRENTLY WE REVIEW AND REVISE, IF NECESSARY, THE PROJECTIONS FOR EACH YEAR'S TRUSTEES' REPORT TO THE CONGRESS. IN ADDITION TO INCLUDING THREE ALTERNATIVE SETS OF RATES OF MORTALITY IMPROVEMENT IN THE REPORT, ESTIMATES ARE USUALLY PRESENTED IN REGARD TO THE SENSITIVITY OF THE FINAL COST ESTIMATES TO CHANGES IN MORTALITY ASSUMPTIONS.

THE DATA WE HAVE ACCUMULATED ON MORTALITY EXPERIENCE BACK TO THE YEAR 1900 SHOW THAT THE RATE OF IMPROVEMENT IN MORTALITY--THAT IS, THE RATE OF DECLINE IN THE DEATH RATE--HAS VARIED CONSIDERABLY IN THE PAST AND, HENCE, MAY BE EXPECTED TO VARY IN THE FUTURE. AN EXAMINATION OF DEATH RATES ADJUSTED FOR AGE AND SEX VARIATIONS REVEALS FOUR DISTINCT PERIODS OF DIVERSE MORTALITY RATE IMPROVEMENT. FROM 1900 TO 1936, ANNUAL MORTALITY RATE

IMPROVEMENTS AVERAGED 0.9 PERCENT. FOLLOWING THIS WAS A PERIOD OF RAPID IMPROVEMENTS, 1936-1954, IN WHICH MORTALITY DECREASED AT AN AVERAGE RATE OF 2.3 PERCENT PER YEAR. THE RAPID IMPROVEMENTS IN THESE YEARS RESULTED IN PART FROM THE DEVELOPMENT OF MANY NEW DRUGS USED TO CONTROL INFECTIOUS DISEASES AND TO BETTER PUBLIC HEALTH PRACTICES.

DURING THE PERIOD 1954-1968, THE MORTALITY RATE REMAINED ALMOST FLAT, IMPROVING ONLY 0.1 PERCENT PER YEAR. THE DEATH RATE FOR MALES ACTUALLY INCREASED DURING THIS PERIOD. BECAUSE OF THIS, IN THE EARLY 1970'S MANY EXPERTS BELIEVED THAT FURTHER REDUCTIONS IN MORTALITY WOULD BE DIFFICULT TO ACHIEVE. IT WAS REASONED THAT THE CAUSES OF DEATH THAT COULD BE CONTROLLED (SUCH AS THE INFECTIOUS DISEASES) WERE ALREADY WELL CONTROLLED AND THAT THE CAUSES THAT ACCOUNTED FOR MOST DEATHS (SUCH AS THE DEGENERATIVE DISEASES) WOULD BE DIFFICULT TO CONTROL. HOWEVER, THE DATA SHOW THAT A NEW PERIOD OF RAPID IMPROVEMENT ACTUALLY BEGAN IN 1969.

FOR THE 12-YEAR PERIOD ENDING IN 1980 THE MORTALITY RATE DECLINED AT AN AVERAGE OF 1.8 PERCENT PER YEAR. FOR THE ENTIRE PERIOD 1900 TO 1980 MORTALITY HAS DECLINED AT THE AVERAGE RATE OF 1.2 PERCENT PER YEAR.

FOR THE PERIOD 1968-1978, DATA ARE AVAILABLE IN MORE DETAIL THAN FOR EARLIER PERIODS, AND WE HAVE ANALYZED DEATH RATES FOR 10 MAJOR GROUPS OF CAUSES OF DEATH. THE SHARPEST DECLINE AMONG THESE DEATH RATES WAS IN CONGENITAL MALFORMATIONS AND DISEASES OF EARLY INFANCY, AVERAGING OVER 5 PERCENT PER YEAR. FOR HEART DISEASE, VASCULAR DISEASE, DIGESTIVE DISEASE, AND DIABETES MELLITUS, DECLINES IN DEATH RATES AVERAGED ABOUT 2.5 TO 4.0 PERCENT PER YEAR. DEATH RATES FOR RESPIRATORY DISEASE AND ACCIDENTS, SUICIDE, AND HOMICIDE AVERAGED ABOUT 2 PERCENT REDUCTION PER YEAR. DEATH RATES FOR CIRRHOSIS OF THE LIVER AND THE RESIDUAL GROUP OF OTHER CAUSES AVERAGED 0.5 TO 1 PERCENT

REDUCTION PER YEAR, WHILE THE DEATH RATE FROM CANCER INCREASED ABOUT 0.5 PERCENT PER YEAR.

WHAT DISTINGUISHES THE RECENT PERIOD OF MORTALITY RATE IMPROVEMENT AS COMPARED TO EARLIER PERIODS IS THE SIGNIFICANT DECLINE IN THE DEATH RATE FOR HEART DISEASES AND VASCULAR DISEASES, WHICH AFFECT MOSTLY OLDER PEOPLE. THESE RECENT TRENDS ARE ESPECIALLY IMPORTANT IN THE PROJECTION OF THE COST OF THE SOCIAL SECURITY PROGRAM. WHEN MORTALITY IMPROVEMENT OCCURS AT THE RETIREMENT AGES, BENEFICIARIES STAY ON THE ROLLS LONGER BUT THERE IS NO OFFSETTING CHANGE IN THE NUMBER OF WORKERS. THIS TYPE OF CHANGE IN MORTALITY ADDS TO THE COST OF THE PROGRAM WITHOUT SIGNIFICANTLY AFFECTING PROGRAM INCOME.

WHEN MORTALITY IMPROVEMENT OCCURS DURING THE WORKING AGES, THE EFFECTS ON THE COST OF THE PROGRAM ARE MIXED. ADDITIONAL NUMBERS OF WORKERS REMAIN ALIVE LONGER TO WORK AND PAY TAXES;

HOWEVER, EVENTUALLY THEY REACH RETIREMENT AGE AND COLLECT BENEFITS.

WHEN MORTALITY IMPROVEMENT OCCURS AT INFANCY OR EARLY CHILDHOOD, THE EFFECT ON SOCIAL SECURITY IS TANTAMOUNT TO A SLIGHT INCREASE IN THE FERTILITY RATE, I.E., THERE IS VERY LITTLE INITIAL EFFECT, LATER THERE IS AN INCREASE IN THE NUMBER OF WORKERS, AND ONLY MUCH LATER IS THERE AN INCREASE IN THE NUMBER OF BENEFICIARIES. THE NET EFFECT IS A DECREASE IN THE PERCENTAGE OF PAYROLL COST OF THE PROGRAM.

AFTER CONSIDERATION OF THE LEVEL AND VARIABILITY OF PAST TRENDS, WE CONSIDER HOW FUTURE MORTALITY WOULD BE AFFECTED BY SUCH FACTORS AS THE DEVELOPMENT AND APPLICATION OF NEW DIAGNOSTIC AND SURGICAL TECHNIQUES, THE ISOLATION AND TREATMENT OF CAUSES OF DISEASE, THE APPEARANCE OF NEW DISEASES (SUCH AS AIDS), THE PRESENCE OF ENVIRONMENTAL POLLUTANTS, IMPROVEMENTS IN EXERCISE AND NUTRITION, THE INCIDENCE OF VIOLENCE, IMPROVEMENTS IN PRENATAL

CARE, THE PREVALENCE OF CIGARETTE SMOKING, THE MISUSE OF DRUGS (INCLUDING ALCOHOL) AND THE EXTENT TO WHICH PEOPLE ASSUME RESPONSIBILITY FOR THEIR OWN HEALTH. ALL OF THESE ARE FACTORED INTO THE PROJECTIONS AS EDUCATED GUESSES OR INFORMED JUDGEMENT BY MEANS OF A CONSENSUS AMONG THE VARIOUS ACTUARIES PARTICIPATING IN THE EFFORT.

IN MAKING A PROJECTION, WE CANNOT JUST ASSUME THAT THE RATES OF IMPROVEMENT THAT HAVE OCCURRED IN THE PAST WILL CONTINUE FOREVER INTO THE FUTURE. FUTURE IMPROVEMENTS WILL BE DIFFERENT FROM PAST IMPROVEMENTS AND WILL COME FROM NEW DEVELOPMENTS. FOR EXAMPLE, THE IMPROVEMENT IN MORTALITY DUE TO THE CONTROL OF INFECTIOUS DISEASES THAT OCCURRED IN THE PAST CANNOT BE USED TO ASSUME SIGNIFICANT IMPROVEMENTS IN MORTALITY FOR THE FUTURE. THE LEADING EDGE OF MEDICAL KNOWLEDGE GIVES US CLUES ON THE VERY NEAR TERM TREND, BUT LONG-RANGE PROJECTIONS MUST ASSUME THAT IMPROVEMENTS WILL OCCUR IN AREAS THAT ARE CURRENTLY UNKNOWN.

IN THE MIDST OF THE LONG-RANGE UNCERTAINTIES ABOUT FUTURE CHANGES, THE BEST THAT WE CAN DO IS TO POSTULATE ULTIMATE ANNUAL RATES OF IMPROVEMENT BY CAUSE OF DEATH AND SEX, KNOWING THAT A DIFFERENT GROUP OF EXPERTS COULD CONCEIVABLY ARRIVE AT A DIFFERENT SET OF POSTULATED RATES. TO INCREASE THE LEVEL OF ACCEPTABILITY OF OUR PROJECTIONS AND TO IMPROVE THE QUALITY OF FUTURE ANALYSES, WE PUBLISH OUR WORK AND SEND COPIES TO KNOWLEDGEABLE GROUPS FOR THEIR COMMENTS. IN ADDITION, WE HAVE HAD THE BENEFIT OF THE OPINIONS OF VARIOUS PANELS OF ACTUARIES AND ECONOMISTS THAT HAVE BEEN APPOINTED BY THE STATUTORY SOCIAL SECURITY ADVISORY COUNCILS TO REVIEW OUR ASSUMPTIONS AND METHODS.

I WOULD LIKE TO POINT OUT THAT BLIND NUMERICAL EXTRAPOLATIONS WITHOUT PROPER ANALYSIS AND WITHOUT THE EXERCISE OF GOOD JUDGEMENT COULD LEAD TO UNACCEPTABLE RESULTS. IF FOR EXAMPLE, THE RECENT RATES OF DECLINE IN MORTALITY FOR THE VARIOUS CAUSES OF DEATH IN WHICH THERE HAVE BEEN IMPROVEMENT WERE ASSUMED TO CONTINUE FOR

MANY DECADES, THE RESULTING RATES WOULD IMPLY LIFE EXPECTANCIES OF OVER 100 YEARS. THIS IS CLOSE TO WHAT SOME EXPERTS BELIEVE IS THE MAXIMUM LIFE SPAN. ON THE OTHER HAND, ASSUMING CONTINUATION OF THE DETERIORATION OF THOSE CAUSES IN WHICH MORTALITY HAS RECENTLY INCREASED WOULD LEAD TO FUTURE LIFE EXPECTANCIES THAT ARE LOWER THAN THOSE WE ARE CURRENTLY EXPERIENCING.

CURRENT ASSUMPTIONS

CURRENTLY THE THREE LEADING CAUSES OF DEATH (DISEASES OF THE HEART, CANCER, AND VASCULAR DISEASES) ACCOUNT FOR OVER TWO-THIRDS OF ALL DEATHS. MORTALITY PROJECTIONS DEPEND HEAVILY ON THE POSTULATED FUTURE COURSE OF THESE CAUSES. AS MAY BE OBSERVED FROM TABLE 1 IN THE ATTACHMENTS TO MY STATEMENT, IN OUR LATEST MORTALITY PROJECTIONS, WHICH SERVED AS THE BASIS FOR THE 1983 TRUSTEES' REPORTS, WE ASSUMED THAT THE RATE OF IMPROVEMENT IN MORTALITY FROM CONTROL OF DISEASES OF THE HEART WOULD ULTIMATELY BE 0.7 PERCENT PER YEAR UNDER ALTERNATIVE II, THE INTERMEDIATE SET

OF ASSUMPTIONS. UNDER ALTERNATIVE I, THE MOST OPTIMISTIC SET OF ASSUMPTIONS IN TERMS OF THEIR EFFECT ON PROJECTED COST, WE ASSUMED AN ULTIMATE AVERAGE ANNUAL RATE OF IMPROVEMENT OF 0.5 PERCENT, WHILE FOR ALTERNATIVE III, THE MOST PESSIMISTIC SET OF ASSUMPTIONS FROM A PROGRAM COST STANDPOINT, WE ASSUMED A 1.0 PERCENT RATE OF IMPROVEMENT, WHICH WOULD REUSLT IN PEOPLE LIVING LONGER AND COLLECTING MORE BENEFITS THAN UNDER ALTERNATIVES I AND II. SOMEWHAT HIGHER RATES OF IMPROVEMENT WERE POSTULATED FOR VASCULAR DISEASES. THE DEATH RATE FROM CANCER HAS ACTUALLY BEEN INCREASING RECENTLY AND ITS FUTURE COURSE SEEMS LESS CERTAIN THAN FOR OTHER CAUSES OF DEATH. BECAUSE OF THIS, A GREATER RANGE OF ULTIMATE RATES OF IMPROVEMENT WERE ASSUMED FOR CANCER. UNDER ALTERNATIVE I, THE DEATH RATE FROM CANCER WAS ASSUMED TO LEVEL OFF ULTIMATELY, WHILE UNDER ALTERNATIVES II AND III ULTIMATE RATES OF IMPROVEMENT OF ABOUT 0.2 AND 0.3 PERCENT PER YEAR AND ABOUT 1.2 TO 1.5 PERCENT PER YEAR, RESPECTIVELY, WERE ASSUMED. ASSUMPTIONS ABOUT THE ULTIMATE AVERAGE ANNUAL RATE OF IMPROVEMENT WERE MADE FOR THE

OTHER GROUPS OF CAUSES OF DEATH IN A SIMILAR MANNER. FOR SOME OF THE CAUSES OF DEATH, THE ULTIMATE RATES OF IMPROVEMENT FOR FEMALES WERE ASSUMED TO BE GREATER THAN FOR MALES. THUS, AS MAY BE NOTED FROM TABLES 2A AND 2C, THE GAP BETWEEN MALE AND FEMALE MORTALITY IS PROJECTED TO CONTINUE TO WIDEN. HOWEVER, THIS IS ASSUMED TO OCCUR AT A DECELERATED RATE FROM THE PAST AS WOMEN BECOME INCREASINGLY SUBJECT TO THE SAME ENVIRONMENTAL PRESSURES AND HAZARDS AS MEN.

THE POSTULATED ULTIMATE RATES OF IMPROVEMENT WERE ASSUMED TO BE APPLIED AFTER THE YEAR 2007, THE 25TH YEAR OF THE PROJECTION PERIOD. WITHIN THE FIRST 25-YEAR PERIOD MORTALITY IMPROVEMENT WAS ASSUMED TO CHANGE GRADUALLY UNDER ALTERNATIVES I, II, AND III FROM 50 PERCENT, 100 PERCENT, AND 150 PERCENT, RESPECTIVELY, OF THE AVERAGE ANNUAL RATES OF IMPROVEMENT OBSERVED DURING 1968-1978 TO THE POSTULATED ULTIMATE RATES.

THE RESULTING AVERAGE ANNUAL RATES OF IMPROVEMENT FOR THE PERIOD 1980 TO 2060 ARE .35 PERCENT, .65 PERCENT, AND 1.17 PERCENT UNDER ALTERNATIVES I, II, AND III, RESPECTIVELY. THIS IS 29 PERCENT, 54 PERCENT, AND 97 PERCENT, RESPECTIVELY, OF THE AVERAGE ANNUAL RATE OF IMPROVEMENT OBSERVED SO FAR IN THIS CENTURY.

IMPROVEMENTS FOR THE YOUNG AGES ARE PROJECTED TO BE RELATIVELY SMALL BECAUSE VERY LITTLE ADDITIONAL IMPROVEMENT IN INFECTIOUS DISEASES IS POSSIBLE AND LITTLE IMPROVEMENT IN MORTALITY FROM VIOLENT CAUSES IS EXPECTED. HOWEVER, IMPROVEMENTS FOR THE AGED ARE EXPECTED TO CONTINUE AT A RELATIVELY RAPID PACE AS FURTHER STRIDES ARE MADE AGAINST DEGENERATIVE DISEASES. FOR PERSONS AGE 65 OR OVER, WE ARE PROJECTING THAT THE AVERAGE ANNUAL RATE OF IMPROVEMENT IN MORTALITY FOR THE NEXT 80 YEARS, UNDER INTERMEDIATE ASSUMPTIONS, WILL BE ABOUT THE SAME AS THAT OBSERVED IN THE LAST 80 YEARS.

From Table 3A it can be noted that, as a result of our assumptions, life expectancy at birth for males, which increased from 46.6 years in 1900 to 69.8 years in 1980 is projected to be 73.4 years, 76.3 years, and 81.3 years under alternatives I, II, and III, respectively, by the year 2060. For females, the corresponding figures are 49.1 years in 1900, 77.5 years in 1980 and a projected 81.2 years, 84.4 years, and 89.7 years under alternatives I, II, and III, respectively, in 2060.

For males, life expectancy at age 65, which as can be seen from Table 3B increased by 2.7 years in the last 80 years (from 11.3 in 1900 to 14.0 years in 1980) is projected to increase in the next 80 years by 2.0 years, 2.9 years, and 7.7 years (to 16.0 years, 17.9 years, and 21.7 years in 2060) under alternatives I, II, and III, respectively. For females, the corresponding figures are 12.0 years in 1900, 18.3 years in 1980, for an increase of 6.3 years in the last 80 years, and 21.2 years,

23.6 YEARS, AND 27.7 YEARS IN 2060 UNDER ALTERNATIVES I, II, AND III, RESPECTIVELY, FOR ASSUMED INCREASES OF 2.9 YEARS, 5.3 YEARS, AND 9.4 YEARS.

EFFECT OF CHANGES IN ASSUMPTIONS IN THE LONG-RANGE COST ESTIMATES

THE THEORETICAL PROJECTION OF MORTALITY RATES IS NOT IN ITSELF OUR MAJOR GOAL. THE IMPORTANCE OF THE MORTALITY RATE PROJECTION STEMS FROM ITS USE IN THE POPULATION PROJECTIONS THAT FORM THE BASIS OF LONG-RANGE SOCIAL SECURITY COST ESTIMATES. AS SUCH IT IS JUST ONE OF THE MANY ASSUMPTIONS USED TO PRODUCE COST ESTIMATES. BECAUSE THE GROWTH IN THE NUMBER OF SOCIAL SECURITY BENEFICIARIES FOLLOWS CLOSELY THE GROWTH IN THE GENERAL POPULATION ABOVE NORMAL RETIREMENT AGE, AND THE GROWTH IN THE NUMBER OF WORKERS PAYING SOCIAL SECURITY TAXES FOLLOWS CLOSELY THE GROWTH IN THE POPULATION IN THE WORKING AGES (AGE 20 THROUGH THE NORMAL RETIREMENT AGE), THE RATIO OF THESE TWO POPULATIONS AND ITS CHANGES THROUGH TIME GIVE A GOOD INDICATION OF THE FUTURE COST OF

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THE SOCIAL SECURITY PROGRAM. THIS RATIO IS REFERRED TO AS THE "AGED DEPENDENCY RATIO" AND CAN BE USED TO OBTAIN AN IDEA OF THE EFFECT ON THE PROJECTED SOCIAL SECURITY COST OF VARIATIONS IN THE MORTALITY ASSUMPTIONS, OR ANY OTHER DEMOGRAPHIC ASSUMPTION.

TABLE 4 SHOWS THE CHANGES IN THE AGED DEPENDENCY RATIO (FROM A VALUE OF 20 PERCENT IN 1983) AND IN THE LONG-RANGE COST OF THE OASDI SYSTEM THAT ARE PROJECTED UNDER THE ALTERNATIVE SETS OF ASSUMPTIONS I, II-B AND III OF THE 1983 TRUSTEES' REPORT. THE COST ESTIMATES SHOWN IN THE UPPER PORTION OF THE TABLE REFER TO THE COMBINED EFFECT OF ALL THE ECONOMIC, PROGRAMMATIC, AND DEMOGRAPHIC ASSUMPTIONS INVOLVED IN EVERY ALTERNATIVE SET. THE OPTIMISTIC SET OF ASSUMPTIONS IN ALTERNATIVE I YIELDS A LONG-RANGE 75-YEAR AVERAGE COST OF 9.81 PERCENT OF TAXABLE PAYROLL. THE INTERMEDIATE SET IN ALTERNATIVE II-B YIELDS A COST OF 12.84; WHILE THE PESSIMISTIC SET IN ALTERNATIVE III YIELDS A COST OF 16.56. THIS WIDE RANGE IN PROJECTED COST IS DUE IN PART TO ASSUMED

VARIATIONS IN FUTURE MORTALITY, BUT MOST OF IT IS DUE TO ASSUMED VARIATIONS IN THE OTHER ASSUMPTIONS USED TO PREPARE THE ESTIMATES.

IT CAN BE SEEN FROM THE BOTTOM PORTION OF TABLE 4 THAT IF IN THE SET OF INTERMEDIATE II-B ASSUMPTIONS THE MORTALITY PROJECTION WERE MODIFIED TO MAKE IT AS OPTIMISTIC AS IN ALTERNATIVE I (ASSUMING ALL OTHER ASSUMPTIONS IN II-B WERE RETAINED) THE PROJECTED LONG-RANGE OASDI COST WOULD DECREASE BY 0.66 PERCENT OF PAYROLL (FROM 12.84 TO 12.18). THIS MEANS THAT OF THE DIFFERENCE OF 3.03 PERCENT OF TAXABLE PAYROLL IN PROJECTED COST BETWEEN ALTERNATIVES I AND II-B (12.84 MINUS 9.81) ABOUT 0.66 PERCENT OF TAXABLE PAYROLL IS DUE TO THE MORE OPTIMISTIC MORTALITY ASSUMPTIONS.

SIMILARLY, IF IN ALTERNATIVE II-B THE MORTALITY PROJECTION WERE MODIFIED TO MAKE IT AS PESSIMISTIC AS IN ALTERNATIVE III (ASSUMING ALL OTHER ASSUMPTIONS IN II-B WERE RETAINED) THE PROJECTED LONG-RANGE OASDI COST WOULD INCREASE BY 0.97 PERCENT OF

TAXABLE PAYROLL (FROM 12.84 TO 13.81). OF THE 3.72 PERCENT OF TAXABLE PAYROLL DIFFERENCE BETWEEN ALTERNATIVE II-B AND III (FROM 12.84 TO 16.56) ABOUT 0.97 PERCENT OF TAXABLE PAYROLL IS DUE TO THE MORE PESSIMISTIC MORTALITY ASSUMPTIONS.

FINAL REMARKS

THE RECENT TRENDS IN LIFE EXPECTANCY HAVE BEEN ANALYZED BY THE OFFICE OF THE ACTUARY AND THE RESULTS INCORPORATED IN THE ASSUMPTIONS FOR THE OASDI COST PROJECTIONS THAT ARE BEING USED BY THE CONGRESS.

THE INTERMEDIATE COST PROJECTIONS ASSUME THAT THE RECENT TRENDS IN MORTALITY WILL CONTINUE FOR A FEW MORE YEARS AND THEN DECELERATE GRADUALLY TO SLOWER RATES OF IMPROVEMENT BY THE YEAR 2007.

THERE IS NO NEED TO MAKE SIGNIFICANT PROGRAM CHANGES NOW TO RECOGNIZE MORTALITY IMPROVEMENTS. ANY DEVIATION IN FUTURE MORTALITY EXPERIENCE FROM OUR CURRENT PROJECTIONS WILL BE ANALYZED AND INCORPORATED INTO REPORTS TO CONGRESS WITH AMPLE TIME TO DETERMINE WHETHER CHANGES MAY BE NEEDED IN THE SOCIAL SECURITY PROGRAM.

ATTACHMENT

Table 1. Postulated Ultimate Annual Percentage Improvements In Central Death Rates For The 1983 OASDI Trustees Report, by Alternative 1/, Sex, and Cause

Group of Causes of Diseases	Code Numbers 2/	Annual Percentage Improvement					
		Alternative I		Alternative II		Alternative III	
		Male	Female	Male	Female	Male	Female
I. Diseases of the Heart	390-398, 402, 404, 410-429	0.5	0.5	0.7	0.7	1.0	1.0
II. Malignant Neoplasms	140-209	0.0	0.0	0.2	0.3	1.2	1.5
III. Vascular Diseases	400-401, 403, 430-458, 582-584	0.7	0.7	0.9	0.9	1.2	1.5
IV. Accidents, Suicide, and Homicide	E800-E989	0.0	0.0	0.0	0.0	0.0	0.0
V. Diseases of the Respiratory System	460-519	0.0	0.0	0.1	0.2	0.3	0.5
VI. Congenital Malformations and Diseases of Early Infancy	740-778	0.7	0.7	1.0	1.0	1.5	1.5
VII. Diseases of the Digestive System	520-570, 572-577	0.4	0.4	0.7	0.7	1.0	1.0
VIII. Diabetes Mellitus	250	0.2	0.2	0.4	0.5	0.8	1.0
IX. Cirrhosis of the Liver	571	0.0	0.0	0.2	0.2	0.5	0.5
X. All Other Causes		0.1	0.1	0.3	0.3	0.5	0.5

1/ Cost estimates in the 1983 OASDI Trustees Report were presented on the basis of four alternative sets assumptions; namely alternatives I, II-A, II-B, and III. Alternatives II-A and II-B, although differing in their economic and programmatic assumptions, share the same demographic assumptions. In terms of the effect on the projected cost of the OASDI program, alternative I is the most optimistic set of assumptions and alternative III is the most pessimistic.

2/ The code numbers refer to the Eighth Revision of the International List of Diseases and Causes of Death.

Table 2a. Alternative I Central Death Rates, by Age, Sex, and Calendar Year (per hundred thousand)

Sex	Age	Calendar Year										
		1981	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
Male	0	1316.9	1272.4	1261.7	1217.1	1174.0	1133.4	1095.1	1059.0	1024.9	992.7	962.4
	1-4	69.0	62.9	59.0	58.0	57.2	56.5	55.8	55.1	54.5	53.9	53.3
	5-9	31.8	27.7	25.3	25.0	24.8	24.6	24.5	24.3	24.2	24.1	23.9
	10-14	37.1	33.9	31.7	31.4	31.2	31.0	30.8	30.7	30.5	30.4	30.2
	15-19	130.5	123.6	118.7	118.0	117.7	117.4	117.2	116.9	116.7	116.4	116.2
	20-24	181.4	171.2	163.7	162.8	162.4	162.0	161.6	161.3	161.0	160.6	160.3
	25-29	195.7	188.2	182.9	181.7	181.0	180.4	179.8	179.2	178.6	178.0	177.5
	30-34	192.6	176.1	165.1	163.4	162.3	161.3	160.4	159.5	158.6	157.8	157.0
	35-39	241.3	216.5	200.3	197.3	195.1	193.0	191.1	189.2	187.4	185.7	184.1
	40-44	362.9	323.9	297.8	291.5	286.7	282.1	277.7	273.6	269.6	265.9	262.3
	45-49	570.8	519.8	485.5	474.7	465.6	456.9	448.6	440.7	433.2	426.1	419.3
	50-54	929.8	862.2	816.8	798.5	782.3	766.9	752.2	738.3	725.0	712.4	700.5
	55-59	1426.4	1287.1	1192.4	1161.0	1134.9	1110.0	1086.5	1064.0	1042.8	1022.5	1003.3
	60-64	2159.0	2016.7	1917.2	1870.5	1828.4	1788.4	1750.5	1714.4	1680.2	1647.7	1616.8
	65-69	3430.9	3289.8	3179.3	3101.8	3030.3	2962.5	2898.2	2837.2	2779.3	2724.3	2672.1
	70-74	5006.4	4834.0	4688.7	4568.9	4458.4	4353.7	4254.4	4160.3	4071.0	3986.3	3905.9
	75-79	7283.3	7044.1	6838.7	6654.5	6481.1	6316.9	6161.3	6013.8	5874.1	5741.6	5616.0
	80-84	10454.7	10348.7	10081.7	9798.9	9531.9	9279.0	9039.5	8812.5	8597.5	8393.8	8200.7
	85-89	16242.3	15697.9	15204.2	14732.4	14292.1	13875.2	13480.6	13106.9	12753.1	12417.9	12100.4
	90-94	23347.4	22244.3	21242.1	20485.8	19799.6	19150.2	18535.4	17953.4	17402.4	16880.5	16386.3
Female	0	1069.8	1022.4	1001.0	963.0	926.9	892.9	860.9	830.7	802.3	775.5	750.3
	1-4	54.0	48.2	44.8	43.9	43.2	42.6	42.0	41.4	40.8	40.3	39.8
	5-9	25.2	21.8	19.8	19.6	19.4	19.2	19.0	18.9	18.7	18.6	18.4
	10-14	23.3	21.3	20.0	19.8	19.6	19.4	19.2	19.1	18.9	18.8	18.6
	15-19	47.0	44.9	43.8	43.6	43.4	43.2	43.0	42.9	42.7	42.6	42.4
	20-24	56.6	54.8	54.3	54.1	53.8	53.6	53.4	53.1	52.9	52.7	52.5
	25-29	69.1	63.0	59.4	58.8	58.4	58.1	57.7	57.4	57.1	56.8	56.5
	30-34	81.2	70.3	64.2	63.4	62.9	62.4	61.9	61.5	61.0	60.6	60.3
	35-39	117.7	99.5	89.3	87.8	86.8	85.9	85.0	84.1	83.3	82.6	81.8
	40-44	202.4	178.6	163.6	160.8	158.8	156.9	155.1	153.4	151.7	150.2	148.7
	45-49	316.2	285.0	264.3	259.5	256.0	252.7	249.5	246.5	243.6	240.9	238.4
	50-54	488.2	449.8	423.2	415.4	409.3	403.4	397.9	392.7	387.7	383.0	378.5
	55-59	749.0	697.5	664.1	652.6	642.2	632.4	623.1	614.2	605.8	597.9	590.3
	60-64	1132.7	1105.7	1088.9	1069.8	1051.3	1033.7	1017.1	1001.3	986.2	972.0	958.5
	65-69	1726.8	1680.0	1649.7	1615.9	1583.0	1551.9	1522.3	1494.3	1467.7	1442.5	1418.5
	70-74	2616.7	2434.6	2316.2	2255.2	2198.4	2144.7	2093.7	2045.4	1999.6	1956.2	1915.0
	75-79	4108.8	3726.9	3457.9	3342.5	3240.0	3142.9	3050.9	2963.8	2881.3	2803.1	2729.0
	80-84	6757.0	6118.2	5661.6	5451.8	5264.6	5087.6	4919.9	4761.3	4611.1	4468.9	4334.2
	85-89	11261.9	10258.9	9496.2	9113.8	8773.2	8450.9	8146.0	7857.4	7584.3	7325.8	7081.0
	90-94	18148.6	16919.2	15878.0	15213.1	14613.5	14046.3	13509.7	13001.9	12521.3	12066.4	11635.8

Note: The central death rate is the ratio of the number of deaths during the year to persons at the tabulated age to the midyear population at that age.

Table 2b. Alternative II Central Death Rates, by Age, Sex, and Calendar Year (per hundred thousand)

Sex	Age	Calendar Year										
		1981	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
Male	0	1316.9	1054.6	990.0	936.1	885.2	838.0	794.2	753.5	715.6	680.3	647.5
	1-4	69.0	57.2	51.3	49.8	48.7	47.7	46.7	45.8	44.9	44.1	43.4
	5-9	31.8	24.2	20.8	20.4	20.1	19.9	19.6	19.4	19.2	19.0	18.8
	10-14	37.1	31.0	27.7	27.2	26.9	26.6	26.4	26.1	25.9	25.6	25.4
	15-19	130.5	117.4	109.6	108.6	108.1	107.7	107.2	106.8	106.4	106.1	105.7
	20-24	181.4	161.8	150.0	148.7	148.1	147.4	146.9	146.3	145.8	145.3	144.8
	25-29	195.7	180.8	171.9	170.2	168.9	167.8	166.7	165.6	164.6	163.6	162.7
	30-34	192.6	161.6	145.0	142.6	141.0	139.4	137.9	136.5	135.1	133.9	132.6
	35-39	241.3	195.0	171.6	167.4	164.3	161.3	158.5	155.9	153.4	151.0	148.7
	40-44	362.9	290.0	252.0	243.8	236.7	230.3	224.2	218.5	213.0	207.9	203.0
	45-49	570.8	473.4	423.1	407.6	394.0	381.0	368.8	357.3	346.4	336.0	326.2
	50-54	929.8	788.8	715.1	687.7	662.9	639.6	617.4	596.5	576.7	557.9	540.1
	55-59	1426.4	1167.4	1034.8	992.0	953.9	917.9	883.9	851.8	821.4	792.7	765.4
	60-64	2159.0	1852.6	1686.4	1617.4	1554.4	1495.0	1438.9	1385.9	1335.7	1288.3	1243.4
	65-69	3430.9	3052.4	2827.0	2710.2	2602.8	2501.5	2405.9	2315.7	2230.4	2149.8	2073.5
	70-74	5006.4	4486.8	4170.0	3993.3	3831.1	3678.3	3534.2	3398.4	3270.3	3149.3	3034.9
	75-79	7283.3	6570.4	6130.8	5865.7	5618.8	5386.8	5168.5	4963.0	4769.5	4587.2	4415.2
	80-84	10654.7	9568.9	8930.0	8534.6	8166.6	7821.0	7496.3	7191.2	6904.1	6633.9	6379.5
	85-89	16242.3	14528.3	13467.1	12829.1	12241.2	11690.4	11174.1	10689.9	10235.5	9808.8	9408.0
	90-94	23347.4	20707.4	18936.2	17953.6	17064.1	16232.5	15454.9	14727.2	14046.1	13408.1	12810.3
Female	0	1089.8	856.6	791.7	745.9	703.2	663.7	627.2	593.3	561.9	532.8	505.7
	1-4	54.0	42.7	37.6	36.4	35.4	34.5	33.7	32.9	32.2	31.5	30.9
	5-9	25.2	19.0	16.2	15.8	15.4	15.2	14.9	14.6	14.4	14.1	13.9
	10-14	23.3	19.6	17.7	17.3	17.0	16.7	16.4	16.2	15.9	15.7	15.5
	15-19	47.0	42.9	41.3	40.9	40.6	40.3	40.1	39.8	39.5	39.3	39.1
	20-24	56.6	51.7	50.4	50.0	49.5	49.1	48.8	48.4	48.1	47.7	47.4
	25-29	69.1	58.0	52.8	51.9	51.2	50.5	49.8	49.2	48.7	48.1	47.6
	30-34	81.2	61.4	53.1	51.7	50.7	49.8	48.9	48.0	47.2	46.4	45.6
	35-39	117.7	84.4	70.5	68.2	66.4	64.7	63.0	61.5	60.0	58.6	57.2
	40-44	202.4	158.1	136.1	131.1	127.0	123.1	119.5	115.9	112.6	109.4	106.4
	45-49	316.2	257.9	226.8	217.6	210.1	203.0	196.2	189.7	183.5	177.6	172.0
	50-54	488.2	416.4	377.2	362.5	349.1	336.4	324.3	312.7	301.7	291.3	281.3
	55-59	749.0	647.6	595.2	571.9	550.1	529.4	509.7	490.9	473.1	456.1	439.9
	60-64	1132.7	1028.1	973.8	935.1	897.8	862.5	828.9	797.0	766.7	737.8	710.4
	65-69	1726.6	1550.6	1461.3	1399.7	1340.6	1284.7	1231.7	1181.5	1134.0	1088.8	1046.0
	70-74	2616.7	2221.2	2025.6	1931.1	1842.8	1759.5	1681.0	1606.9	1536.9	1470.7	1408.2
	75-79	4108.8	3374.0	2988.5	2831.3	2688.9	2555.2	2429.7	2311.7	2200.8	2096.5	1998.3
	80-84	6757.0	5495.0	4817.6	4545.3	4300.9	4072.2	3858.0	3657.4	3469.3	3293.0	3127.6
	85-89	11261.9	9257.9	8104.0	7619.7	7188.1	6784.9	6408.3	6056.2	5727.0	5419.1	5130.9
	90-94	18148.6	15530.2	13825.0	12973.2	12212.1	11502.4	10840.1	10222.0	9644.8	9105.7	8602.0

Note: The central death rate is the ratio of the number of deaths during the year to persons at the tabulated age to the midyear population at that age.

Table 2c. Alternative III Central Death Rates, by Age, Sex, and Calendar Year (per hundred thousand)

Sex	Age	Calendar Year										
		1981	1990	2000	2010	2020	2030	2040	2050	2060	2070	2080
Male	0	1316.9	881.7	788.0	726.2	669.7	618.9	573.0	531.5	494.0	459.9	428.8
	1-4	69.0	52.3	44.9	43.0	41.5	40.2	38.9	37.8	36.9	36.0	35.2
	5-9	31.8	21.2	17.2	16.7	16.2	15.8	15.5	15.2	14.9	14.6	14.4
	10-14	37.1	28.4	24.3	23.6	23.1	22.6	22.2	21.8	21.4	21.1	20.8
	15-19	130.5	111.7	101.7	100.4	99.6	98.9	98.3	97.7	97.1	96.7	96.2
	20-24	181.4	153.2	138.2	136.4	135.4	134.4	133.6	132.8	132.0	131.4	130.8
	25-29	195.7	174.1	162.4	159.6	157.5	155.6	153.9	152.3	150.8	149.5	148.2
	30-34	192.6	148.6	128.1	124.5	121.8	119.4	117.1	115.1	113.2	111.5	110.0
	35-39	241.3	176.2	147.7	141.5	136.5	132.0	128.0	124.2	120.8	117.8	115.0
	40-44	362.9	260.2	213.5	200.1	188.9	178.8	169.6	161.4	153.9	147.1	140.9
	45-49	570.8	432.9	368.3	338.7	312.8	289.5	268.5	249.6	232.5	217.2	203.3
	50-54	929.8	724.0	621.8	566.8	518.1	474.4	435.1	399.8	368.1	339.5	313.8
	55-59	1426.4	1063.7	896.3	812.8	738.9	672.6	613.1	559.6	511.6	468.4	429.6
	60-64	2159.0	1706.9	1470.5	1332.3	1209.5	1099.4	1000.5	911.6	831.8	760.0	695.4
	65-69	3430.9	2836.9	2483.5	2252.4	2046.7	1862.0	1695.9	1546.6	1412.3	1291.3	1182.4
	70-74	5006.4	4171.2	3664.4	3328.3	3025.6	2755.4	2512.3	2293.6	2096.7	1919.4	1759.5
	75-79	7283.3	6140.1	5448.8	4966.9	4533.7	4143.6	3792.0	3475.0	3189.0	2930.7	2697.4
	80-84	10654.7	8863.9	7851.3	7171.2	6559.7	6008.2	5510.4	5060.8	4654.5	4287.1	3954.5
	85-89	16242.3	13468.7	11861.0	10836.2	9918.9	9090.8	8342.7	7666.4	7054.6	6500.8	5999.1
	90-94	23347.4	19310.7	16836.1	15368.6	14065.6	12888.4	11824.3	10861.9	9990.9	9202.2	8487.4
Female	0	1069.8	722.7	633.7	580.6	532.8	490.1	451.7	417.3	386.2	358.2	332.8
	1-4	54.0	38.0	31.9	30.3	29.1	28.0	27.0	26.1	25.3	24.6	24.0
	5-9	25.2	16.5	13.2	12.7	12.2	11.8	11.4	11.1	10.8	10.6	10.3
	10-14	23.3	18.1	15.8	15.2	14.7	14.2	13.9	13.5	13.2	13.0	12.7
	15-19	47.0	41.2	39.3	38.7	38.2	37.8	37.4	37.0	36.7	36.4	36.2
	20-24	56.6	49.2	47.1	46.5	45.8	45.2	44.7	44.2	43.8	43.5	43.1
	25-29	69.1	53.8	47.4	45.7	44.5	43.3	42.3	41.4	40.6	39.9	39.3
	30-34	81.2	54.0	44.0	41.5	39.6	37.8	36.3	35.0	33.8	32.8	31.9
	35-39	117.7	71.8	55.3	51.1	47.7	44.6	42.0	39.7	37.6	35.8	34.2
	40-44	202.4	140.3	111.7	101.4	92.8	85.3	78.7	73.0	67.9	63.4	59.5
	45-49	316.2	234.1	193.2	173.1	155.8	140.7	127.5	115.9	105.8	96.9	89.1
	50-54	488.2	386.9	331.6	294.7	262.4	234.3	209.8	188.3	169.5	153.1	138.6
	55-59	749.0	604.0	523.9	464.9	413.3	368.2	328.8	294.3	264.1	237.6	214.3
	60-64	1132.7	958.6	852.7	759.2	676.6	604.2	540.6	484.8	435.7	392.5	354.4
	65-69	1726.6	1435.4	1271.2	1134.7	1013.7	907.4	813.9	731.4	658.7	594.5	537.7
	70-74	2616.7	2036.1	1755.1	1569.2	1405.1	1260.4	1132.7	1019.9	920.0	831.6	753.2
	75-79	4108.8	3069.4	2571.7	2300.7	2064.0	1854.8	1669.5	1505.2	1359.5	1230.0	1114.8
	80-84	6757.0	4950.7	4081.9	3652.2	3279.1	2948.5	2655.3	2394.9	2163.5	1957.4	1773.8
	85-89	11261.9	8372.2	6889.5	6175.6	5557.6	5008.3	4519.5	4084.1	3695.8	3349.2	3039.4
	90-94	18148.6	14274.5	11987.1	10772.5	9719.0	8779.3	7940.4	7190.7	6520.0	5919.4	5381.0

Note: The central death rate is the ratio of the number of deaths during the year to persons at the tabulated age to the midyear population at that age.

Table 3a. Life Expectancy at Birth, by Sex, Calendar Year, and Alternative (in years)

Calendar Year	Sex	
	Male	Female
1900	46.6	49.1
1901	48.0	51.0
1902	49.1	52.2
1903	49.3	52.2
1904	48.2	51.2
1905	48.9	52.0
1906	48.4	52.1
1907	48.4	52.3
1908	50.3	53.7
1909	51.2	54.5
1910	50.2	53.7
1911	51.9	55.1
1912	52.4	55.9
1913	51.8	55.5
1914	53.0	56.4
1915	53.6	56.9
1916	52.5	56.1
1917	52.3	56.0
1918	45.4	49.1
1919	54.3	56.5
1920	54.6	56.3
1921	57.3	59.3
1922	57.1	59.4
1923	56.4	58.8
1924	57.2	60.0
1925	57.3	60.0
1926	56.6	59.4
1927	58.0	60.9
1928	56.8	59.9
1929	57.1	60.2
1930	58.0	61.4
1931	58.6	62.1
1932	59.5	62.6
1933	59.6	63.1
1934	58.9	62.7
1935	59.5	63.4
1936	58.8	62.9
1937	59.4	63.6
1938	60.9	64.8
1939	61.5	65.4
1940	60.9	65.3
1941	61.4	66.1
1942	62.1	66.9
1943	62.0	66.9
1944	62.4	67.5
1945	62.5	68.2
1946	63.4	68.6
1947	64.4	69.5
1948	64.6	69.9
1949	65.0	70.4
1950	65.3	70.9
1951	65.4	71.1
1952	65.5	71.4
1953	65.7	71.8
1954	66.5	72.6
1955	66.6	72.7
1956	66.6	72.8
1957	66.3	72.6
1958	66.5	72.9
1959	66.7	73.2
1960	66.6	73.2
1961	67.0	73.6
1962	66.8	73.5
1963	66.6	73.4
1964	66.8	73.7
1965	66.8	73.8
1966	66.7	73.9
1967	66.9	74.3
1968	66.6	74.2
1969	66.8	74.5
1970	67.1	74.8
1971	67.4	75.1
1972	67.4	75.2
1973	67.6	75.5
1974	68.2	76.0
1975	68.8	76.6
1976	69.1	76.8
1977	69.4	77.2
1978	69.6	77.3
1979	69.9	77.8

Calendar Year	Sex and Alternative					
	I		II		III	
	Male	Female	Male	Female	Male	Female
1980	69.8	77.5	69.8	77.5	69.8	77.5
1981	70.3	77.8	70.3	77.8	70.3	77.8
1982	70.4	77.9	70.6	78.1	70.7	78.2
1983	70.5	78.0	70.8	78.3	71.1	78.6
1984	70.6	78.1	71.1	78.5	71.5	79.0
1985	70.7	78.2	71.3	78.8	71.8	79.3
1986	70.8	78.3	71.5	79.0	72.2	79.7
1987	70.9	78.4	71.7	79.2	72.5	80.0
1988	71.0	78.5	71.9	79.4	72.8	80.3
1989	71.1	78.6	72.1	79.7	73.1	80.6
1990	71.1	78.7	72.3	79.8	73.4	80.9
1991	71.2	78.8	72.5	80.0	73.6	81.2
1992	71.3	78.9	72.6	80.2	73.9	81.5
1993	71.4	78.9	72.8	80.4	74.1	81.7
1994	71.4	79.0	72.9	80.5	74.3	81.9
1995	71.5	79.1	73.0	80.6	74.5	82.1
1996	71.5	79.2	73.1	80.7	74.6	82.2
1997	71.6	79.2	73.2	80.8	74.8	82.4
1998	71.6	79.3	73.3	80.9	74.9	82.5
1999	71.7	79.3	73.4	81.0	75.0	82.7
2000	71.7	79.3	73.4	81.0	75.1	82.8
2005	71.9	79.5	73.7	81.3	75.7	83.4
2010	72.0	79.7	73.9	81.6	76.2	84.0
2015	72.2	79.8	74.2	81.9	76.7	84.6
2020	72.3	80.0	74.4	82.2	77.2	85.2
2025	72.5	80.1	74.7	82.5	77.8	85.8
2030	72.6	80.3	74.9	82.7	78.3	86.4
2035	72.8	80.4	75.1	83.0	78.8	86.9
2040	72.9	80.6	75.4	83.3	79.3	87.5
2045	73.0	80.7	75.6	83.6	79.8	88.1
2050	73.2	80.9	75.8	83.8	80.3	88.6
2055	73.3	81.0	76.1	84.1	80.8	89.2
2060	73.4	81.2	76.3	84.4	81.3	89.7
2065	73.6	81.3	76.5	84.7	81.8	90.3
2070	73.7	81.5	76.8	84.9	82.3	90.8
2075	73.8	81.6	77.0	85.2	82.8	91.4
2080	73.9	81.8	77.2	85.5	83.3	91.9

Note: The life expectancy is the average number of years of life remaining to a person if he were to experience the age-specific mortality rates for the tabulated year throughout the remainder of his life.

Table 3b. Life Expectancy at Age 65, by Sex, Calendar Year, and Alternative (in years)

Calendar Year	Sex	
	Male	Female
1900	11.3	12.0
1901	11.3	12.0
1902	11.7	12.6
1903	11.4	12.2
1904	11.1	11.9
1905	11.4	12.0
1906	11.4	12.2
1907	11.0	11.8
1908	11.6	12.3
1909	11.8	12.4
1910	11.4	12.1
1911	11.5	12.2
1912	11.8	12.3
1913	11.6	12.4
1914	11.6	12.4
1915	11.4	12.2
1916	11.3	12.0
1917	11.2	12.1
1918	11.6	12.5
1919	12.3	12.8
1920	11.8	12.3
1921	12.2	12.8
1922	11.8	12.4
1923	11.5	12.2
1924	11.8	12.6
1925	11.6	12.5
1926	11.4	12.2
1927	11.7	12.7
1928	11.3	12.3
1929	11.4	12.4
1930	11.8	12.9
1931	12.0	13.1
1932	11.8	13.0
1933	12.0	13.2
1934	11.9	13.1
1935	11.9	13.2
1936	11.6	12.8
1937	11.8	13.1
1938	12.1	13.5
1939	12.0	13.4
1940	11.9	13.4
1941	12.2	13.8
1942	12.4	14.1
1943	12.1	13.7
1944	12.5	14.1
1945	12.6	14.4
1946	12.9	14.6
1947	12.6	14.5
1948	12.7	14.7
1949	12.8	14.9
1950	12.8	15.1
1951	12.8	15.2
1952	13.0	15.3
1953	12.9	15.3
1954	13.2	15.7
1955	13.1	15.6
1956	13.0	15.7
1957	12.9	15.6
1958	12.9	15.7
1959	13.1	15.9
1960	12.9	15.9
1961	13.1	16.1
1962	12.9	16.0
1963	12.7	16.0
1964	13.0	16.3
1965	12.9	16.3
1966	12.9	16.3
1967	13.0	16.6
1968	12.8	16.6
1969	13.0	16.9
1970	13.1	17.1
1971	13.1	17.1
1972	13.1	17.2
1973	13.2	17.4
1974	13.5	17.7
1975	13.7	18.0
1976	13.7	18.1
1977	13.9	18.3
1978	13.9	18.3
1979	14.2	18.6

Calendar Year	Sex and Alternative					
	I		II		III	
	Male	Female	Male	Female	Male	Female
1980	14.0	18.3	14.0	18.3	14.0	18.3
1981	14.2	18.5	14.2	18.5	14.2	18.5
1982	14.3	18.6	14.3	18.7	14.4	18.8
1983	14.3	18.7	14.4	18.9	14.6	19.0
1984	14.3	18.8	14.5	19.0	14.8	19.3
1985	14.4	18.8	14.6	19.2	14.9	19.5
1986	14.4	18.9	14.7	19.3	15.1	19.8
1987	14.4	19.0	14.8	19.5	15.2	20.0
1988	14.5	19.0	14.9	19.6	15.4	20.2
1989	14.5	19.1	15.0	19.8	15.6	20.4
1990	14.5	19.2	15.1	19.9	15.7	20.7
1991	14.5	19.2	15.2	20.0	15.8	20.9
1992	14.6	19.3	15.3	20.2	16.0	21.0
1993	14.6	19.3	15.3	20.3	16.1	21.2
1994	14.6	19.4	15.4	20.4	16.2	21.4
1995	14.6	19.4	15.5	20.5	16.3	21.5
1996	14.7	19.5	15.5	20.6	16.4	21.6
1997	14.7	19.5	15.6	20.6	16.5	21.8
1998	14.7	19.6	15.6	20.7	16.6	21.9
1999	14.7	19.6	15.7	20.8	16.7	22.0
2000	14.8	19.6	15.7	20.8	16.8	22.1
2005	14.9	19.8	15.9	21.0	17.2	22.5
2010	15.0	19.9	16.1	21.3	17.6	23.0
2015	15.1	20.0	16.3	21.5	18.0	23.5
2020	15.2	20.2	16.4	21.7	18.4	24.0
2025	15.3	20.3	16.6	22.0	18.8	24.4
2030	15.4	20.4	16.8	22.2	19.2	24.9
2035	15.5	20.6	17.0	22.4	19.6	25.4
2040	15.6	20.7	17.2	22.6	20.0	25.8
2045	15.7	20.8	17.4	22.9	20.4	26.3
2050	15.8	20.9	17.5	23.1	20.9	26.8
2055	15.9	21.1	17.7	23.3	21.3	27.2
2060	16.0	21.2	17.9	23.6	21.7	27.7
2065	16.1	21.3	18.1	23.8	22.1	28.2
2070	16.2	21.5	18.3	24.0	22.5	28.6
2075	16.3	21.6	18.5	24.3	23.0	29.1
2080	16.4	21.7	18.7	24.5	23.4	29.6

Note: The life expectancy is the average number of years of life remaining to a person if he were to experience the age-specific mortality rates for the tabulated year throughout the remainder of his life.

Table 4. Aged Dependency Ratio and OASDI Cost Rate by Alternative and Mortality Assumption

Assumption	Aged Dependency Ratio in 2060 1/	1983-2057 OASDI Average Cost Rate 2/
1983 OASDI Trustees Report:		
Alternative I	.257	9.81
Alternative II-B	.348	12.84
Alternative III	.553	16.56
Alternative II-B except:		
No Mortality Improvement		
Alternative I Mortality	.305	12.18
Alternative II-B Mortality	.348	12.84
Alternative III Mortality	.424	13.81
Continuation of Recent Mortality Improvement		

1/ The aged dependency ratio is defined as the number of persons above the OASDI normal retirement age, which is 67 in 2060, divided by the number of persons aged 20 up to the OASDI normal retirement age. In 1983, the normal retirement age is 65 and the aged dependency ratio is .200.

2/ The OASDI cost rate for any year is the total outgo of the OASDI program expressed as a percentage of taxable payroll.

Senator CHAFEE. You have a very optimistic presentation here, Mr. Bayo, but I am not sure that I agree with it, I think you used the term in here 0.97 percent of payroll. To most people, 0.97 percent seems like a very modest amount, nothing to get terribly excited over, but what does that translate into dollars a year paying out under the social security system, if it is a change of 0.97 percent?

Mr. BAYO. It would be about $15 billion a year by 1985 or 1986.

Senator CHAFEE. $15 billion. And as I understand it the reserves of the social security program are in the neighborhood of $15 billion; are they not?

[Answers to questions from Senator Chafee:]

QUESTION FOR MR. BAYO

1. You may state on pages 20-21 that if the mortality element of your intermediate (II) projection were changed to reflect a more optimistic (by optimistic, I mean longer-lived) view of mortality as in Alternative III, the projected long-range cost to the Social Security Trust Funds (OASDI) would increase by "only" 0.97 percent of taxable payroll.

Now this sounds very calming, very reassuring.

But I would like to know how 0.97 percent translates into dollars—either for one year or over the long range? And what if the low mortality (Estimate III) proved to be too low? Do you have this percentage translated into dollars?

(Note.—The taxable payroll in 1983 is about $1.5 trillion, meaning that an increase in cost of 1 percent of payroll is equal to $15 billion per year?)

ANSWER TO QUESTION 1

The taxable payroll in 1983 is estimated at about $1,475 billion. Therefore, an increase in cost of 0.97 percent of payroll would equal $14 billion in 1983.

Mr. BAYO. A little bit higher than that. Not much.

Senator CHAFEE. How did we get this figure? Did we not have the figure $14 billion?

When we were considering in the short-range situation, that is, prior to 1992, right in that area, we were looking at reserves of $15 billion to $20 billion, and here a change of 0.97 percent is $18 billion, so we are talking some significant dollars. That is the point I am making.

Mr. BAYO. In terms of dollars, they are significant, Mr. Chairman.

Senator CHAFEE. So when one talks of 0.97 percent, which seems—which does not affect many things significantly, 0.97 percent in this program means a very, very large sum of money, and indeed could significantly affect the viability of the system, could it not?

Mr. BAYO. Yes, sir. Yes, Mr. Chairman. I was more looking at it from the point of view of the accuracy of the cost estimate. I wish we were only off by 1 percent in the 75-year projection, which means I will be off by 7 percent relatively of the cost being quoted.

Senator CHAFEE. I agree with you. I am just looking at it from an observer's point of view that the improvements for the young, as far as improving their life expectancy are probably modest that we can expect because of the control of the infectious diseases that we have reached to date, but it seems to me that the improvements for the aged—I agree with you where you say on page 16—are expected to continue at a relatively rapid pace as further strides are

made against degenerative diseases. The whole control of smoking, the better exercise, the better nutrition. So this is the group that obviously affects your system.

It seems to me, if somebody reaches the age of 75 now, the chances of them reaching the age of 80 are very, very good. Do you have any statistics on that, what the life expectancy of somebody who reaches the age of 75 is?

Mr. BAYO. Mr. Wilkin, do you have these?

We will have the figures in just a second, Mr. Chairman. Currently, 70 percent of males aged 75 live to age 80, and about 82 percent of females aged 75 live to age 80. The idea that I was trying to convey is that mortality does not change very quickly, that there will be ample time in which to take a look at the changing trends. Even if we were able to conquer some of the strongest killers that we have at the older ages, we will not be able to implement it that quickly. It takes a few years to get new discoveries to be applied and to save people.

Senator CHAFEE. Let us take on page 21 of your testimony where you say that the intermediate projections assume that the recent trends in mortality continue for a few more years and then decelerate to lower rates by the year 2007. In the 50 years thereafter, I understand, you assume mortality is to improve at only about a third of the rate experienced since 1900, and at about only a fifth of the rate experienced since 1968.

QUESTION FOR MR. BAYO

2. On page 21 you say that the intermediate (II) projections assume that the recent trends in mortality continue for a few more years then decelerate to slower rates by the year 2007. In the 50 years thereafter, I understand that you assume mortality is assumed to improve at only about a third of the rate experienced since 1900, and is only about a fifth of the rate experienced since 1968. Now, to a layman, your current intermediate projections seem awfully unrealistic just in terms of the historical record. Could you elaborate? Why, for example, would you estimate such a drop of mortality improvement at about the turn of the century, just as one might expect we could be making major breakthroughs against disease?

ANSWER TO QUESTION 2

A good projection cannot just extrapolate historical trends, especially something like declines in mortality. Consideration must be given to the reasons for past declines and the likelihood of future declines. Even the choice of the trends to be projected has a significant effect on the result. For example, projecting the recent (1968 to 1978) rapid rate of decline by age and sex to continue indefinitely, while disregarding the causes of death, would result in the life expectancy at birth increasing from 73.6 years in 1980 to 92.5 years in 2060. This would result in an increase of about 2 percent of payroll in the long-range OASDI average cost. However, projecting in a similar manner by cause and sex, while disregarding age (as was done by Professor Eileen Crimmins), results in a life expectancy at birth of only 85.1 years in 2060, and an increase in the long-range OASDI average cost of about 1 percent of payroll. The reason for the difference is that although recent data show declines in all age groups, it does not show declines in all causes of death; cancer shows an increase in mortality. When projecting by cause, the effect of the continued increases in the death from cancer eventually overpowers the declines in all other causes and the projected life expectancy will actually begin to decrease.

It must be remembered that a projection of continuously declining death rates implicitly assumes a continuous stream of breakthroughs in the control of disease and of the aging process. Because most of the infectious diseases, which were the major causes of death for persons under age 65, are already under control, little mortality improvement can be expected for these ages (with the exception of the ages affected by diseases of infancy). Therefore, it should be expected that when the projected mortality declines are combined over all ages the overall total would be lower than

in the past. For ages 65 and over, our current Alternative II assumptions result in a decline in mortality from 1980 to 2060 that is 123 percent and 77 percent of the decline from 1900 to 1980 for males and females, respectively. Although recent rates of improvement have been more rapid than the average since 1900, the historical data show that rates of decline in mortality have fluctuated in the past and also that the current rates of decline for the 65 and over are unprecedented. A continuation of this recent trend for the next 100 years seems highly unlikely.

QUESTION FOR MR. BAYO

3. On page 5 you suggest that changes in mortality affect Social Security costs but slowly, and thus there is ample time to consider whether program changes are necessary. Very calming.

I wonder, Mr. Bayo, how closely you followed this Committee's two-year struggle to reach agreement on the Social Security salvation package? Significant changes—such as changes in the retirement age—are very difficult and can only occur with plenty of advance notice.

Wouldn't it be better to represent conservative estimates of mortality that would, if wrong, provide a happy margin of safety for these critical programs?

ANSWER TO QUESTION 3

Some actuaries would agree that if they were responsible for the funding, they would provide estimates with a built-in level of conservativism, at least for private plans. However, the funding of the Social Security program is quite another matter. Congress is responsible for the funding of Social Security, and it would be presumptuous of the actuary to conceal from Congress a safety margin that has been added to the best estimate. This is particularly so in a subject as technical and specialized as mortality projections. If specifically requested I would be glad to provide the Congress with conservative estimates. In the meantime I interpret my principal responsibility as providing my best estimate.

QUESTION FOR MR. BAYO

4. It is also calming to predict a future in which mortality rates, particularly in the over 65 group, are static (as you stress on page 4). But as Dr. Brody points out (on page 2, second paragraph) we have been quite surprised by the very rapid drop in mortality in this group from 1920 to 1945. How different our planning would have been could we have forecast this phenomenon.

Wouldn't you agree with Dr. Brody (page 4) that we should use all the improving techniques of data gathering and analysis and combine epidemiologic methods with the actuarial techniques you now rely on? For example, have you factored into your estimates the correlation between education and increased longevity?

It seems to me that the stakes are very large in using the best available methods. Are you convinced you are doing so?

ANSWER TO QUESTION 4

In the interest of simplicity, on page of the written statement I stressed that of all the assumptions needed for cost projections the mortality rates are the most stable. However, this does not mean that they do not change, but only that their rate of decline is much steadier. Because we project mortality to decline in the near future at rates close to the recent rates of decline, it would take several years of actual declines at rates significantly different from the recent past before the level of mortality would be significantly different from what we projected. It would take several more years after that before the size of the actual population over age 65 was significantly different from what we projected. In Table 4 of my statement we show the cost effect of assuming mortality rates static at their 1982 levels. It should be understood that this projection is illustrative, just as that of Professor Crimmins which was based on a continuation of recent trends indefinitely. These two projections may be considered the extremes between which reasonable projections should fall. Table 4 shows that the estimated long-range OASDI cost rate under Alternative II-B would be lower by 1.18 percent if mortality were not projected to improve, and higher by about 1 percent of payroll if mortality were projected to continue at the recent rate of decline by cause and sex.

Naturally we agree that we should use the best projection techniques possible. I would like to mention that the Office of the Actuary is the only group of people that we know of in the United States who annually produce mortality projections, widely distribute the results, and invite comment from the general public. As such, we are

recognized experts in the field, and obviously we are often criticized by various groups and individuals both for projecting mortality to decline too rapidly and too slowly. We will continue to gather more data and do more analysis to improve our projections.

We are limited by our small staff as to the number of epidemiological or correlation studies that we can do, but we do try to stay abreast of the current literature for practical improvement to our work. The new data and methods could help in trying to predict what will happen in the near future, but it should be recognized that there is usually just as much uncertainty about the future path of these correlated variables as there is about the overall mortality itself. It would be foolhardy to start comprehensive and costly programs of data gathering and analysis with the expectation of making significant improvement on our knowledge of what will happen up to 75 years in the future.

Mr. BAYO. That is true, Mr. Chairman, with respect to the entire population, because there is not much improvement that could be made at the younger ages. But for the aged, those 65 and over, our assumption is that the rate of decline for 1980–2060 will be about 42 percent of what we have had in the last 10 years, and very close to what we have had since the turn of the century.

Senator CHAFEE. Could you repeat that please?

Mr. BAYO. After the year 2007, the assumption that we have is that mortality will decrease at about one-third of the rate that it has been decreasing since the turn of the century. That is for the entire population. When we limit ourselves to the aged, our improvement is projected to be higher.

Senator CHAFEE. Now I am confused. You expect mortality, to improve at only about a third of the rate experienced since 1900, and only about one-fifth of the rate experienced since 1968. These are your post-2007 projections. Is that correct?

Mr. BAYO. That is correct for the whole population of the United States, but most of the cost of the program is related to the aged, and for the aged we assume higher increases. In other words, we have different assumptions. For younger, there is not much improvement that can be obtained.

Senator CHAFEE. How do those statistics compare for the experience of the aged from, say, 1968 on?

Mr. BAYO. For the next 80 years, we assume under the intermediate assumption that the mortality for the aged will be about 90 percent of what we have had in the last 80 years.

Senator CHAFEE. What do you base that on?

Mr. BAYO. For the next 80, it is about 90 percent of what we had in the last 80.

Senator CHAFEE. And that is where we differ, the only difference being you have got experience and a host of statisticians helping you. But it just seems to me that people are living a lot, lot longer, and that trend is accelerating. You do not agree with that?

Mr. BAYO. Well, the thing is, where are those improvements in mortality going to come from? That is the problem that we have. We are now conquering the cardiovascular and renal diseases, but we have not been able to do much about cancer.

Senator CHAFEE. Well, I do not see why you expect these improvements to decrease. If you had been sitting here in 1968, you would have never anticipated just the changes in lifestyles that have come about.

Mr. BAYO. That is correct. The mortality since 1968 has been decreasing very fast. But I doubt that that pace of improvement can be sustained for a long period of time.

Senator CHAFEE. But the ramifications, if you are wrong, are very significant. You say you have got plenty of time. There is no rush in these things. But making changes in the social security system is very, very difficult for Congress to do, and we have to have lots of warning. It is a program that cannot be changed quickly. We went through this painful process last year and this year. So why do you say that you have got plenty of time?

Mr. BAYO. We will have plenty of time because mortality decreases 2 or 3 percent per year at the most, and the costs will not be affected by 2 or 3 percent per year either. For example, let us assume that the mortality of the aged is about 5 percent per year, all of the ages taken together. So that means that of 1,000 beneficiaries, 950 will survive 1 year. With decreasing mortality by a very large amount, like 10 percent, that means that the mortality will go from 5 percent to 4.5 percent. It also means that instead of having 950 survivors, we have 955 survivors. So the effect on the program is going to be about half a percent increase in the cost in that year, and it will be a while before it would be large enough to require drastic changes in a program that is supposed to last many years into the future.

I believe that the best approach for the Congress is to wait until we have a definite trend that is generally agreed upon, and then recognize that trend.

Senator CHAFEE. We have a definite trend.

Mr. BAYO. We have a definite trend and we have recognized it, Mr. Chairman. We are recognizing what we have had. In the near future we assume the trend is going to continue, we project to continue at that level of improvement.

Senator CHAFEE. Is it my understanding that within 10 years you have had at least two major revisions of your life expectancy projections?

Mr. BAYO. We have had more than two. We have had four. In 1977, 1978, 1979, and 1980.

Senator CHAFEE. And have they always been upward?

Mr. BAYO. With respect to mortality, yes.

Senator CHAFEE. I just think that you are overly sanguine, and—excuse me.

[Whereupon, a brief recess was taken.]

Senator CHAFEE. Now, if Dr. Brody could come to the table, and if you could remain there, Mr. Bayo, why do we not hear from Dr. Brody, and see how his testimony works out, and there may be some questions that I would have with you based on his testimony.

Doctor, we welcome you here. Dr. Brody is the associate director of the National Institute on Aging. You have a statement, I believe, Doctor.

STATEMENT OF JACOB A. BRODY, M.S., ASSOCIATE DIRECTOR, NATIONAL INSTITUTE ON AGING

Mr. BRODY. Yes, Mr. Chafee. I first wish to thank you and your staff for permitting me to speak here and more importantly for

opening the exploration of this very important area of projections, life expectancy, mortality rates, and lifespan.

Projection of overall mortality, including those who will be age 65 and over in the future, is the basic issue of our discussion, and a very complicated issue at that. It is my opinion that with increasing utilization of modern computer technology and access to more complete medical and social data, as well as the implementation of such new tools as the National Death Index, there is hope for substantial achievement through a meld of actuarial and epidemiologic approaches.

The epidemiologic approach is one in which health, illness, and related factors are studied in populations rather than in individual patients. The task of projecting the population is difficult from both a mathematical and a biological point of view. In order to make projections, the technique requires accurate information. This has proved to be elusive.

While the number of reported deaths in the United States is fairly reliable, the specific causes are not as accurate. Furthermore, in the 1980 census, there was an estimated undercount of approximately 5½ million persons. Data for those over aged 65, however, have improved remarkably, and at present medicare records and the death certificates show a concurrence approaching 100 percent.

Thus, for data relating to those 65 and over, we can be more comfortable in utilizing the epidemiologic information as well as the classical actuarial approaches which depend more heavily on fixed theoretical assumptions.

A review of age specific mortality figures for the United States during this century will illustrate the array of surprises which have occurred and suggest the degree of humility we must bring to future attempts at making projections.

Attached to my statement and also on this chart on the wall are two figures which I will address. In the upper figure, we show deaths from all causes for 1900 to 1979. The top line signifies males, the bottom line females, and the middle line the total population. As expected, females at all ages have lower age specific mortalities than males. A noteworthy element in this chart is that during the period shown, half the reduction in mortality occurred by 1920. This was during a period where the greatest changes were due to general conditions of living and sanitation rather than any spectacular medical or social breakthroughs.

In the bottom figure, the same time period is covered, but only for people aged 65 and over. In this figure, we see that the elderly themselves since 1900 are indeed living longer, a point we have already stressed repeatedly. Looking closely at the curves, we note that there was barely a 5-percent decline during the first 20 years of this century, the period in which half the decline occurred for the entire population.

By 1945 or so, half the decline in those aged 65 and over had been accomplished. This pattern of a plateau until 1920 and then a rapid decline by 1945 would be difficult to predict either from a theoretical or an empirical approach. This very large decline definitely occurred, but for reasons we just do not understand. Had we been aware of it during that period, we would have perhaps shaped

our initial approach to social security taxation and payments along different lines.

As we follow the curve for those aged 65 and over toward recent years, small differences become more important. This is because in 1900 only 25 percent of all deaths occurred in people 65 and over, while by 1979 70 percent of all deaths were occurring in this population of only 11 percent. The deceptive plateau following World War II, particularly when analyzed for all ages in the upper figure, caused us to assume that life expectancy had stabilized at a peak, and for a brief time projections made by any technique were easy.

Focusing again on the lower figure, we see that dramatic changes were taking place among those age 65 and over throughout this period, with a rise in mortality from the late 1950's until about 1968, and a rapid decline since that time. Please note that the decline in the elderly mortality is far greater than the curve for all ages, comparing the furthest right portion of both the upper and lower charts. This suggests that increases in longevity are occurring at a disproportionately high rate among the elderly. Thus, the oldest are increasing in their life expectancy the most.

It would be comforting to claim that we are the agents responsible for the decline in mortality since 1968 through our social and medical interventions. This is unlikely, however, since major reductions in smoking and in the use of antihypertensive drugs and surely dietary modification did not really exert powerful effects until the early to middle 1970's.

This suggests that a large proportion of the decline was really not readily explainable, and more important in terms of epidemiologic projections is that benefits from antihypertension medications or smoking cessation and many other interventions have not yet been fully maximized.

Senator CHAFEE. I could not agree with you more. Go ahead. You are singing my song.

Dr. BRODY. Areas where epidemiologic information can supplement actuarial approaches are numerous. To mention a few, we know that influenza has a particularly devastating effect on the older population. Thus there was an actual increase in mortality during 1980 and 1981, largely ascribed to influenza. We know that a greater proportion of our population will be older, and there are scientists who are doing better and better in creating computer models to predict influenza epidemics. By incorporating this type of information into future projections, we gain the richness of another factor which has marked effects on the population most susceptible to dying.

Another example is the well-documented observation that the level of education measured even apart from socioeconomic status has an extraordinary effect on longevity. The least educated die approximately 5 to 8 years earlier than the most educated in both the United States and Great Britain. Level of education represents an enormous influence on mortality, having more than twice the impact of cancer. The population now 65 and over has 2 to 3 years less education than those under age 65. During the next 25 years or so, the educational level of the 65 and over group will equal that of all adult age groups. It is likely that this change will be accompanied by a strong shift away from premature mortality and to in-

creased longevity as well, of course, as creating a larger and more articulate political subgroup.

To summarize, there is ample evidence that the forces which influence mortality are generally predictable, but specifically and for any given period of time are subject to substantial variations. Given this information, it behooves us to develop iterative approaches utilizing all the improving techniques for data gathering and analysis, and combine epidemiologic methods and actuarial techniques in establishing projections and their parameters.

Thank you again, Mr. Chairman. I would be pleased to try to answer any questions.

[The prepared statement of Dr. Brody follows:]

STATEMENT

BY

JACOB A. BRODY, M.D.

ASSOCIATE DIRECTOR FOR EPIDEMIOLOGY, DEMOGRAPHY, AND BIOMETRY PROGRAM

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

PROJECTION OF OVERALL MORTALITY, INCLUDING THOSE WHO WILL BE AGE 65 AND OVER I: THE FUTURE, IS THE BASIC ISSUE OF OUR DISCUSSION AND A VERY COMPLICATED ISSUE A THAT. IT IS MY OPINION THAT WITH INCREASING UTILIZATION OF MODERN COMPUTER TECHNOLOGY AND ACCESS TO MORE COMPLETE MEDICAL AND SOCIAL DATA, AS WELL AS THE IMPLEMENTATION OF SUCH NEW TOOLS AS THE NATIONAL DEATH INDEX, THERE IS HOPE FOR SUBSTANTIAL PROGRESS THROUGH A MELD OF ACTUARIAL AND EPIDEMIOLOGIC APPROACHES. THE EPIDEMIOLOGIC APPROACH IS ONE IN WHICH HEALTH, ILLNESS, AND RELATED FACTORS ARE STUDIED IN POPULATIONS RATHER THAN IN INDIVIDUAL PATIENTS.

THE TASK OF PROJECTING THE POPULATION IS DIFFICULT FROM BOTH A MATHEMATICAL AND BIOLOGICAL POINT OF VIEW. IN ORDER TO MAKE PROJECTIONS, ANY TECHNIQUE REQUIRES ACCURATE INFORMATION. THIS HAS PROVED TO BE ELUSIVE. WHILE THE NUMBER OF REPORTED DEATHS IN THE UNITED STATES IS FAIRLY RELIABLE, THE SPECIFIC CAUSES AR NOT AS ACCURATE. FURTHERMORE, IN THE 1980 CENSUS THERE IS AN ESTIMATED UNDERCOUNT OF APPROXIMATELY 5.5 MILLION PERSONS. DATA FOR THOSE 65 AND OVER, HOWEVER, HAVE IMPROVED REMARKABLY AND, AT PRESENT, THE MEDICARE ROLLS AND THE DEATH CERTIFICATES SHOW A CONCURRENCE APPROACHING 100 PERCENT. THUS, FOR DATA RELATING TO THOSE 65 AND OVER, WE CAN BE COMFORTABLE UTILIZING EPIDEMIOLOGIC INFORMATION AS WELL AS CLASSIC, ACTUARIAL APPROACHES WHICH DEPEND MORE HEAVILY ON FIXED, THEORETICAL ASSUMPTIONS. BESIDES ACCURATE DATA, WE NEED RELIABLE CONCEPTUAL MODELS OF FERTILITY AND MORTALITY RATE CHANGES, BOTH AREAS OF SUBSTANTIAL CONTROVERSY AND UNPREDICTABILITY.

A REVIEW OF AGE-SPECIFIC MORTALITY FIGURES FOR THE UNITED STATES, DURING THIS CENTURY, WILL ILLUSTRATE THE ARRAY OF SURPRISES WHICH HAVE OCCURRED AND SUGGES THE DEGREE OF HUMILITY WE MUST BRING TO FUTURE ATTEMPTS AT MAKING PROJECTIONS. ON THE FIRST FIGURE WE SHOW DEATHS FOR ALL AGES FROM 1900 TO 1979. THE TOP LI

SIGNIFIES MALES, THE BOTTOM LINE, FEMALES AND THE MIDDLE LINE, THE TOTAL POPULATION. AS EXPECTED, FEMALES AT ALL AGES HAVE A LOWER AGE-SPECIFIC MORTALITY THAN MALES. A NOTEWORTHY ELEMENT IN THIS CHART IS THAT, DURING THE PERIOD SHOWN, HALF THE REDUCTION IN MORTALITY OCCURRED BY ABOUT 1920. THIS WAS DURING A PERIOD WHERE THE GREATEST CHANGES WERE DUE TO IMPROVED GENERAL CONDITIONS OF LIVING AND IN SANITATION RATHER THAN ANY SPECTACULAR MEDICAL OR SOCIAL BREAKTHROUGHS.

IN THE SECOND FIGURE THE SAME TIME PERIOD IS COVERED, BUT ONLY FOR PEOPLE AGE 65 AND OVER. IN THIS FIGURE, WE SEE THAT, SINCE AT LEAST 1900, THE ELDERLY THEMSELVES ARE CLEARLY LIVING LONGER. LOOKING CLOSELY AT THE CURVES, WE NOTE THAT THERE WAS BARELY A 5 PERCENT DECLINE IN DEATHS DURING THE FIRST 20 YEARS OF THE CENTURY, THE PERIOD IN WHICH HALF THE DECLINE OCCURRED FOR THE ENTIRE POPULATION. BY 1945 OR SO, HALF THE DECLINE IN THOSE AGE 65 AND OVER HAD BEEN ACCOMPLISHED. THIS PATTERN OF A PLATEAU UNTIL 1920 AND THEN A RAPID DECLINE BY 1945 WOULD BE DIFFICULT TO PREDICT EITHER FROM A THEORETICAL OR EMPIRICAL APPROACH. THIS VERY LARGE DECLINE DEFINITELY OCCURRED, BUT FOR REASONS WHICH WE DO NOT UNDERSTAND. HAD WE BEEN AWARE OF IT DURING THAT PERIOD, WE WOULD HAVE PERHAPS SHAPED OUR INITIAL APPROACH TO SOCIAL SECURITY TAXATION AND PAYMENTS ALONG DIFFERENT LINES.

AS WE FOLLOW THIS CURVE FOR THOSE 65 AND OVER TOWARD RECENT YEARS, SMALL DIFFERENCES BECOME MORE IMPORTANT. THIS IS BECAUSE IN 1900 ONLY ABOUT 25 PERCENT OF DEATHS OCCURRED IN THOSE 65 AND OVER, WHILE BY 1979 ABOUT 70 PERCENT OF ALL DEATHS WERE OCCURRING IN THIS SUBPOPULATION OF ONLY 11 PERCENT. THE DECEPTIVE PLATEAU FOLLOWING WORLD WAR II, PARTICULARLY WHEN ANALYZED FOR ALL AGES (IN FIGURE 1), CAUSED US TO ASSUME THAT LIFE EXPECTANCY HAD STABILIZED AT A PEAK, AND FOR A BRIEF TIME, PROJECTIONS MADE BY ANY TECHNIQUE WERE ACCURATE.

FOCUSING AGAIN ON THE SECOND FIGURE, WE SEE THAT LARGE, DRAMATIC CHANGES WERE TAKING PLACE AMONG THOSE AGE 65 AND OVER THROUGHOUT THIS PERIOD WITH A RISE IN MORTALITY FROM THE LATE 1950'S UNTIL ABOUT 1968, AND A RAPID DECLINE SINCE THAT TIME. PLEASE NOTE THAT THIS DECLINE IN ELDERLY MORTALITY IS FAR GREATER THAN IN THE CURVE FOR THOSE OF ALL AGES, SUGGESTING THAT INCREASES IN LONGEVITY ARE OCCURRING AT A DISPROPORTIONATELY HIGH RATE AMONG THE ELDERLY. THUS, THE OLDEST ARE INCREASING THEIR LIFE EXPECTANCY THE MOST.

IT WOULD BE COMFORTING TO CLAIM THAT WE ARE THE AGENTS RESPONSIBLE FOR THE DECLINE IN MORTALITY SINCE 1968 THROUGH OUR SOCIAL AND MEDICAL INTERVENTIONS. THIS IS UNLIKELY, HOWEVER, SINCE MAJOR REDUCTIONS IN SMOKING AND IN THE USE OF ANTI-HYPERTENSIVE DRUGS AND, SURELY, IN DIETARY MODIFICATION DID NOT REALLY EXERT POWERFUL EFFECTS UNTIL THE EARLY TO MIDDLE 1970'S. THIS SUGGESTS THAT A LARGE PROPORTION OF THE DECLINE IS REALLY NOT READILY EXPLAINED AND, MORE IMPORTANT, IN TERMS OF EPIDEMIOLOGIC PROJECTIONS, IS THAT BENEFITS FROM ANTI-HYPERTENSIVE MEDICATIONS AND SMOKING CESSATION HAVE NOT YET BEEN MAXIMALLY REALIZED.

AREAS WHERE EPIDEMIOLOGIC INFORMATION CAN SUPPLEMENT ACTUARIAL APPROACHES ARE NUMEROUS. TO MENTION A FEW, WE KNOW THAT INFLUENZA HAS A PARTICULARLY DEVASTATING EFFECT ON THE OLDER POPULATION. THUS, THERE WAS AN ACTUAL INCREASE IN MORTALITY DURING 1980 AND 1981 LARGELY ASCRIBED TO INFLUENZA. WE KNOW THAT A GREATER PROPORTION OF OUR POPULATION WILL BE OLDER, AND THERE ARE SCIENTISTS WHO ARE DOING BETTER AND BETTER IN CREATING COMPUTER MODELS OF THE PATTERNS OF INFLUENZA EPIDEMICS AND PANDEMICS (WORLD-WIDE EPIDEMIC). BY INCORPORATING THIS TYPE OF INFORMATION INTO FUTURE PROJECTIONS WE GAIN THE RICHNESS OF ANOTHER APPROACH WHICH HAS MARKED EFFECTS ON THE POPULATION MOST SUSCEPTIBLE TO DYING.

ANOTHER EXAMPLE IS THE WELL-DOCUMENTED OBSERVATION THAT LEVEL OF EDUCATION, MEASURED EVEN APART FROM SOCIOECONOMIC STATUS HAS AN EXTRAORDINARY EFFECT ON LONGEVITY. THE LEAST-EDUCATED DIE APPROXIMATELY 5 TO 8 YEARS EARLIER THAN THE MOST-EDUCATED IN BOTH THE UNITED STATES AND GREAT BRITAIN. LEVEL OF EDUCATION REPRESENTS AN ENORMOUS INFLUENCE ON MORTALITY, HAVING MORE THAN TWICE THE IMPACT OF CANCER. THE POPULATION NOW 65 AND OVER, HAS 2 TO 3 YEARS LESS EDUCATION THAN THOSE UNDER AGE 65. DURING THE NEXT 25 YEARS OR SO, THE EDUCATIONAL LEVEL OF THE 65 AND OVER GROUP WILL EQUAL ALL OTHER ADULT AGE GROUPS. IT IS LIKELY THAT THIS CHANGE WILL BE ACCOMPANIED BY A STRONG SHIFT AWAY FROM PREMATURE MORTALITY, AND HENCE, INCREASED LONGEVITY, AS WELL, OF COURSE, AS CREATING A LARGER AND MORE ARTICULATE POLITICAL SUBGROUP.

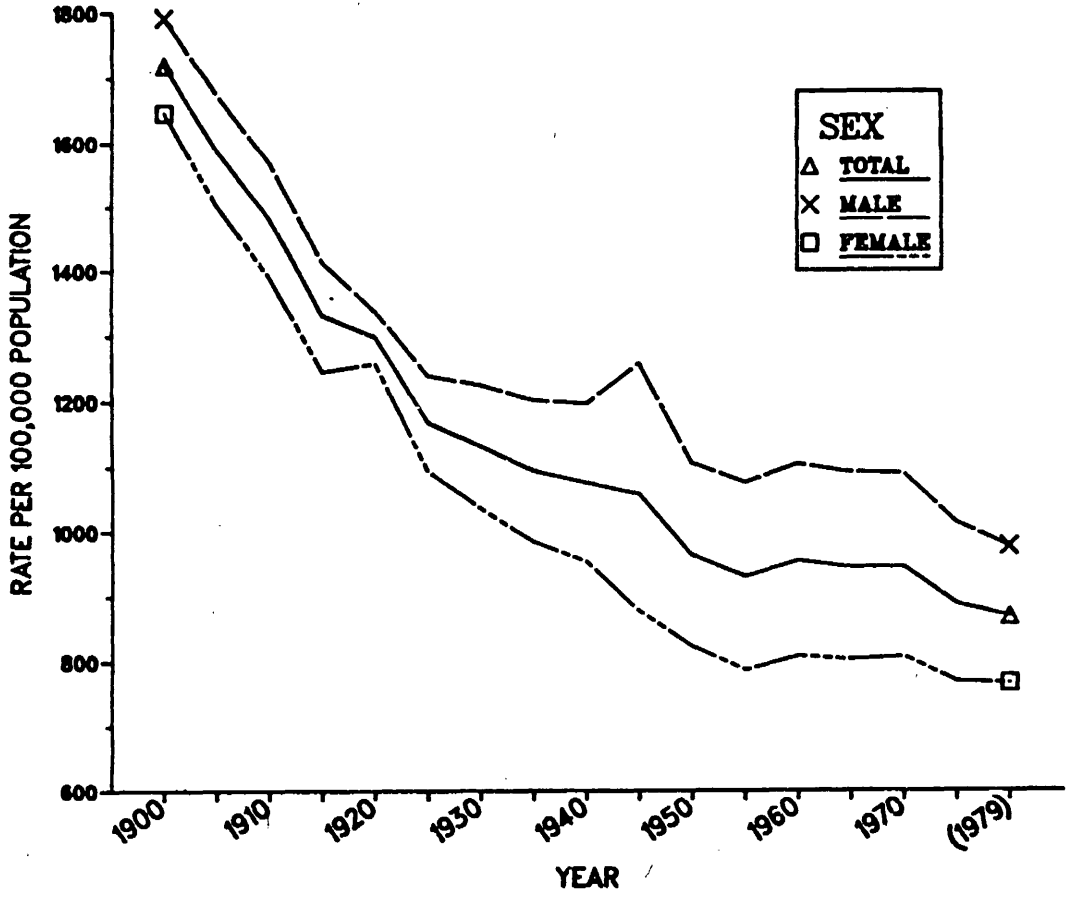
TO SUMMARIZE, THERE IS AMPLE EVIDENCE THAT THE FORCES WHICH INFLUENCE MORTALITY ARE GENERALLY PREDICTABLE, BUT SPECIFICALLY, AND FOR ANY GIVEN PERIOD OF TIME, ARE SUBJECT TO SUBSTANTIAL VARIATIONS. GIVEN THIS INFORMATION, IT BEHOOVES US TO DEVELOP ITERATIVE APPROACHES UTILIZING ALL THE IMPROVING TECHNIQUES OF DATA GATHERING AND ANALYSIS AND COMBINE EPIDEMIOLOGIC METHODS WITH ACTUARIAL TECHNIQUES IN ESTABLISHING PROJECTIONS AND THEIR PARAMETERS.

EPIDEMIOLOGIC INFORMATION COLLECTED FROM ELDERLY POPULATIONS READILY DEMONSTRATES THAT ILLNESSES REQUIRING GREAT EXPENDITURES AND LONG-TERM CARE RISE STEEPLY AFTER AGE 75. WITHIN THE NEXT 10 TO 15 YEARS, ALMOST 50 PERCENT OF THOSE OVER AGE 65 WILL BE OVER AGE 75. THUS, WE CAN PROJECT THAT THE NECESSARY MEDICAL COSTS FOR THE POPULATION SERVED BY MEDICARE AND SOCIAL SECURITY WILL BE MUCH HIGHER THAN AT PRESENT. USING THE MOST ACCURATE DATA AVAILABLE ON CHRONIC CONDITIONS IN THE ELDERLY, WE CAN BETTER APPROACH THE INEVITABLE HEALTH NEEDS OF THIS AGE SEGMENT.

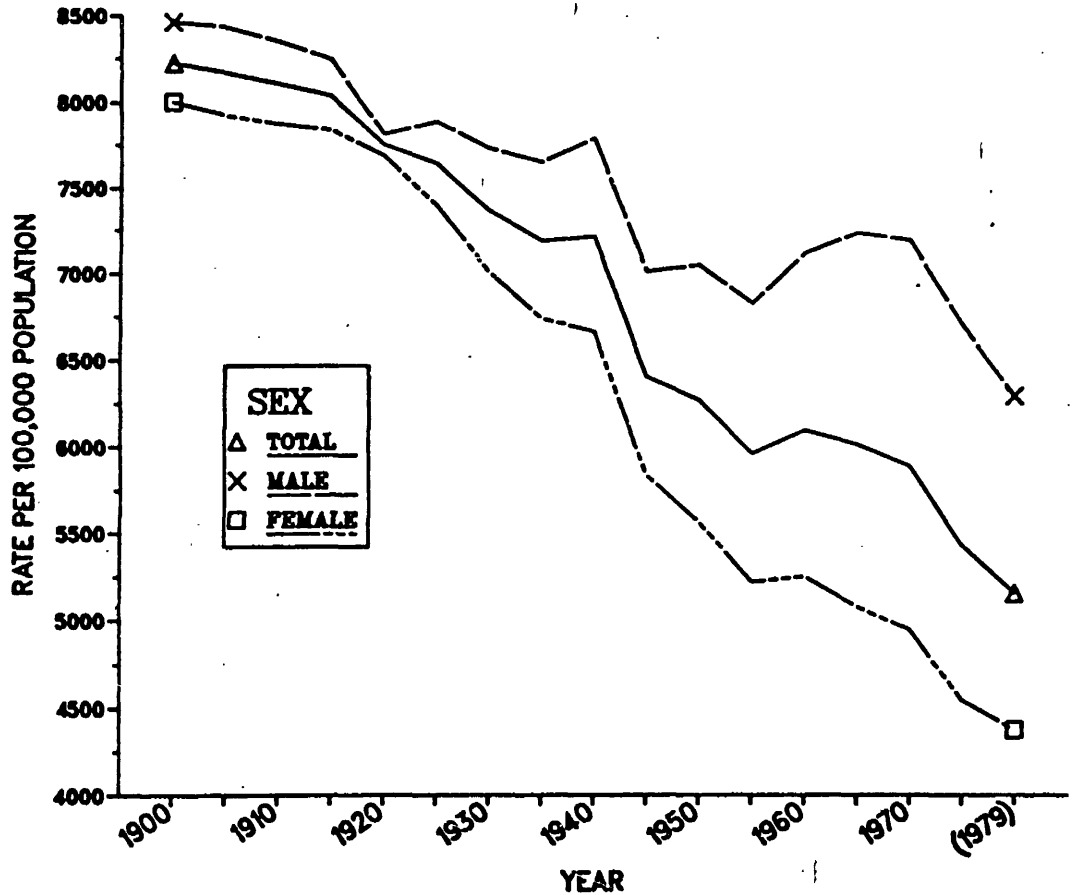
THE NATIONAL INSTITUTE ON AGING HAS DEVELOPED A MACROECONOMIC-DEMOGRAPHIC MODEL (MDM) WHICH UTILIZES A POPULATION MODEL COMBINED WITH ADDITIONAL SECTORS TO PROJECT THE ECONOMY, LABOR MARKET, SOCIAL SECURITY AND PRIVATE PENSIONS, AND MEDICARE EXPENDITURES. ADDITIONAL RESEARCH HAS BEGUN ON LONG-TERM ASPECTS OF HEALTH EXPENDITURES, UTILIZATION, AND HEALTH STATUS. ALTHOUGH OUR STAFF OF EPIDEMIOLOGISTS, ECONOMISTS, BIOSTATISTICIANS, AND SOCIAL SCIENTISTS IS SMALL WE CAN CLAIM SOME USEFUL PROGRESS IN MULTIDISCIPLINARY RESEARCH ON POPULATION AGING. SUCCESS, HOWEVER, IS SLOW IN COMING AND THE TASK IS FORMIDABLE.

THANK YOU, MR. CHAIRMAN. I WOULD BE PLEASED TO TRY TO ANSWER ANY QUESTIONS YOU MAY HAVE.

MORTALITY RATES FOR YEARS 1900–1979, BY SEX (ALL AGES)



MORTALITY RATES FOR YEARS 1900–1979, BY SEX (AGES 65 AND OVER)



Senator CHAFEE. Well, thank you very much, Doctor. I find that very interesting. Is there any information we can gain from other societies that might be helpful? You mentioned the fact that in Britain they have also found that increased education results in, I think, you said an additional 4 years of longevity. What about in Sweden or Japan?

Dr. BRODY. I think certainly Sweden and Japan offer us very important lessons. In both Sweden and Japan, for instance, heart disease mortality is increasing. It is decreasing in the United States, and certainly is the cause for part of our recent life extension. We can see, however, that if heart disease is increasing in other countries in which they are also having major increases in life expectancy, there are bound to be other forces which will drive life expectancy even higher.

What I am saying is that by contrasting the experience in these countries, which are all increasing in life expectancy, it appears that there are many forces which we are not aware of or in control of that will increase life expectancy in the future.

Senator CHAFEE. Dr. Bayo mentioned in his testimony the fact that the changing lifestyles for women will probably influence the life expectancy of women in the future. They are going into the market-place and being subjected to the stresses, presumably, that men have been subjected to.

Do you think there is much to that?

Dr. BRODY. This is certainly a factor, a strong factor. Women are not only in the marketplace but are smoking more and drinking more, which is going to compromise their life expectancy.

On the other hand, there seem to be other strong forces afoot as well, so that in countries in which women have been in the marketplace for many years, such as in Sweden, where the life expectancy for women is still comfortably ahead of males and increasing, although not at the same high rate as in the United States. In general, the female survival advantage is increasing.

Senator CHAFEE. In your testimony you said on the first page, "the array of surprises which have occurred and the degree of humility we must bring to future attempts at making projections." Is it safe to say that the surprises always stem from increased longevity?

Dr. BRODY. During the century, for the most part they have been. However, there were surprises in the opposite direction, which I mentioned in 1980 and 1981 from influenza, and on the data in the curve I showed, from 1950 to 1968 for the elderly there were increases in morality. So, concerning the surprises, while the major thrust was toward an increase in longevity, there are mitigating—I do not know if mitigating is the right word—there are contrary surprises.

Senator CHAFEE. In your conclusion you suggest that we must be alert and try to assemble our information and correlate it. Are there two or three important steps you think we should take to improve life expectancy projections?

Dr. BRODY. I think a most hopeful one is at hand in gaining new types of access to data which are already available in different large Federal data sets. This would be in the social security system, in the IRS, in medicare data itself, the National Death Index, and

large studies conducted by the National Center for Health Statistics and the National Center for Health Services Research and other, nongovernmental and, of course, Government agencies.

These data are being used for very specific purposes but not being linked to learn the maximum from the potential that exists in them. There are some very minor limitations because of privacy legislation. I think these limitations could be overcome with the proper presentation of the cost and scientific benefits that would result from linking already existing data.

Senator CHAFEE. Do you think the Social Security Administration is sufficiently taking into account the forces that are at work now that you mentioned?

Dr. BRODY. It is very difficult for me to get a firm feeling for that. I think I could easily argue that they are not because nobody has spoken to me, but what I really want to say is that there is a limit to the number of data variables they can handle. There is a limit to the number of adjustments you can make in any given model.

I do think, however—as I have tried to present in my statement—that there are very strong and positive areas in the field of biomedical work, certainly at the National Center for Health Statistics and NIH, which I think could be made available to Social Security that are not currently being used.

Senator CHAFEE. What do you say to that, Doctor Bayo?

Mr. BAYO. I agree that we could and that we should continue to extend the research in mortality and particularly determine or try to find out what has been causing the recent fast trend in decline in mortality. This, I think, is a very useful in the projection of mortality into the near future.

As I said in my statement, when you go 75 years into the future, it is very difficult to base it on what has happened recently. After 20 or 25 years we are really in an area that is unknown and possibly with very little relation to what has happened in the last 10 years.

Senator CHAFEE. It seems to me that you could say that about anything. Any projection is difficult for the future and you can always say that you cannot go by what has taken place in the past, but that gives you a pretty good indication.

Let me ask you this, Dr. Brody. You mentioned that the census in 1980 was probably under by, I think you said, 5.5 million. I suppose that these 5.5 million were, for the most part illegal aliens and Spanish Americans would you think?

Dr. BRODY. It is my understanding that that is apart from the illegal aliens, for which there is another estimate. I think Mr. Bayo would know this better than me.

Senator CHAFEE. Do you know, Mr. Bayo?

Mr. BAYO. Mr. Chairman, is it a question with respect to the undercount in the census?

Senator CHAFEE. Yes.

Mr. BAYO. There are several reasons why we have an undercount in the census. It is almost impossible, really, to knock on every door and find every individual there, and so I would say that the majority of it is not related to illegal aliens. There has been tre-

mendous improvement in the level of coverage, but we should expect that there will always be a certain level of net undercount.

Senator CHAFEE. Yes, I would expect that. But what is the effect on the life expectancy as a result of the very substantial increase of Spanish Americans in our society? Is that going to affect it one way or the other?

Mr. BAYO. It will affect it definitely because it is expected that the mortality of the Spanish American will be higher than that of the rest of the population. The question is, by how much and what will be the level. We have 235 million people and 10 percent of the population, at the most, could be included in the Spanish American [that] group. The difference in mortality, although significant, would have little affect on future mortality trends.

I do not know whether that will have that much of an effect in the projections.

Senator CHAFEE. Well, thank you both very much for coming. We appreciate it. You have been very helpful. Thank you, Mr. Bayo, Dr. Brody, and Mr. Wilkin.

[Questions and answers submitted to Dr. Brody follows:]

QUESTIONS FOR DR. BRODY

1. Fundamentally, Dr. Brody, I think we want to know how to develop the best possible projections of life expectancy and mortality. We need to know this—not just for Social Security/Medicare planning—but for many reasons.

Tell me what you think are the 2 or 3 most important steps we should take to improve life expectancy projections by both the government and the private sector? What should we do?

Answer. Among the most important steps to improve life expectancy projections is the better utilization of already collected and existing data which I referred to on page 34, lines 9 to 22. Another is the meld of actuarial and epidemiologic approaches referred to on page 26, lines 15 to 16. This would involve a careful review of available data to determine the most realistic assumptions for future central or intermediate projections as well as the range of error now encompassed in the high and low projections. Epidemiologic and biomedical input should be organized through the Directors of NIH and NCHS. They, in turn, would have access to other federal agencies, state and academic expertise as well as major private sector authorities in the spectrum of fields related to long-term care of the elderly. By involving biomedical thinking we could improve on the currently used assumptions driving the Social Security actuarial model.

2. Dr. Brody, I take it that you do not believe that the current actuarial work of the Social Security Administration sufficiently takes into account the forces at work in the scientific community, and in the society (such as increased education). How should this situation be corrected?

Answer. As discussed in my response to the previous question, we must have epidemiologic and related biomedical and social input monitoring events which have important effects on life expectancy. I have mentioned influenza and levels of education. In addition, we must have measures of available family and household support as well as a better surveillance mechanism for disease-specific mortality. We must learn the causes of the massive decline in heart disease mortality in the United States and how we can influence its continuate decline.

3. Do you agree with the Social Security Administration's intermediate projections for mortality for the next 80 years? Do these projections seem plausible?

Answer. I am not personally comfortable with the Social Security Administration's intermediate projections for the next 80 years. During the next 20 years I believe the low mortality projection is more likely to occur. As I stated on page 29, lines 19 to 23, the real gains from recent medical and social interventions have not been maximized. Further, increased educational levels (page 39, lines 23 to 25) will increase life expectancy. I agree with the Social Security Actuaries that projections beyond 20 years or so become increasingly problematic. After 2005 the Social Security Administration measures change by using a theoretical "ultimate annual percentage improvement." While this provides a mathematical basis for projections to an infinite age, it must ignore the physiologic reality that life span is finite. Cur-

rently life span for the human species is about 110 years. Breakthroughs or manipulations could alter life span, but whether this will happen, and, if the increase will be gradual or slow, and how many additonal years the human species could survive, are even woollier concepts than the "ultimate annual percentage improvement." I believe some extension of life span is probable and I also believe that new diseases (such as AIDS—acquired immune deficiency syndrome) and inevitable events such as major influenza epidemics could shorten life expectancy. I sugggest that through increasing use of the National Death Index of NCHS and Medicare population records we will be able to monitor mortality rapidly and precisely. Short-term projections would be empirical and long-term projections would increasingly based on accumulated actual experience.

4. Are there alternatives to actuarial approaches in making mortality projections?

Answer. I believe that some actuarial approach is necessary and desirable but that we must increasingly use empirical, epidemiologic input. This requires a strengthening of data and data access and an approach outlined in the last two sentences of my response to question No. 3.

5. I understand that in other industrial countries life expectancy is increasing dramatically, but for quite different reasons. Are there any lessions in this experience for us?

Answer. Yes. I would reiterate my response to Senator Chafee's question on page 32. Great research potential toward understanding and improving healthy longevity exists by studying the different and occasionally contradictory appearing patterns by which life expectancy has increased in the United States and in other countries.

Senator CHAFEE. Now, the next panel—Dr. Manton, Dr. Keyfitz, and Dr. Walford—if each of you would please come up. All right, now. Dr. Walford we know—why do we not start with Dr. Manton?

STATEMENT OF KENNETH G. MANTON, PH. D., ASSOCIATE RESEARCH PROFESSOR, CENTER FOR DEMOGRAPHIC STUDIES, DUKE UNIVERSITY, DURHAM, N.C.

Mr. MANTON. Thank you.

The broad range of financial impacts——

Senator CHAFEE. Now we do have a time problem, so could you summarize?

Mr. MANTON. I will collapse it as much as possible. Most importantly is I have three recommendations at the end.

Senator CHAFEE. That is what we always like to hear—recommendations.

Mr. MANTON. At some point you can stop me and I can summarize those three.

Senator CHAFEE. All right, go ahead.

Mr. MANTON. The broad range of financial impacts on both the private and public sector of life expectancy changes places a high premium on forecasting such changes as accurately as possible. Unfortunately, over the last 35 years such forecasts have often underestimated actual mortality declines and underestimated the size of the over-65 population.

A number of factors contributed to these systematic underestimates. First, population scientists tend to view mortality as a realtively stable process. Second, during the period 1954 to 1968 mortality conditions in the United States appeared relatively static. This evidence reinforced the theoretical perspective that human life expectancy had reached levels where biological limits to lifespan would permit little opportunity for improvement.

Furthermore, many of the techniques used to forecast mortality involve simple extrapolations from observed patterns. Forecasts continued to produce underestimates in mortality declines, even after significant declines were observed after 1967.

More recently, forecasts have been prepared by the Office of the Actuary which employ more liberal assumptions about future patterns of mortality declines. Most importantly, the forecasts in the SSA reports are based on mortality trends determined from data covering the rapid declines from 1968 to 1978.

In addition, cause-specific mortality changes are assumed to continue at ultimate annual percentage rates to the year 2080. Thus it should not be assumed that we are near enough to biological limits to the human lifespan to preclude life expectancy improvement, at least through 2080.

Although the 1981 life expectancy forecasts in Actuarial Report 85 represent a considerable increase from prior forecasts, there exist researchers who argue that these forecasts may be too conservative. For example, Crimmins performed projections to evaluate the implications of an assumption made in the forecast in Report 85.

The assumption was that the mortality declines over the period 1968 to 1978 were historically extreme and would be unlikely to continue. Consequently, the observed cause-specific changes were tapered over the period 1981 to 2005 to a postulated ultimate annual percentage change. Crimmins made forecasts where the mortality changes observed 1968 to 1977 continued unaltered to 2000.

Dorothy Rice, former head of NCHS, achieved similar results using a similar methodology, and these were reported in 1978.

Five observations can be made. One, Crimmins forecasts of life expectancy at birth for the year 2000 are 1.4 years higher than the middle mortality variant of the SSA forecasts for males, and 5.1 years higher for females.

Two, the 1981 SSA forecasts for 2000 are much greater than those prepared in 1977. Three, the low mortality variant of SSA forecasts for males and females include Crimmins' forecasts for males, but not females.

Four——

Senator CHAFEE. Do not go too fast here. I read that Crimmins report. I just saw the newspaper account of it. What you are saying is that she based it on the 1977——

Mr. MANTON. 1968 to 1977.

Senator CHAFEE. Whereas in point two here, the Social Security had updated their 1977 report in 1981, is that correct?

Mr. MANTON. Yes. The actuaries have indicated that the mortality assumptions were updated between 1977 and 1981 four times From the Actuarial Report 85 in 1981, the postulated ultimate changes were modified again in Actuarial Report 87, which was published in 1982——

Senator CHAFEE. So I guess what you are saying is that the great discrepancies that Ms. Crimmins noted were not so great given that she neglected to take into account the latest Social Security report?

Mr. MANTON. The later Social Security reports are much closer to her estimates, and their range includes her projected values for males, but did not include—Crimmins' projected life expectancy values for females.

Senator CHAFEE. Is it not very normal to always do both?

Mr. MANTON. To analyze males and females?

Senator CHAFEE. Males and females.

Mr. MANTON. Yes. There are such great differences between male and female life expectancy.

Senator CHAFEE. I know it, but you say that one report did not include Crimmins' forecasts for males. She had a forecast for females.

Mr. MANTON. She forecast values for both males and females. Here numerical estimate was within the range of the alternative 1-alternative 3 values for the social security estimates of male life expectancy; social security used a middle mortality variant alternative 2 and then divided the annual improvement in mortality rates in half for the low values and doubled them, for the high values and this produced a range of estimates.

Crimmin's estimate for males fell within that upper bound of life expectancy change. But for females, Crimmin's estimate fell outside the upper bound, so the uncertainty that the actuaries anticipated would encapsulate what Crimmin's projected for males, but not for females. Consequently, her estimates for females, based on current trends, were higher than the SSA upper range.

Senator CHAFEE. OK. Go ahead.

Mr. MANTON. Because mortality reductions are limited to the postulated ultimate annual percentage changes after 2005 in Report 85, increase over the 20-year period, 1980–2000 is larger than the total life expectancy over the 50-year period 2000–2050. Thus, both the Rice and Crimmins forecasts suggest that the postulated ultimate annual percentage changes in mortality rates are a critical feature of the forecast in Report 85.

To assess the reasonableness of the forecast, one should evaluate the data and analyses by which those values were estimated. Since the process by which the ultimate annual percentage changes were postulated is not well described in the reports, we cannot directly evaluate them. We can ask, however, whether life expectancy levels forecast by Crimmins and Rice are plausible.

Since forecasting life expectancy is difficult and uncertain, fiscal planning should explicitly cover the full range of scientifically defensible alternative estimates. In this assessment we argue that it is not appropriate to evaluate the reasonableness of a set of life expectancy forecasts from the data on which they were based.

This would be a tautology. Assessment of the reasonableness of a set of forecasts must be based on external evidence, in this case biomedical data and theory on human life expectancy and on the impact of medical innovations.

First, Crimmins and Rice's life expectancy forecasts are not inconsistent with rough estimates in changes in life expectancy which biologists suggest could be achieved by eliminating major chronic diseases. Unfortunately, those estimates are based on mortality and are not independent of the data on which extrapolations are generated.

The second type of evidence is available from cross-national studies. For example, we know that certain countries have already achieved male life expectancy levels at birth near the values projected by Crimmins and Rice. In 1981 male life expectancy in

Japan was 73.8. This is one half year less than Crimmins and Rice's projections for the United States in the year 2000.

Is it unreasonable, then, for us to anticipate that we may achieve the same values for life expectancy 19 years after the Japanese? The projected male life expectancy for 2000 in Japan is 77.4, a value which they now anticipate may be too low. The comparable value observed in 1981 for Japanese females is 79.1.

Another important factor is that life expectancy for the current birth cohort is often higher than calculated from the cross-sectional mortality data for the same date. To the extent that we view life expectancy as a biological property of individuals and not a summary index of current mortality rates, the period calculations might also be viewed as biologically artificial. Thus, it may be easier to construct a biomedically motivated model from cohort data.

Additionally, there are often pronounced cohort differences in cause-specific mortality trends. The prime implication of cohort differences is that declines in mortality are likely to be temporarily more persistent than using period data. Thus, we would be more likely to project that mortality rate declines could persist based on cohort extrapolations.

The available quantitative arguments are clearly not definitive but suggest the importance of carefully evaluating the prospects of higher life expectancy changes. Such concern can be argued even more forcefully when we speculate about the effects of technological change and social movements in future life expectancy.

One important factor is that we may be entering a period of major medical advances in the treatment and management of chronic disease. This may be traced to increased funding after World War II of biomedical research in the mechanisms of chronic disease. Systematic research programs on basic aging processes is an even more recent phenomena.

Strehler has speculated that significant interventions in the basic rate of aging might occur in the next 35 years. It seems reasonable to anticipate innovations in the next 100 years.

Noting the time, I think I will jump to some recommendations. At this point we would like to make three suggestions about the process of making life expectancy forecasts.

One, use technical advisory groups. It is not reasonable to expect the Office of the Actuary to evaluate the breadth of scientific evidence we have identified as relevant to making such forecasts. Thus, to aid and facilitate their efforts, we would suggest the creation of two advisory groups.

The first would evaluate epidemiological and biomedical evidence and provide recommendations on how mortality patterns are likely to change and the impact of possible technical innovations. This group would probably best be formed by NIH and NCHS, especially as to how forecasting and technology should be modified to reflect substantive changes and true uncertainty of forecasts.

A second advisory group could recommend how forecasting technology could be modified to reflect substantive changes. This might be formed by the Committee on National Statistics of the National Research Council.

These two advisory groups might serve to increase confidence in that the full range of scientific evidence is being exploited in forecasts and that some hope was offered for anticipating changes.

The other two recommendations simply are that there ought to be standardization or some process for evaluating the actuarial forecasts used by the different Federal programs. The third recommendation reflects upon the numerous programs dealing with the health and social welfare of the elderly where the quality of life changes that are associated with our projected life expectancy changes may be very important parameters in program planning and management.

As a consequence it seems important to forecast how disability and morbidity change in association with the changes in life expectancy. Thank you.

[The prepared statement of Kenneth G. Manton and answers to questions from Senator Chafee follows:]

TESTIMONY ON TRENDS IN PROJECTED LIFE EXPECTANCY IN THE UNITED STATES

Before

U.S. Senate Committee on Finance, Subcommittee on Savings, Pensions, and Investment Policy

by

Kenneth G. Manton
Associate Research Professor of Demographic Studies
Associate Medical Research Professor of
Community and Family Medicine
and
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Forecasts of future changes in life expectancy, especially changes after age 65, are important for estimating the future liability of many federal insurance and pension programs. For example, in one analysis of Social Security Old Age Insurance indebtedness, it was estimated that a one-year extension of the retirement period could increase indebtedness by $250 billion (Boskin et al., 1980). Social Security is just one of many government programs affected. Changes in life expectancy will also be of great importance for private insurance and pension programs as well as for a broad range of governmental programs providing social and medical services (Torrey and Norwood, 1983).

The financial impact of life expectancy changes places a high premium on a.) producing the most accurate forecasts possible, and b.) in the face of the technical complexity and uncertainty in making such forecasts, appropriately developing fiscal strategies to deal with the uncertainty of such forecasts. Unfortunately, as noted by many investigators, over the last 35 years such forecasts have generally underestimated actual mortality declines and underestimated the size of the over 65 population (e.g., Myers, 1981; Siegel, 1978). Furthermore, as noted by both Myers (1981) and Siegel (1978) though the Census Bureau has tended to revise their projections of the over 65 population upward with time, revised estimates have consistently tended to be low. This can be amply demonstrated by the following table of selected official population projections.

Table 1: Selected Official Projections of the United States Population 65 Years of Age and Over, 1950 to 1980, and Reported Population Figures, 1950 to 1980 (figures in thousands)

Date of Projection	Year for Projection						
	1950	1955	1960	1965	1970	1975	1980
Reported	12,397	14,527	16,659	18,156	20,156	22,405	25,544
7/1977							24,927
10/1975							24,523
12/1972						22,170	24,051
11/1971						21,859	23,703
8/1970						21,503	23,492
2/1967					19,585	21,160	23,063
7/1964					19,571	21,171	23,087
7/1962				18,243	20,035	22,040	24,458
11/1958			15,779	17,638	19,549	21,872	24,526
10/1955			15,800	17,371	18,879	20,655	
8/1953			15,701	17,336	18,885	20,689	
†7/1950L		13,310	15,068				
M		13,491	15,491				
H		13,745	16,127				
†6/1947LM	11,306	12,928	14,675	16,310	18,065	19,935	
HM	11,197	12,592	13,993	15,181	16,404	17,690	

†Different Assumptions.

SOURCES: Selected issues of U.S. Bureau of the Census, Current Population Reports, P-25 Series, *Population Estimates and Projections*. (Adapted from Myers, 1981)

Of particular note is the comparison of the size of the population actually enumerated in the census years 1950, 1960, 1970, and 1980 and the projections of that population at various dates. For example, even estimates of the elderly population made by the Census Bureau released in 1977 for the year 1980 were still 617,000 too low--over a three-year year period. It is also important to note that percentage errors in the projections of the size of the component of the elderly population over age 85 seem to be even larger than the age 65-84 group (Myers, 1981). Since the age 85+ group has generally high health and social service requirements, such systematic error will have a much greater per capita effect. Thus, careful attention must be paid to projections of specific components of the elderly population which will have a disproportionate impact on different types of federal and private programs.

A number of factors contributed to these systematic underestimates. First, population scientists tend to view mortality as a relatively stable population process. Hence, compared to other demographic factors (e.g., fertility), mortality receives relatively little attention from researchers. Second, during the period 1954 to 1968 mortality conditions in the United States were relatively static with male mortality slightly increasing over this interval (S.S.A., 1981, report no. 85). Third, the absolute size of changes in life expectancy at older ages tended to be modest when compared with those at birth--even though the proportional changes were sizeable.

This stasis had three effects. One, it re-enforced the perspective that mortality was static. Two, it re-enforced the theoretical perspective that human life expectancy had reached levels

where biological limits to life span would permit little opportunity for improvement (N.C.H.S., 1964). Three, since many of the techniques used to forecast mortality involved extrapolation from observed patterns, forecasts continued to produce underestimates of mortality declines for a number of years after significant declines began in 1968.

More recently, forecasts have been prepared by the Office of the Actuary of the Social Security Administration (S.S.A.) which employ more liberal assumptions about the future pattern of mortality declines. Most importantly, the forecasts in the S.S.A. reports are based on mortality trends determined from data covering the rapid mortality declines from 1968 to 1978. In addition, cause specific mortality changes are assumed to continue at "ultimate annual percentage" rates to 2080. Thus, it is not assumed that we are near enough to biological limits to the human life span to preclude life expectancy improvement--at least through 2080. A series of analytic studies are presented in Actuarial Report No. 87 (S.S.A., 1982) which suggest the human life span may have increased 8.5 years for U.S. females over the period 1900-1980 (from 105.4 to 113.9)*. Although any estimate of a life span increase is uncertain, it is argued in the report that there is little empirical evidence from human populations to support the notion that we are currently experiencing constraints on life expectancy at later ages.

Although the 1981 life expectancy forecasts in Actuarial Report No. 85 represent a considerable increase from prior forecasts,

*The actual measure studied was "life endurancy," or the age to which 1 in 100,000 people would be assumed to survive.

there exist researchers who argue that those forecasts may yet be too conservative. For example, Crimmins (1983a,b) performed projections to evaluate the implications of an assumption made in the forecasts in Actuarial Report No. 85. The assumption was that the mortality declines over the period 1968-1978 were historically extreme and would be unlikely to continue. Consequently, the observed cause specific changes were tapered over the period 1981-2005 to a "postulated" ultimate annual percentage change. Interestingly, the ultimate annual percentage changes "postulated" for 2005 in Report No. 85 were shortly revised to more optimistic values in Report No. 87. Crimmins made forecasts where the mortality changes observed 1968 to 1977 continued unaltered to 2000.

Five observations can be made about the Crimmins and S.S.A. forecasts.

1. Crimmins' forecasts of life expectancy at birth for the year 2000 are 1.4 years higher than the middle mortality variant of the S.S.A. forecasts for males (74.3 versus 72.9) and 5.1 years higher for females (86.2 versus 81.1). The differences between the projections at this point will be smaller than for years beyond 2000 since the tapering of the rates in the S.S.A. projections to the year 2005 were not complete by 2000.
2. The 1981 S.S.A. forecasts of life expectancy at birth for 2000 are much greater than those prepared in 1977. For males and females respectively, the 1981 forecasts are 72.9 and 81.1 (medium variant), whereas just four years previously in 1977 they were projected to be only 69.6

and 77.4--forecasts which were surpassed in 1980 when provisional life expectancies of 70.0 and 77.7 were calculated (N.C.H.S., 1982).

3. The low mortality (optimistic) variant of S.S.A. forecasts for males (75.9) and females (84.9) include Crimmins' forecasts for males (74.3) but not females (86.2). A similar pattern is noted for life expectancy at age 65 (i.e., 17.4 and 24.2 versus 16.4 and 25.6).

4. Because mortality reductions are limited to the postulated ultimate annual percentage changes after 2005 in Report No. 85, increases over the 20-year period 1980-2000 are larger than over the 50-year period 2000-2050 (i.e., for males 3.1 years versus 2.1 years; females 3.4 years versus 2.5 years).

5. Dorothy Rice, former director of the National Center for Health Statistics, also made an alternate set of forecasts which she reported in 1978. She notes that:

   "One cannot be certain whether the momentum of the past will continue. Will death rates from diseases of the heart continue to decline? Will those for malignant neoplasms continue to increase? Even our foremost biostatisticians, epidemiologists, and other scientists disagree on the answers to these questions. But since we are not certain of the factors associated with trends in these major causes of death, it is quite difficult to find an effective substitute for extrapolating past trends as the basis for projecting the future health status of the United States." (page 5).

The forecasts conducted by Rice (1978), although using a

slightly different period (1966 to 1976) to calculate mortality trends and a different methodology (i.e., extrapolation of total mortality), produced estimates for the year 2003 similar to those projected by Crimmins (i.e., 74.2 versus 74.3 for males and 84.2 versus 86.2 for females).

The conclusion to be reached from both the Rice and Crimmins forecasts is that the postulated ultimate annual percentage changes are a critical feature of the Report No. 85 forecasts, especially for forecasts after the year 2000. Thus, to assess the reasonableness of the forecasts one should evaluate the data and analyses by which those values were estimated. Since the process by which the ultimate annual percentage changes were postulated is not well-described in the reports, we cannot directly evaluate them.

Instead, we must proceed indirectly and determine whether life expectancy levels forecast by Crimmins and Rice are plausible. In one way this may be even more important than evaluating the middle variant of the S.S.A. forecasts for this will tell us the likelihood of experiencing even more extreme life expectancy increases. By "plausible" we do not necessarily mean "most likely". This is because we are assuming that a prudent approach to financing is to maintain adequate resources to cover reasonable variations in outcome. Since our perspective is that forecasting life expectancy is a technically difficult and uncertain task, we would argue that fiscal planning should explicitly consider the full range of scientifically defensible alternative estimates. Assessing the full range of scientifically plausible projected life expectancy values and selecting a reasonable upper bound figure is a procedure

that must be justified by identifying the different types of risks in accepting any one set of forecasts for the purposes of planning. The operational principle in producing life expectancy forecasts, at least up to the forecasts presented in Actuarial Report No. 85, seems to be one of "scientific" conservatism. That is, based upon existing data and a wide range of scientific opinion the forecasts were constructed to project what were then perceived as scientifically conservative values of future life expectancy. There are a number of legitimate questions about whether these estimates were the best that could be achieved. Putting technical issues aside, it seems that the fiscally conservative approach would have been to plan on plausible high values. The implications of the errors of such an approach seem to be simply to generate reserve funding.

The assumption that alternative projections could be generated by assuming that Alternative I and III annual improvements averaged "half and twice the Alternative II improvements" (p.7) probably does not adequately represent the true degree of uncertainty in those forecasts. Such a practice will tend to give a very narrow confidence interval when anticipated changes in mortality are small, and a large interval when anticipated changes are large. For example, if one were to assume no change in the mortality rates, all three alternatives would be identical (i.e., a range of 0.0) using this procedure. That is, the range of projections is a function of the assumptions rather than of the data and, hence, could be viewed as tautological. Furthermore, the high and low mortality alternatives will likely produce overly broad ranges for short-run projections and too narrow ranges for longer-run projections because of the way stochastic error will propagate over time. A more satisfactory procedure would be based on explicit analytic consideration of the empirical variation of mortality conditions in the past. Even such

a time series analysis of the variance of past mortality will not, however, be able to anticipate major technological innovations. For example, it should be recognized that Rice's and Crimmins' projection of future life expectancy changes are, by no means, the most extreme. There are a number of biologists (e.g., Strehler and Walford) who argue that we may experience major changes in life expectancy due to the development of practical life span extension technologies.

In an assessment of the plausibility of the Rice and Crimmins forecasts, we argue that it is not appropriate to evaluate the reasonableness of a set of life expectancy forecasts from the data on which they were based. This would be tautological. Assessment of the reasonableness of a set of forecasts must be based on external evidence--in this case, biomedical data and theory on human life expectancy and on the impact of medical innovations on a wide range of morbidity/mortality processes. Indeed, forecasting by extrapolating past trends in mortality rate changes will be sensitive to the interval over which past trends are measured. Additionally, forecasts based on the extrapolation of past trends will be unlikely to anticipate changes in mortality patterns due to significant improvements in medical technology, advances in life span extension, or major changes in lifestyle.

First, the higher projected life expectancy values estimated for the year 2000 do not seem to be inconsistent with the rough estimates of the changes in life expectancy which Strehler (15 years--1975), Hayflick (20 years--1977), and Fries (upper limit of 85.6 years--1980) suggest could be achieved by the elimination of

mortality from major chronic diseases (i.e., without an alteration of biological life span). Unfortunately, the estimates produced by Strehler and Hayflick from life table analyses and the estimates produced by Fries' extrapolation procedure are all based on U.S. mortality data and thus are not independent of the data used in determining trends for extrapolation. Furthermore, they are based on methodologies (i.e., cause elimination strategies for Strehler and Hayflick; extrapolation of rates of change in age specific life expectancy for Fries) that are subject to certain technical criticisms (Manton, 1982).

A second type of evidence is available from cross-national studies of mortality patterns. For example, we know that certain countries have already achieved male life expectancy levels at birth near the values projected for 2000 under the assumptions made by Rice and Crimmins that the recent rate of life expectancy improvements could continue. In 1981 male life expectancy of 73.8 years has been observed in Japan (Koizumi, 1982). This is about one-half year less than that projected by Rice and Crimmins for the United States in 2000 assuming a continuation of the current rate of mortality reductions. It is also equal to the "best county composite" estimate of life expectancy based on observed mortality patterns in 1974 (Siegel, 1978). Is it unreasonable, then, for us to anticipate that we may achieve the same values for male life expectancy 19 years after the Japanese? The comparable value observed in 1981 for Japanese females is 79.1. This is also close to the best country composite estimate of life expectancies (79.4) based on the mortality experience of 1974 (Siegel, 1978). We might also note

that efforts to project limits on life expectancy change based on observed patterns are themselves endeavors which led to revisions as projections of ultimate life expectancy values were approached and then exceeded (e.g., Bourgeois-Pichat, 1978). Thus, extrapolation of mortality conditions based on international experience may also tend to understate what is biologically feasible in mortality reductions.

Another important factor in evaluating the likelihood of continuing major increases in life expectancy is that the life expectancy for the current birth cohort is often higher than calculated from the cross-sectional (or period) mortality data for the same date (Jacobson, 1964; Dublin and Spiegelman, 1941; Myers, 1981). This is because the period mortality rates for later ages reflect the generally higher mortality rates of older cohorts.

Furthermore, to the extent that we view life expectancy as a biological property of individuals and not a summary index of current mortality rates, the period calculations might be viewed as biologically "artificial." Thus, it may be easier to construct a biomedically-motivated model from cohort or partial cohort data (Manton et al., 1981). Additionally, there are often pronounced cohort differences in cause specific mortality patterns (Patrick et al., 1982; Manton and Stallard, 1982). One important implication of a major component of cause specific mortality declines being a product of cohort differences is that such declines are likely to be temporally more persistent. Thus we would be more likely to project that mortality rate declines would persist based on a cohort extrapolation model. The primary restrictions on cohort models are more stringent data requirements.

The available quantitative arguments are clearly not definitive, but suggest the importance of carefully evaluating the prospects for life expectancy changes higher than those currently projected. Perhaps the reasonableness of concern over such prospects can be argued even more forcefully when we speculate about the effects of technological change and social movements on future life expectancy.

One important factor is that we may be entering a period of major medical advances in the treatment and management of chronic disease. This may be traced to the increased funding after W.W. II of biomedical research into the mechanisms of chronic disease. Given that systematic research programs on basic aging processes are an even more recent phenomenon (N.I.A. initiated in 1976, see Strehler, 1977), it might be reasonable to expect significant interventions in the basic rate of aging in the next 35 years (Strehler, 1975). Certainly it is reasonable to anticipate innovations in the next 100 years.

Such speculations raise questions about how life expectancy forecasting techniques should possibly be modified--especially to reflect mortality changes at later ages. In particular, there are a number of medical and epidemiological questions that might be raised in extrapolating mortality rates for major causes of death. For example, the category of malignant neoplasms is a quite heterogeneous collection of diseases with much of the recent modest increases attributable to lung cancer. Thus the cause of death categories used for projection may aggregate over diseases with different trends making it difficult to anticipate future changes. Certain investigators have argued that deaths at later ages are often mis-

takenly assigned to various disease categories and that mortality from aging processes should often be diagnosed as a discrete pathological entity at later ages. Though a highly speculative notion, this would call into question the use of a cause specific strategy for forecasting future mortality rates--especially at later ages. Others have questioned the assignment of deaths to certain disease categories (e.g., it has been argued that Alzheimer's disease might be the fourth leading cause of death). Research has also indicated the importance of multiply-caused death at later ages (Manton and Stallard, 1982). Since N.C.H.S. has released multiple cause mortality data for most years 1968-1979, forecasts could be based on data with considerably more information on morbid and mortal processes. Finally, all of these arguments suggest that we may need to conduct a basic conceptual re-assessment of morbidity and mortality at later ages (Manton, 1982)--a re-assessment that might lead to alternate modes of forecasting.

Another important factor in projecting life expectancy change is that policy commitments will affect whether life expectancy changes that are technically feasible are achieved. Their achievement will depend on the national level of commitment to health service delivery and the improvement of health status among the elderly. Such factors represent a series of imponderables that will be difficult to represent in any series of mortality forecasts. Nonetheless, the sensitivity of the life expectancy forecasts to such changes could be assessed. Precedents for this are found in Japan where several major econometric studies of population aging, including health status and life expectancy change, have been conduct-

ed (Ogawa, 1982; Nihon University, 1982).

Finally, one should be aware of the potential impact of certain social phenomena on life expectancy change. First, there are many groups involved in health promotion through nutrition and exercise. It is notable that one strategy for life span extension that has been proposed, based on scientific evidence from animal models, relies upon modification of nutrition. Many other groups are involved with educational programs to control certain major risk factors. Recently we have seen evidence of their efficacy, e.g., smoking levels have moderated in certain population groups in the United States. More recently, we see the emergence of groups explicitly concerned with longevity and life span extension (e.g., the American Longevity Association). This suggests that if the technology becomes available for life expectancy increases, there is considerable public interest and motivation to employ it.

At this point, we should like to make three recommendations for improving the process of making life expectancy forecasts.

1. Technical Advisory Groups--It is not reasonable to expect the Office of the Actuary to evaluate the breadth of scientific evidence we have identified as relevant to making forecasts. Furthermore, it is undesirable to constantly change forecasting procedures and assumptions. Thus, independent advisory groups could fully evaluate both new methods and substantive insights before making recommendations about possible changes in forecasting. Thus to aid and facilitate their efforts, we suggest the creation of two advisory groups.

The first would evaluate epidemiological and biomedical evidence and provide recommendations on how mortality patterns are likely to change, and assess the impact of possible technical innovations. This advisory group would probably best be formed by the National Institutes of Health and the National Center for Health Statistics.

Second, it is important that advice on forecasting and statistical technology be available--especially as to how forecasting technology should be modified to reflect substantive changes and the true uncertainty of forecasts. The trend extrapolation methodologies typically employed in forecasting life expectancy might be considered primitive by statisticians and mathematicians specializing in time series modeling and forecasting. This would be especially true of the ways in which the uncertainty of future forecasts is assessed. Such a committee might be formed by the Committee on National Statistics of the National Research Council.

The impact of these two advisory groups may be as much to increase our confidence in mortality forecasts as to actually change forecast values. At least we would feel confident that the full range of scientific evidence was being exploited and that some hope was offered for anticipating changes.

2. Standardization--It has been found that there is considerable variation in the actuarial statistics used by various federal insurance and pension programs. For example, the

Federal Reserve uses Group Annuity tables from 1951 when life expectancy at age 65 was 15 percent less than it is today (Torrey and Norwood, 1983). Given the fiscal significance of life expectancy forecasts, it seems critical that standards are established for federal agencies and programs to insure that they are employing the most current and up-to-date forecasts. Questions of such standardization might appropriately fall to executive OMB.

3. The Association of Health Status and Functional Change With Life Expectancy Changes--The fiscal commitment of many federal agencies may be dependent on how functional and health status changes as life expectancy is increased. This is particularly true for the very old population (i.e., ages 85+) whose need for health and social services is likely to be high but for whom forecasts have even greater biases than the total ages 65+ population. Thus, projections of the changes in "quality of life" perhaps should be conducted in parallel to changes in "quantity of life." Conceptual models for integrating forecasts and estimates of life expectancy change with morbidity and disability have been developed and actually employed to assess the health status of the Japanese population. These issues are certainly of great importance in assessing entitlement age issues. Some such efforts are necessary though the Office of the Actuary may not be the appropriate agency to undertake them.

Given the immediacy and magnitude of the implications of mortality changes for Social Security and many other federal, state, and private programs, it seems reasonable that serious attention be paid to the process for making such forecasts and to any possibility for improving the quality and public and scientific credibility of that exercise.

Where does this go. Don Mason

SENATE TESTIMONY

I. There Are Two Specific Steps That Should Be Undertaken To Improve Our Life Expectancy Projections

A. Increase the Range of Scientific Input to the Forecasting Process

Current procedures for making life expectancy projections do not adequately take into account the range of scientific evidence that must be considered if those projections are to be fully scientifically credible. The additional scientific input that must be taken into account is both substantive and methodological in nature.

i.) Necessary substantive inputs

Forecasting future morbidity and mortality risks is a topic of considerable complexity and one for which there exists a wide range of evidence derived from numerous epidemiological studies. Two particular substantive inputs need to be incorporated into these forecasts. First, medical advances related to prevention, early detection, and therapy must be assessed. Assessing the impact of innovations in clinical science and life span extension is a complex and hazardous task. Nonetheless, one can probably make reasonable guesses about the likely impact of such innovations in the next 20 to 30 years based upon a.) the current level of effort in basic biomedical and clinical studies and b.) the current status (i.e., primary findings) of research in those areas. Second, changes in the distribution of risk factors among generations need to be considered. The increase in education, athletic participation, nutrition, and changes in smoking and drinking behavior and other known risk factors need to be factored into the forecasts of

life expectancy based on current findings.

Thus, a technical advisory board should be formed to aid the forecasting efforts of the Social Security actuaries by collecting information on the status of basic and clinical science as well as risk factor distributions and by helping the actuaries assess the likely implications of these factors for future life expectancy changes. For example, such an advisory group could help assess the likelihood of basic breakthroughs in life span extension technology which a number of well known scientists (e.g., Strehler and Walford among others) believe are possible. Such a scientific advisory board could be formed by the National Institutes of Health (e.g., N.I.A.) and draw upon the current leaders in biomedical research.

ii.) Necessary methodological inputs

The current methodology for making life expectancy forecasts do not take advantage of a wide range of statistical and mathematical techniques that have been developed for modeling time series data and in forecasting. Such technical innovations in forecasting must be evaluated in order to determine how the current forecasting methodology should be improved. We feel that the procedures currently employed in forecasting life expectancy would not, for example, be viewed as adequate for modeling time series and forecasting by the statistical and scientific community. For example, the forecasting technology used in the evaluation of many individual Defense Department applications is considerably more sophisticated than the technology used in forecasting life expectancy changes--even though the fiscal impact of each of those individual defense programs will be far smaller. Of particular emphasis in the

development of new forecasting procedures should be the assessment of ways in which more realistic assessments of the variation in life expectancy forecasts could be produced. Such a committee should draw upon experts in the current "state of the art" in forecasting. Such a committee should properly be formed by a group such as the Committee on National Statistics at the National Research Council. Naturally the efforts of this committee on statistical methods and the scientific advisory committee on biomedical and epidemiological factors should be strongly coordinated.

B. Implement a Formal Review Process for Life Expectancy Projection

Forecasts of life expectancy changes are important for over 51 retirement programs for federal workers, in addition to Social Security and private plans. Currently there appears to be little coordination or standardization of forecasts used for program planning. Thus it seems essential that a review process be implemented to assess life expectancy forecasts to achieve the following goals.

1.) Standardization

It is desirable to insure that federal programs are using credible, up to date life expectancy forecasts. The available evidence suggests that there is a wide variability in the currency of the life expectancy forecasts used by various programs. Clearly then a commission to insure that minimal standards are met is necessary.

2.) Credibility

Forecasts of future life expectancy change must not only be as accurate as possible but also credible. It is likely that a process for reviewing the life expectancy assumptions for various

federal programs could greatly increase their credibility. Specifically, such life expectancy assumptions are one component in determining the future liability of these programs. The failure to have an independent review of these assumptions is analogous to a failure to have an independent audit of the financial status of a corporation. If a total reliance on an internal audit of the assets and liabilities of a corporation is not credible in the corporate world then the failure to independently audit the assumptions determining the future liability of federal pension or insurance programs can be no more credible. A further current practice that adversely affects the credibility of life expectancy forecasts is the continual adaptation of mortality assumptions for long range forecasts. It is difficult to have confidence in forecasts that have been revised so often. An independent review commission could possibly resolve this difficulty.

3.) Assurance that policy goals are met

Currently many policy goals and Congressional actions must be implemented through a series of technical decisions. It is possible that those technical decisions can influence or even determine the outcome of policy and Congressional actions. It is necessary to have an independent assessment of whether the technical decisions will implement the intent of the policy or Congressional action. For example, a fiscally conservative approach to life expectancy forecasts is to attempt to insure that the bias in forecasts is toward over estimation. This will imply a tendency to have adequate funding even in the face of short-run variations. With such policy it would not be necessary to "adapt" and "fine tune" life expectancy forecasts so often.

Operationally, executive OMB has the responsibility for standardizing a broad range of government technical applications. For example, federal data collection efforts (down to the actual design of questionnaries) are currently reviewed by them. It would thus seem appropriate that they perform this independent review.

II. The Effects Of An Aging Population

I do not believe that it is utopian to expect people to begin new careers after age 62 or 65 for a number of reasons. First, increases in life expectancy at later ages is a relatively recent phenomena. Current retirement plans made by individuals may not take this situation into account. Thus average age at retirement and labor force participation of those over 65 have been declining even as life expectancy has increased. Second, there are many international examples where persons remain actively involved in the labor force, though possibly in a modified role, at later ages (e.g., Japan). Third, there are currently many economic and institutional pressures to retire. If these barriers were removed, persons might choose the greater economic benefits of remaining in the workforce. Finally, recent scientific evidence from a number of groups suggests that the functional status of older persons can be improved even at fairly advanced ages. If the potential for regaining such functional capacity is great then certain types of retraining programs could be instituted to retain older workers in the labor force.

These factors must be considered in the face of certain caveats. First, the desire to remain in the labor force will strongly be related to the nature of the job held by a person. For example, construction workers might be very difficult to retain in

the labor force. With the shift of the economy to a high technology basis, this may be less of a hindrence to continued labor force participation than in the past. Second, one must carefully consider the "social contract" that is implied by the current social insurance system. That is, for workers currently paying into the system there has been created an expectation of certain retirement benefits. Thus, if changes are to be implemented they must be implemented far enough in advance that expectations generated by this social contract are fulfilled. This is one reason why constantly adapting life expectancy forecasts to current conditions will not be satisfactory.

III. Problem of Mortality Forecasting For Retirement Plans

The current liability of any retirement or pension program will be determined by the number of persons currently in the system and the average number of years they can expect to live. Thus, life expectancy must be an important determinant of the current indebtedness of such programs. Clearly a wide range of factors must be considered in the assessment of the fiscal soundness of any program. For example, current fertility rates will determine the number of workers who will enter the labor force 20 to 25 years later to support the retired population. Economic conditions and unemployment rates may also affect the availability of funds to meed current liability. Current fertility rates will affect the number of retirees 65 or more years in the future. Though all of these factors deserve consideration, it is still evident that life expectancy is an important determinant of program liability and it is probably the factor that has received the least attention by researchers and policy planners. It is also a factor over which there is considerable uncertainty about the implications

of certain basic scientific breakthroughs and technological innovations (i.e., life span extension technology).

IV. Life Expectancy Trends In Foreign Countries

There are several lessons to be derived from a study of life expectancy trends in foreign countries. First, there are several countries that have achieved life expectancies greater than in the U.S. For example, life expectancy at birth in Japan in 1981 was 73.8 years for males and 79.1 years for females. An even higher life expectancy for females is claimed in Iceland. The 73.8 years achieved for Japanese males in 1981 is particularly notable, given the value of 74.2 and 74.3 years for U.S. males in 2000 extrapolated by Crimmins and by Rice. It strongly implies, for males at least, that there are no biological limits to prevent achievement of much greater life expectancy levels in the U.S.--especially for males. It should also be noted that increases in life expectancy have not been universal in developed countries. For example, increases in Eastern European countries have been smaller than in the West, with the Soviet Union apparently experiencing decreases in life expectancy. Male life expectancy in the U.S.S.R. reached a peak of 66 years in the mid-60's and dropped to only 64 years in 1971-72. Soviet mortality data have not been reported since 1972 and there have been few recent studies of those trends. Indeed it seems to be explicit Soviet policy not to report current life expectancy levels and mortality conditions. The situation for Soviet females is somewhat different, with female life expectancy being similar to that for Eastern European females (~74 years). These declines for males suggest that life expectancy increases are not inevitable and that a failure to actively pursue improved

health can lead to actual declines in life expectancy.

It is also instructive to note that officials in Japan are very concerned about their planning which did not take into account the rapidity and magnitude of the life expectancy changes they experienced. Their calculations show that economic growth and public expenditures are very sensitive to assumptions about life expectancy change. Furthermore, causality in the reverse direction (i.e., of the effects of economic growth and public expenditure on life expectancy) must be recognized. This is why the Japanese have explicitly included health status and life expectancy in econometric models of their pension and social security systems.

It should also be noted that many developed countries have achieved their current life expectancy levels by different pathways i.e., by reducing the mortality risks of different diseases. For example, stroke was the number one cause of death in Japan in 1980 with rates (139.7 per 100,000) much higher than in the U.S. If the Japanese could reduce the stroke mortality rates to U.S. levels, they could considerably increase their already high life expectancy levels. Likewise, if the U.S. could reduce the heart disease mortality rate to Japanese levels we could also achieve major increases in life expectancy. This suggests a considerable potential for increases in life expectancy due to the elimination of chronic disease risks.

Senator CHAFEE. Your definition of quality of life depends how fit the person is and whether they can participate and function as an active human being, as opposed to somebody who is ill in a nursing home?

Mr. MANTON. Right. Quality of life should be considered explicity in terms of both morbidity and disability which would reflect the ability to maintain normal daily functions.

Senator CHAFEE. All right. We will have some questions for you, but let us take Dr. Keyfitz.

STATEMENT OF NATHAN KEYFITZ, DEPARTMENT OF SOCIOLOGY, OHIO STATE UNIVERSITY

Mr. KEYFITZ. Thank you, sir. I was only informed of this as recently as Tuesday, and so I did not have a chance to prepare a written statement.

Senator CHAFEE. That is all right.

Mr. KEYFITZ. But I did have a chance to get on my microcomputer and make some calculations, and I have a few copies here.

Senator CHAFEE. Good. I want to say to all the witnesses that we appreciate your coming on and helping us out. I know under the austerity rules of the Congress we do not pay witness transportation, which you are painfully aware of. So we are grateful to each of you and the other witnesses today for taking the trouble.

All right, Dr. Keyfitz, go to it.

Mr. KEYFITZ. What I did was to make an independent forecast of the population of the United States and the population of working age, the population 65 years of age and over, not because I know the future better than anybody else, but because I have studied the past and I am able to make the assumption that the variation in the future is going to be similar to the variation in the past.

And that is what these are based on. The assumption gives a range on which you can bet 20-to-1 odds the future population will lie.

Senator CHAFEE. Do I understand what you are saying? You are basing your statistics on what has happened in the past?

Mr. KEYFITZ. That is right, including the trend of past improvement, and especially including the variation, the unanticipated variation in the past.

Senator CHAFEE. All right.

Mr. KEYFITZ. I will not ask you to look at all the numbers here but in the lower righthand is a figure 519.36 on the first page, which is the ratio of people of retired age, people of 65 and over, to those 20 to 65, in what Mr. Bayo had called the worst case.

Senator CHAFEE. If people live longer?

Mr. KEYFITZ. Yes. So if you look along that line you will see how in this case we start at about 200 per 1,000—that is the present condition—and then we do not get much worse until about the year 2010.

Senator CHAFEE. Perhaps if the other witnesses had this, then they could follow along, because we would be interested in their comments. Now, Doctor, you have to speak right into that mike.

Senator CHAFEE. We are on the bottom line of the first page, is that right, not quite the bottom line?

Mr. KEYFITZ. That is PR for premium, that is to say, the ratio of the 65 and over to those 20 to 65.

Senator CHAFEE. For instance, the last figure is 519.

Mr. KEYFITZ. That is right.

Senator CHAFEE. In the year 2035, what does that figure 519 mean?

Mr. KEYFITZ. That tells you that for each 1,000 people of working age, there will be 519 drawing.

Senator CHAFEE. Over 65?

Mr. KEYFITZ. That is right. This is the worst case and the next page gives you the middle case.

Senator CHAFEE. And if you go back on that in 1980, let's take 1985, it is just about 200 people over 65.

Mr. KEYFITZ. Per 1,000 20 to 65.

Senator CHAFEE. Per thousand people over 20.

Mr. KEYFITZ. Per thousand, 20 to 65.

Senator CHAFEE. Per thousand contributors. I see. So, in other words, it is 5 to 1.

Mr. KEYFITZ. Yes, that is right. One of the things this tells you is that present difficulties in the social security position really are not due to demographic causes—not yet. Those demographic causes will really start to operate around the year 2010, so we will have all of our present troubles, plus the demographic ones starting in the year 2010—

Senator CHAFEE. Because in 2010 this thing really starts shooting up, from 234 to 273, to 326, to 399, to 474, to 519. These figures represent the number of people drawing to the per thousand contributors.

[Prepared statement of Nathan Keyfitz follows:]

Statement of Nathan Keyfitz
Andelot Professor of Sociology and Demography
Harvard University
Robert Lazarus Professor of Social Demography
The Ohio State University
To the Senate Committee on Finance
Subcommittee on Savings, Pensions, and Investment Policy
July 15, 1983

Summary

The short version of my statement is

1. The present difficulties of social security and those in prospect up to the year 2015 are not primarily due to demographic but to economic causes.
2. If past tendencies continue the extension of life will indeed impose a burden on the program, but low births subsequent to the baby boom will have greater effect.
3. An unprecedented extension of the life span, of which there is so far no sign, would have the most drastic consequences for social security.
4. Experience shows that forecasts are subject to substantial error, and this has not so far been adequately taken into account in planning taxes and benefits.

My contribution consists in measuring these effects.

Pay-as-you-go Rests on Increase of Population and Income

On the system of social security that we have in the United States and Western Europe, increase of population and of income provide a quasi-interest to participants. If over a long period population increases at 2 percent and income at 5 percent, then it is a mathematical fact that participants will obtain an effective 7 percent per annum on their contributions. The

statement is true whether expressed in money terms or in fixed dollars. Something like that condition has held in the past; it cannot be counted on for the future. Slowing of population and economic growth shows through as rising costs in relation to benefits. The public is disappointed that present generations cannot expect the generous return that our parents had.

For this purpose change of population and change of income are equivalent. The dollars earned by those 20-65 provide the incomes to those 65 and over. If the dollars subject to social security tax keep increasing, that is just as good as the population increasing; a given fraction of current income paid in tax and divided among the beneficiaries will provide them with a generous return on what they contributed in their time.

TABLE 1 shows the cost to current wage-earners of a fixed benefit of $1000 to those past 65. Under each percent rate is the payment that must be made per $1000 benefit if the number of wage-earners has been rising at the percent given. The percent increase of the population or of the economy will continue to provide quasi-interest in the future, but at a lower rate than it has in the past.

Social security was intended to help the working man, and for several decades it did, but we have now moved into a more nearly stationary condition in which the working man will obtain a smaller return on his investment through social security than he would if allowed to invest the same funds in bonds or equities. No alteration of demographic conditions is likely to change this; we are not going back to 5-child families.

TABLE 1. RATIO OF POPULATION AGED 65+ TO THAT 20-64 WITH VARIOUS LIFE EXPECTANCIES AND RATES OF POPULATION INCREASE (PER THOUSAND PERSONS)

EXPECTATION OF LIFE	RATE OF INCREASE OF POPULATION				
	-1%	0%	1%	2%	3%
73	418	300	213	151	106
76	471	337	239	168	118
79	532	379	269	189	132
82	603	429	303	212	148
86	687	487	343	240	166

With pay-as-you-go the burden depends on expansion, and the above table shows in what degree. It can be interpreted as the effect of the expansion of the population or the economy or both. If our population had been increasing at 3 percent per year we would have a ratio of drawers to contributors one third as large as if we were stationary: 106 per thousand against 300 per thousand. The burden goes up from 300 to 487 under stationarity as life expectancy rises to 86 years, but even a moderate rate of increase could offset this. If we compare 0 percent increase at the present expectancy of 73 years to 2 percent increase with an expectancy of 86 years, the burden falls from 300 to 240. Expansion of the economy has a similar effect if the burden of contribution is reckoned as a fraction of wages.

The prospects starting about 2020 are dismal. The estimate in the last three lines of TABLE 2, assuming the continuance of present fertility and a fall in mortality only about half as fast as during the 1970s, gives the number of persons aged 20 to 64 and the number 65 and over. For what is left of the 20th century the two rise at about the same rate, but in the 21st century pensionable persons rapidly outstrip those of working age. The demographic component of the tax per $1000 of pension more than doubles, rising from less than $200 to over $400. This rise can be disregarded for the next 30 years, but after that it will hit hard. To fail to provide for it in advance causes inequity between the generations.

Our medium estimate of TABLE 2 was worked out independently of the United Nations and of the U.S. Bureau of the Census, but it comes close to their results. Thus we have (in thousands):

Year	Present paper	UN 1980 assessment	USBC 1983
1980	226,506	223,233	226,506
2000	268,264	263,829	267,990
2020	299,075	298,986	296,339
2040	315,468		307,952

differences far less than the error of any of the estimates.

The projection (TABLE 3) that shows the prospects of social security in the worst light is the one that has low fertility, low mortality, and low immigration. (Note that this does not give the lowest possible population, which would be obtained with high mortality.) The wide range of uncertainty in the numbers of

TABLE 2. POPULATION PROJECTION FOR THE UNITED STATES FROM 1980, WITH PRESENT FERTILITY, MORTALITY DECLINING AT ABOUT ONE HALF THE RATE OF THE 1970S, AND NET IMMIGRATION OF 700,000 PER YEAR; thousands of persons.

	1980	2000	2020	2040	2060	2080	2100
0-	16,344	16,884	17,118	16,782	16,560	16,466	16,380
5-	16,697	17,880	17,531	17,037	16,909	16,824	16,717
10-	18,241	18,803	17,614	17,316	17,287	17,155	17,030
15-	21,162	18,859	17,645	17,782	17,695	17,493	17,376
20-	21,313	17,560	18,138	18,397	18,082	17,875	17,790
25-	19,518	18,050	19,275	18,966	18,500	18,389	18,318
30-	17,558	19,575	20,211	19,085	18,822	18,816	18,703
35-	13,963	22,279	20,128	18,993	19,168	19,111	18,932
40-	11,668	22,105	18,564	19,202	19,506	19,231	19,051
45-	11,088	19,799	18,535	19,828	19,593	19,182	19,109
50-	11,709	17,312	19,466	20,230	19,241	19,056	19,104
55-	11,614	13,312	21,380	19,593	18,664	18,942	18,971
60-	10,086	10,570	20,356	17,467	18,287	18,742	18,610
65-	8,000	9,324	17,267	16,644	18,137	18,176	17,988
70-	7,578	8,878	13,996	16,403	17,540	17,041	17,148
75-	4,000	7,546	9,591	16,367	15,681	15,423	16,031
80-	3,000	5,200	6,388	13,497	12,393	13,611	14,467
85-	2,967	4,328	5,872	11,879	12,191	13,885	14,391
TOTAL	226506	268264	299075	315468	314255	315417	316115
LIFE EXPECTANCY	73.31	77.03	79.40	81.04	82.24	83.16	83.88
RECTANGULAR H	0.163	0.132	0.110	0.094	0.082	0.073	0.066
BIRTHS	0	3413	3452	3379	3331	3309	3290
NRR	0.88	0.89	0.89	0.89	0.90	0.90	0.90
RATE OF INCREASE	0.00	0.85	0.70	0.55	0.41	0.33	0.28
PERSONS 20-64	128517	160563	176053	171762	169863	169343	168588
PERSONS 65+	25545	35276	53114	74790	75941	78137	80025
RATIO 65+/20-64	198.77	219.70	301.69	435.43	447.07	461.41	474.68

The bottom line is the ratio of persons 65 and over to those 20-64, what may be called the burden of social security. Its increase is small until about 2020. Note that the peak of the age distribution is at 15-24 years, and it reaches 55-64 years by 2040. Our assumption of 700,000 net immigrants helps to soften the effect of the baby boom, but even so the burden of social security remains above 400 for the rest of the 21st century. That means more than twice as much tax as is now required.