Session 18PD
Technical Concerns: Increasing Longevity
in North America

Track: International/Pension
Key words: Demography, Mortality, Social Security

Moderator: MICHAEL M.C. SZE
Panelists: BERNARD DUSSAULT
              ANNA M. RAPPAPORT

Summary: Almost as long as man's life span has been recorded, it has increased. Mortality improvement has a significant impact on funding requirements, liability levels, and the actual dollars needed to pay various forms of benefits. Mortality improvement also serves as one of the bases for projecting costs of our various social insurance systems.

Recently, the American Association for the Advancement of Sciences (AAAS) discussed mortality improvement and its impact on social insurance programs in the U.S., Canada, and Mexico. Also, the Society of Actuaries Retirement Plans Experience Committee is addressing the need for new mortality tables for uninsured pensioners. This is an extremely important activity of the Society of Actuaries, as it is the first research project of such magnitude in which the Society has taken a lead role. Continued longevity is becoming a concern for these programs as they look at future costs and benefit payments.

Mr. Michael M.C. Sze: The first speaker is Anna Rappaport. She is the president of the Society of Actuaries and a great patron of retirement income and Social Security. Besides doing a lot of work for the Society of Actuaries, I want you to know that she is also a member of the National Academy for Aging, and the Pension Research Council. She is doing a lot of research work on Social Security and pension plans.

Ms. Anna M. Rappaport: Participating in the Pension Research Council, the National Academy of Aging, and the National Academy of Social Insurance has been a wonderful experience for me. I've really had a chance to learn a lot and to get different perspectives from people who have different training and who are looking at some of the same issues that actuaries are examining. I would really encourage you to participate in any of these organizations; it is a great experience.

The presentation that I am about to give is a presentation that I gave at the International Congress of Actuaries, in early June 1998, in Birmingham, England. It's also very similar to the presentation that we gave at the AAAS. I'll discuss the project on Social Security and mortality projection methods and what we did. Mike Sze and Irwin Vanderhoof were the project leaders, and they did a great job. We think this is one of the best research projects that the Society of Actuaries has ever done, and we're really proud of it.

So I'm going to give you a little overview about the project and what we found. The quote that I'd like to start with is, "The development of scientific forecasting is progressive and based not just on observation, but also upon a theory that makes the observation coherent. Without a valid theory of the cause and effect of a phenomenon, we are left with no assurance that the whole system and the rules governing it will not change without warning." This statement came from our colleagues who were managing the project oversight group, and part of our project was about looking for a theory. I think we have had a lot of successes in this project. One of the successes was to *not* actually end up with a theory. Our challenge was to study historical data. We constructed many tables, but we didn't find any unified, widely accepted theory, and we found many questions at the end.

Our agenda is to start with the research project and discuss who was involved, what we did, why was it important, what we learned, and what the key issues were that came out of it. Then, Mike and Bernard are going to tell you about the findings as they were applied in the United States, Canada, and Mexico.

I'd like to tell you a little bit about how the project was put together and who was involved with it. The lead sponsor of the project was the Society of Actuaries. The other sponsors were the Social Security administrations of the three countries. We're thrilled to have Bernard with us, but very sorry that Steve Goss could not make it to fill us in on Mexico, but Mike's going give us some of the details. Another sponsor is the Pension Research Council. This is a group that's connected with the Wharton School at the University of Pennsylvania. It's a very multidisciplinary group, and it does a lot of work on retirement-related issues.

Funding support came from the Society of Actuaries, the Actuarial Foundation, and the Retirement Research Foundation. This was our first time to partner with the Retirement Research Foundation, and we thought that was another significant thing about this project. Funding support also come from the American Society of Pension Actuaries' Pension Education and Research Foundation. We had many partners in terms of the money and doing the project.

Our participants and our expert panel were actuaries, demographers, medical researchers, and economists. They were all experts. We tried to get the leading people, and we feel we did, in each of these groups. We were very thrilled at the response we got. We had a one-day seminar as part of this, and everybody left feeling that they knew more and had gained by the interdisciplinary context. So we were really thrilled about the whole thing.

Why were actuaries involved in this project at all? Of course, mortality is our traditional area of expertise. We're responsible for the financial projections in Social Security, and mortality improvement was a significant issue raised by the technical panel in the 1994–96 Social Security Advisory Council.

Our mission and vision is to advance actuarial knowledge, and to enhance the ability of actuaries to provide expert advice and relevant solutions for financial, business, and societal problems involving uncertain events. As amplification, the Society is a research organization. It conducts research and develops studies of historical experience and techniques for projections into the future to analyze the actuarial aspects of public policy. So our goals in doing this project were to: understand mortality improvement; discuss the best methods of projecting mortality; proceed ahead on the development of a theory (however, we didn't really get that far with that part); get input from experts representing a variety of different disciplines; and analyze the impact on the three Social Security systems.

Phase one was a background paper on mortality research and a survey of work, which was a commissioned paper. We had some academics help us with that. Phase two was a seminar on mortality projections, presentations, and discussions by a number of experts, and that's where we had this whole group of different people. We had to discuss the methodology of projections, and we collected input at the end of the day from our survey. I'm going to report to you that input. Phase three, the results of the output from Phase two were applied to recalculate the numbers for the Social Security systems, and Mike and Bernard are going to tell you about what they found in the numbers.

So why is this all important? We looked at it really in two ways. One is the result informs policymakers. What we say it's going to cost for Social Security has a big influence on the changes that people will make. But one of the insights, and one of Bernard's colleagues from Canada is the person that gave us this insight to think about, is that the policies also influence the results. Someone said that it's really important for us to be much more aware of this and to inform our policymakers that if they make policy decisions that don't seem particularly connected to mortality, that in fact, they might be influencing mortality, and actuaries ought to be involved in that. Aging societies, of course, present many challenges. We've heard from Dr. Lundberg that the age spans might go up to 120 or 130 years. I'm going to talk about the same thing in terms of our expert panel. We actually did not have an inconsistent result there.

Let's discuss the question of results informing policymaking. The results are a direct input to cost calculations. They're part of the basis that we use to project the populations that will be covered, and they influence the design and retirement ages, which is an issue that I think all actuaries would agree needs to be addressed a lot more than it has been.

Policies also influence the results. What are some of the kinds of policies that might influence results? Health and health care, income and education, policies that relate to distribution of income and education, and infrastructure policies are just a few. Some examples in the areas of health and health care are how much we spend, how we ration care, and where we spend our health care research dollars. Taxes on tobacco and alcohol can play a role. If we can significantly reduce the amount of use of tobacco or alcohol by the way we allocate our taxes, we would be influencing mortality. There are other tax incentives that might impact lifestyles.

In the area of income and education, there was one finding that I think was a surprise to some of us. We weren't too surprised to see mortality correlated to income. I think we were much more surprised to see mortality correlated to education and to see results that showed that in multiple countries. So the distribution of education and income are connected. Infrastructure would include things like sewers and sanitation, the educational infrastructure, and highways. So when you start to think about this, you realize that there are a very wide range of public policies that may drive future mortality in a country.

Our aging society presents many challenges. The decisions we make affect well-being and mortality. Benefit costs are going up. Health care utilization rises with aging. There are special needs of the frail elderly, and this study didn't really deal with that, but that's very much one of the issues of an aging society. It's a major

concern to me, and I think it's a major concern, as it should be, to our profession. There's a potential conflict between expectations and resources. Resource allocation may be very difficult in an aging society, depending on the demand, and this leads us into the retirement issue. Housing stock can be a challenge, and females live a lot longer and are much less well off, which is a subject I'm very interested in, but not going to talk about.

The aging society is a result of two trends—mortality improvement and differences in births in different years, such as the baby boom. I'm going to show you some very interesting data about Mexico. All three North American Free Trade Agreement countries recognize that aging has implications for social programs, and they've gone in some different directions. Canada has modified their Society Security system, fine-tuned it, and theirs is a traditional system that has a new investment strategy. Mexico has gone to defined-contribution plans, and in the U.S., we're talking about what to do. We're going to hear more about all this in a couple of minutes.

The general messages, in terms of the lessons from our project, were that multiple disciplines can contribute to this discussion. Data are vital and can be a major project. We'll all say that's a no-brainer, but I'll tell you that in doing this project, the data issues were important, and we had some stopping and going back and working to get data that we were happy with for all the countries. And this was more of a problem with the Mexican data. Diverse work informs the search for a theory, and that was a big lesson. The observable variations in mortality were due to factors beyond what we traditionally, as actuaries, thought about. We also found more historical improvements than many of us had anticipated at the older ages. In the U.S. and Canada, we realized that you could have significant future improvements in life span, only if older-age mortality improved. In Mexico, the anticipated changes in the population age structure were dramatic, and major future improvements were expected in all countries.

We started out by looking at the life expectation at birth. In Canada, from 1960 to 1990, for males, we had about a six-year improvement in life expectation at birth, which went from 68.1 in 1960 to 74 in 1990. Females were about parallel going from 59.4 in 1960 to 73.8 in 1990. In Mexico, we had twice as much improvement over the 30 years for males with expectation going from 56.2 in 1960 to 68.7 in 1990. Expectation of life at birth went from 59.4 to 73.8 for females. In the U.S., the expectation for males went from 66.6 in 1960 to 71.9 in 1990, and females went from 73.2 to 79.0.

Let's discuss expectation of life at age 65. Then I want to discuss Mexican population data. In Canada, the expectation of life at age 65, over the 30 years, for males went from 13.3 in 1960 to 15.5 in 1990. Females had a similar change with 15.8 in 1960 to 19.9 in 1990. Mexico was not nearly as different at age 65 as it was at birth, and the improvements were quite parallel: males were at 13.8 in 1960 and 16.3 in 1990 and females were at 14.4 in 1960 and 17.5 in 1990. The U.S. was, again, about the same: males were at 12.9 in 1960 and 15.2 in 1990 and females were at 15.9 in 1960 and 19.2 in 1990.

I think most of us have seen graphs of population trees, that show how populations are changing. But one of the things that really struck me in the study was that when we looked at Mexico, we realized that the speed at which the population changed was so much faster than it is in the U.S. and Canada, and the lessons learned here are lessons that might be learned in many developing countries. The population has gotten quite a bit older from 1970 to 1995, and that's not so bad. It will change even more if we project out to the year 2050. The mortality rates are dropping very fast. What is not too surprising is that in a country where a lot is changing, fertility rates are dropping very fast. There is a third piece of this, and I'm going to see if we can get somebody to guess what that is.

From the Floor: Urbanization.

Ms. Rappaport: No.

From the Floor: Birth rates.

Ms. Rappaport: No, it's not birth rates. We already said fertility. It is out migration. You have a combination of out migration, dropping mortality rates, and dropping fertility rates, and a far faster and more dramatic change in the population than anything that we've witnessed in the U.S. or in Canada, or than anything that I would have thought about. This has taught me that when you're working in different countries, you really need to pay a lot of attention. The World Bank has put out a book called *Averting the Old Age Crisis*, and in that book, there are data from different countries. When you look at countries, there are a lot of differences. You know, this is a clear warning to pay attention to the data, and don't assume that if it works that way in one place, it's going to work that way in another.

We had a lot of different ideas at the seminar. Lee and Carter talked about a stochastic extrapolation model. J. O'Shansky, is a biological scientist, and he talked about a search for a theory of mortality. One of the things that I was fascinated about in the O'Shansky work is that he is looking at human beings, as well as other

species. Hayflick talked about the biological basis for mortality improvement, and Wolfson and Preston discussed the factors accounting for differences in mortality.

So what were some of the key issues with regard to projecting mortality? First of all, we all agreed, and actuaries would agree, that back-testing was important. We also talked about the importance of expert opinion, and we did a lot to collect expert opinion. Dr. Lundberg, when he talked about the different methods of scientific research, talked about how his last method was expert opinion. The methods of handling variability that we looked at were high, medium, and low versus stochastic. The majority of our experts said, let's think about doing more research in stochastic methods. We also had discussions about how this is a great discussion for actuaries and theoretical people, who can debate high, medium, and low versus stochastic. But the policymakers want one answer. Regardless of whether you do scenarios or stochastic, they want one answer, and so we need to be aware of how we present it to the policymakers.

One of the other projection issues and questions were aggregate versus by-cause projections, and we had a good discussion. The opinion was very divided. Some people said by-cause-of-death was a good start, and good for testing, but they talked about some challenges. I was, again, very struck by what Dr. Lundberg said which spoke to this issue. Two main challenges were pointed out. One was independence of causes, and the other one was data reporting and the quality of it.

What was talked about in our session was not just whether people reported well, but the whole question that fashion in medical practice in a country or a community would affect what was reported, and that could really influence the same situation a doctor would report differently. Dr. Lundberg said that, oftentimes, they don't really know. So these really are issues.

We know that there are significant mortality differences by sex, and that they are narrowing in the U.S. We don't know whether they're biological, and we don't know if they'll continue to narrow. Our experts said they would continue to narrow, but not disappear.

Subsequent to that, in just the last few weeks, the Society of Actuaries has received a request for a research grant on differences in mortality by sex, and I believe that project is going to be going forward, so we'll have some additional information there. To find the reasons for variations in mortality, I would point you to the paper from Sam Preston. The observed differences are based on sex, education, income, and marital status. In many countries, we don't know whether there is the significance of each factor and what really drives the differences, but our experts

said there'd be less narrowing of mortality by factors other than sex, and that's what we expect.

We asked our experts whether there is a maximum life span. About two-thirds of them said yes, and about one-third said no. These are experts, but there's no specific study. This just reflects the opinion of experts. The average of the guesses for maximum life span was 135 at present, and this represents two-thirds of our experts.

So what factors might drive future improvements in mortality? In Canada and the U.S., this mostly applies to the upper ages because the mortality is already quite low at the lower ages. We said that two factors could be lifestyle changes and medical advances. In Mexico the factors were greater public health initiatives, income growth and distribution, changes in the economy, medical advances, and lifestyle changes. This is based in expert opinion. Factors that might increase mortality in Canada and the U.S. are unanticipated catastrophes, like natural disasters, new diseases or diseases that become resistant to antibiotics, and environmental conditions. We said the same thing might increase mortality in Mexico. In summary, I told you a little bit about the project overview, why we thought it was important, and some of the key issues. I'll be happy to answer questions later, and I know Mike and Bernard will as well, because they were all very involved on the project team.

Mr. Sze: The second speaker is Bernard Dussault. Bernard is the chief actuary of public plans in Canada. He is in charge of all the actuarial work for the Canada Pension Plan (CPP) and other public plans. He is a member of the Committee on Social Security—Retirement and Disability Income and a member of the Social Security Committee of IFAA. He is also on the CIA task force on pension plan financial reporting. He is going to talk about how social security is affecting life in Canada.

Mr. Bernard Dussault: I'm pleased that what I was asked to do here is not talk about all the things I learned about the mortality improvements, because I knew very little when this project was started. As you probably realize, the more you know, the less you know. So I know even less than before. So the best thing I could do, in terms of presentation, is just to be defensive and present some negative aspects of this project. It's not a matter that it is negative, but I will talk about some caveats and about some apparent inconsistency of the results, and then the *piece de resistance*, is to tell you what I intend to do with what I have learned. And I can tell you immediately that what I intend to do is probably not use the results. I'll do something else with them anyway.

The first part of my presentation is the caveats. When we started the project, we had not yet started, in Canada, to analyze the mortality of the retirees, the retirement pensioners of the CPP. As you know, Canadian life tables have been published since the early century on population, and when the project was started, I urged my staff to develop mortality rates on the CPP. Let me tell you why. I always suspected the Canadian life tables, because they are based on censuses, which are done only once every five years, and they set the denominator of mortality rates. The numerator consists of deaths that are done on a survey basis in Canada, for three years around the census. Because the numerator is a set of data totally separate from the denominator, I always suspected that there might be inconsistencies in the Canada life tables.

We completed the mortality study of the CPP data, and these data are administrative data, so both the numerator and denominator are closely related. Effectively, we found some inconsistencies, but let me tell you what the three main ones are. First, you would expect that the average level of mortality of pensioners under the CPP would be lower than the Canadian population mortality. The reason is because people who are entitled to a retirement pension have had previous earnings. But not everybody in the population had earnings. Because of the relationship we know of between mortality and earnings, those with earnings should have a lower mortality. The CPP mortality rates proved to be 1% higher than those of the Canada life tables. The main reason for that is, first, that the Canada life tables are not based on administrative data. Second, these mortality rates in the Canada life table, based on census, are developed using an extensive smoothing process or interpolation process, so these data are quite manipulated. The CPP data were not manipulated at all. The size was so large that we could use them without adjustment.

The second major caveats regarding the data were that, contrary to what the Canada life table revealed for the period from 1980 to 1995 for females, mortality has improved for ages 65 and older by about 1.3%. On the other hand, the CPP data, which I considered more reliable, indicate that, for the same ages and about the same period, female mortality had improved by only 0.2%. So these are important caveats.

Third, the project is essentially one of looking at mortality improvement. The CPP mortality study indicated that at some ages, mostly those over age 80, for many years in the 1980 to 1995 study, mortality is increasing with respect to some ages, especially with respect to people with low earnings. So when interpreting the results of the study, we have to keep in mind these caveats.

At the one-day symposium in Washington in late October 1997, the experts in the room were asked to give their views about what they think mortality will be in the 21st century. Table 1 is a comparison between what the experts' views are and what we had traditionally used in Canada for the CPP projections. I think we should concentrate on age 65 and over because the mortality study we have conducted is on pensioners only or people over age 65. You can rapidly observe here that, in the short term, the experts' views correspond to about twice the assumption made for the CPP, and for the long term, for years after 2020, the experts' views are about 25% higher than those of the CPP. For males, we assume about 24%, and the experts arrive at 25%, so that's a 25% increase, and the same applies to females.

TABLE 1
SHORT-TERM MORTALITY DECLINES (PERCENTAGE)*

	Age Group	CPP Assumptions	Experts' Views
Male	0-14 15-64 65+	1.27 1.33 0.52	2.27 1.40 1.08
Female	0-14 15-64 65+	1.38 0.78 0.66	3.17 1.96 1.51

*(i.e., now to 2020)

We were asked to replace the mortality improvements assumed by experts by our improvements, and see what it would do in the CPP projections. So what should we expect in terms of results? The assumptions made for the CPP are such that, over the next 100 years, the assumptions that we just presented are such that the life expectancy at age 65, which is about 15 for males and 20 for females, would increase by about five years by the year 2100. An increase of 25% translates to a CPP steady-state contribution rate increase of 3%. So you would expect the CPP pay-as-you-go rates to increase by about 25% by virtue of the mortality improvements.

The result we got from the study is that the CPP now works with a steady-state rate. It's an average of the pay-as-you-go rate over the 21st century. Currently, the CPP contribution rate is 9.9%, and using the expert rates, the 9.9% becomes 10.2%. That appears as a slight increase, but we have to keep in mind that we are comparing the difference between the experts' views and the CPP view; it's not the whole experts' views. The effect of CPP assumptions for retirees is 26% in the year 2100, 100 years down the road, for retirement benefits. So if we look at the total of CPP benefits, which includes the retirement and survivor benefit, the effect comes down to 18% because the effect of mortality improvements is not too great on

survivor and disability benefits. Because the CPP financing mechanism is one that averaged the costs over the 21st century, then the effects should be cut by 50%, from 18% to 9%. The ultimate effect is 18%, on average, and during the 21st century, it is 9%. So as we have seen, the difference between the experts' views and the CPP assumption is an increase of about 25–33%. So rather than getting an increase of 9%, we got an increase of 3%. This was just to reconcile the results that we got. Let's keep in mind that mortality improvements have a big impact on plans like the CPP.

What have I decided to do with all the knowledge we acquired from the experience on mortality improvements? We already knew, and most of you already knew, that there's a strong correlation between the level of mortality and the level of earnings. The CPP study corroborated that very strongly. The point I want to make is that this is just a correlation. Maybe there is some causality involved, but we don't know whether the egg came before the chicken or vice versa. Is it higher earnings that cause lower mortality, or is it better health that brings people to have better earnings? That remains to be proven, but the correlation is still there, so we use it in making our assumptions.

After looking at the results of the experts, I am in no position to determine whether our assumptions or the experts' assumptions are better. Something crossed my mind during the process, and I was looking at the effect of mortality improvements during the 20th century, versus the effect of a productivity increase. The reason I thought of that is that we'd just said, and we all agreed, that there's a strong correlation between the level of earnings and the level of mortality. So the question that crossed my mind was, if there is such a correlation between these two levels, couldn't there be a correlation between the derivative of the increase in average earnings and the decrease or increase in mortality?

I looked at the data that showed what happened in the 20th century (Chart 1). The curve in the middle is the CPP projections. We just started from scratch, and we removed the mortality improvements that we assume. By removing the mortality improvements, we got this curve, but by removing the effect of the productivity increase, which, by the way, is 1%, we assume that earnings will increase on a real basis by 1% per year. There seems to be a correlation between mortality improvements and the productivity increase. I don't have too much for you, at this time, to support this possible theory, but at least we can observe that, in times of recessions or economic downturns, there are more disabilities under either private disability insurance plans or under the CPP. As you know, disabled people have a higher mortality. I don't know if you ever looked at it this way, but looking at the specific mortality of disability pensioners under the CPP, whether you look at

someone disabled at age 30, 40, 50, 60, the difference between mortality of a disabled person and a nondisabled person is such that most disabled people have mortality corresponding to age 70 or over, so that's a big impact. So that's one point that could support the view that there's a strong correlation between mortality improvements and productivity increases.

Based on what I learned, I decided that I would compare the same for the future. We are assuming mortality improvements exactly in line with what the actuary for the OASDI is using. So these assumptions are not ours. So I did the same exercise, our projections for the 20th century. These are projections without mortality improvements and without productivity increase. So if we include in projections the productivity increase, then the costs go down. And if we had the mortality improvements that are assumed to be lower for the 21st century than for the 20th century, Chart 2 is what we get. As you can see, we are, for the 21st century, using assumptions that are a bit more favorable than what happened in the 20th century. It's not easy to determine what level of mortality improvements to use. What I'm telling you is that, irrespective of what mortality improvements will be in the future, if an expert were to tell me tomorrow, "Bernard, you should double your mortality decreases," I would say, "Fine, but at the same time, I am going to increase by 1% the assumptions for salary increases." That completes the results and how we will use them for CPP projections for the 21st century.

Mr. Sze: I want to tell you how we thought of the whole process, and what we did. Some of us said that it isn't right that Social Security is hotly debated without input from actuaries. All the economists and the demographers, right or wrong, said something, but we actuaries, who have the technical background to analyze these things, haven't done anything and have kept quiet. In this world, if you're not heard, then you're nobody. So we decided to do something so that we can be heard. Some of us, including Bernard Dussault, Steve Goss, Irwin Vanderhoof, and very much so Warren Luckner, and me, said we should do something that we are good at, which is analyzing mortality. How can we get heard? What better forum is there than the AAAS; even Bill Clinton goes to the meeting. We know that AAAS was holding its 150th anniversary meeting in Philadelphia, so we decided to try to get a session at the meeting.

We found out that the meeting would be in February 998. We had more than a year to plan, but as it turns out, we didn't even get the sponsorship and the funding until the middle of May 1997. Many people told us it couldn't be done. We were talking about a major project with three phases. They said we didn't have enough money or resources, but we did it. Of course, it couldn't have been done without

the major support of the research staff of the Society of Actuaries, under Warren Luckner's guidance. Thanks should be given to Warren and his staff.

Let's look at where we began. We asked Steve Goss, Bernard Dussault, and some Mexican actuaries to analyze it. During the research, the person who was doing the analysis got kidnapped and killed in the process. We were very fortunate to have another leading expert in Mexico to stand in, who is Jose Gomez de Leon. Then, we gathered the experts in Washington, like Anna said. We are very fortunate. There was a lot of preparation involved which we could do. We also involved the Pension Research Council. More than ever, we wanted the experts. We wanted 80-90 experts, so we sent out 120 invitations. We thought we'd be lucky to get a response from one-third, but we got the 80-90 that we wanted. So we got their opinion, and each expert was committed to their position; however, their beliefs varied a lot.

Now we have that data from phase two. We want to go into the third phase, which was testing it out. Testing what out? Garbage in, garbage out. You have data that has varied so much. Would the results tell anything at all? I'll let you be the judge. I'm going to show you some results that we got from the whole process that have been presented at the AAAS meeting. They were also presented in Vienna at the International Institute for the Advancement of System Analysis meeting. It was quite well received. We had a good audience.

In Chart 3, the mortality improvement for males goes from the beginning of the century to 1995 and then it is projected forward. At the beginning of the century, the mortality rate for Mexico is twice as high as the U.S. and Canada. The U.S. and Canada, because of our cultural relationship and other reasons, is closer together. Mexico started out with very high mortality, but they are improving very fast. We are expecting, towards the early part of the next century, that they will be catching up. We are going to be at about the same place, as far as mortality goes. Females show the same trend.

I always believed that Social Security is affected by demography. That is what prompted us in this research. We all know that mortality rates are improving quite fast. If the demography is going up, and nobody is dying, don't you have a problem? It's quite evident, isn't it?

Let's look at Chart 4, which shows Canada right now. Males are on one side and females are on the other side. The bars in the graph form a star. We are at the best time right now. There are a lot of workers supporting not so many older people. How would that change through the years? As you go up, the bunch of people who

are workers will be getting older, so the shape of the bars would look more like a vase. Chart 5 shows how the population will progress from year to year. Ultimately, you are going to have a vase shape. In Canada, if you look at it at every age, the population is expanding, but you have to look at the older ages. The change is greatest at the older ages. Second, if you look at both sides of that line, male versus female, there is a gradual increase in females at the older ages. It is something that Anna alluded to, and it is something that we really need to think about.

And what does Canada do? Canada changes its CPP funding, and the changes are quite minor. Initially, the contribution rate is employer and employee each contribute 2.8%, and they go up gradually. If you go up gradually, then you will eventually be hitting a 14% tax rate. Politically, that wouldn't sell. What they do is quickly accelerate the funding from the current rate to 9.9% in 2003. The projection is, according to Bernard and his colleagues, that it can then stay flat after that point and still keep funding well. They are going to have some diversification in the investment that would increase the investment return, and they are also going to lower the benefit a little bit in terms of using five-year average instead of three-year average, final average pay, and they are going to monitor these disability and death benefits more closely. So, if you think about it, with just minor twist, they would be able to fix up the Canadian Social Security system.

As I said, all these are driven by demography. The U.S., as you know, cannot decide what to do. Let's look at the demography of the U.S. first (Chart 6). The working ages are right now, and by 2020 the bulge would go up toward the older ages. By the year 2060, the bars would form a vase shape (Chart 7). The U.S. and Canada are very close together. Whatever problem there is in Canada, multiply it 10 times to find the problem in the U.S., because the population is about 10 times bigger in the United States. The shape of the graphs are quite close. If we believe that all of these are demographically driven problems, then what should the U.S. solution be? I'm not going to talk about that just yet.

Let's talk about Mexico. Look at the current population in Chart 8. How is that different from the U.S.? Mexico has a very small group of older people. The average age of the population is less than 25. It is quite different from the U.S. and Canada. In Chart 9, the bars are shaped like a vase, and there is a bulge. It is not a vase that's straight down; it is a vase that's narrowing at the bottom. If we say that Canada and the U.S. has a big problem, Mexico's problem will be much bigger. What is their solution? They basically change the current system from a defined-benefit system to a defined-contribution system. There will be some contributions from employers, from government, and from employees. The contribution rate,

depending upon the pay of the person, would be roughly 12–17% going into the person's individual account every year. They expect that will take care of them in their retirement.

Mexico has a young work force with lots of time to accumulate the assets, unlike those of us in U.S. and Canada, right? What might be working for them might not be working for us. Look at Chart 8. They don't have a lot of older people. Their baggage is not so big. For all the people who have retired or for all the people who would be able to retire, they would later on get them the bigger of the two, the old defined-benefit system, which by the way, for all your practical consideration, is bankrupt, or they would get them what their accounts can buy. If you think about the baggage being too small, then the risk of having too much funding is small.

With that kind of background, let's see how these solutions work out, in Canada, in Mexico, and perhaps we can talk about the U.S.

In Canada, as I said, if we do not have changes, then the tax rate would go up from 5.6% to 14% later on. That would be political suicide, so change is needed. They would accelerate the funding so that, by the year 2003, the rate would be flat. Would that mean that they would not be putting in enough, and that the Social Security system would be bankrupt? Without doing the change, the answer is yes. There would not be any funds after 2015. With the change, just minor tweaking of the system would be needed. We expect that there will be enough money to be equal to more than four times the payout right now. But that's what Bernard says. What if we have mortality improvement that is sizeably bigger than what Bernard is predicting? How can we trust him? When we looked at what the experts were saying, we saw that the dilemma was that there was wide discrepancy in what they believe. So we test out the worst possible scenario.

Let's see what that would be in Chart 10. Look at the star that we have, and look at the projected population under the very low extreme, no mortality improvement, and very high extreme, with a lot of mortality improvement. What do you see in the graph, in terms of the projected population? Even when we are talking about extremes, we are talking about two standard deviations away. That is extreme enough for everybody who studies statistics. The population is not changing that much.

What is the impact on the trust fund balance? There would be impact as we can see from Chart 11. Look at the impact in terms of when we get into trouble, when we get to zero, when the trust fund goes out. Even under the worst possible scenario, it would be going out in 2060. We have plenty of time to make adjustments. This

points out the fact that mortality is not the force that would drive the system into trouble.

What about the U.S.? I don't have results on what the U.S. changes are, but suppose that the U.S. doesn't have change, and we look at just the mortality improvement scenarios, extreme scenarios, or two standard deviations (see Chart 12). By 2030, we run out of money. What's the impact of mortality changes? If it changes a little bit, it is not something that we should be extremely alarmed about.

We have only talked about mortality. Are we so sure that Social Security doesn't have a problem? There are other factors. We test out one factor, and that is the investment return. According to the projections that Bernard's people are doing, the real return rate is expected to be more than 8%. We assume that the real return rate is half of that. Tagging on inflation, we get 5.43%. The impact is quite a bit bigger than mortality improvement, even in its extreme. It points out that the driving force may not be mortality; it's probably more the economy. This is probably something that we need to test out later on.

What about Mexico? By just looking at the population that's projected out, we see that the Mexican funding results are quite similar (Chart 13). Without mortality improvement, the bars form a vase, but even with mortality improvement, the population's shape doesn't change enough so that you would expect a sizeable change in the results.

As you know, in the U.S., there are all these studies on what kind of retirement policy should be made, and they asked the National Commission on Retirement Policy. I'll just talk about a couple of the prevailing sets of proposed changes, and what kind of impact they will have. Most of these are just minor twitches. We would expect Social Security's problem can be remedied. What is the current Social Security problem? In the U.S., they always want to distill everything down to one single number. The one single number that people are looking at these days is the actuarial balance. What is that? It is the present value of all the outgo as compared to the present value of all the tax that they are going to collect in the future. If the actuarial balance is positive, that's good. If the actuarial balance is negative, then we would have a problem some time down the road. Right now, without changes, the deficit, in terms of the actuarial balance, which is in the 1997 Trustee Report, is 2.27%. We must fix that.

What is on the table these days are some changes that I'm sure will be political, but they're proposing a half a percent lower indexation. In other words, the cost of living adjustment increase, instead of the consumer price index (CPI), will be CPI

minus half a percent. There has been a lot of debate about why that is relevant. You all probably heard Greenspan saying that the CPI methodology is off and is too high by up to 1%. So half a percent lower indexation with produces 0.7% improvement of the actuarial balance.

The next thing that they are talking about is increasing the normal retirement age. They are recommending going to age 70. That will have a huge impact, and will increase the actuarial balance by 1.6%. Expanding coverage to state and local governments would get more money, and that would increase it by 0.25%. There would also be a beneficiary changing from 50% to 33%, and it would have an impact of 1.17%.

The next item is bigger. Social Security is currently based on 35-year averaging. They are saying that extending it to 40-year averaging would increase the actuarial balance by 0.41%. As you have heard, the earnings test has all kinds of problems. So they might be doing away with it. Much of the income of Social Security has been shifted to Medicare, and they are saying that they can put it right back into Social Security. Now, there is one thing that's going to be put in, which is a floor on Social Security benefits equal to 100% of the poverty level for the aged. That would cost 0.7%. Put it all together, they would be increasing the actuarial balance by about 2.5, which means it would save the system.

There's another group of people who are suggesting that we ought to have a defined-contribution element. Instead of using the current formula, as you remember from Rob Brown's discussion, Social Security has two bend points before the ceiling, and you have 90%, 32%, and 15% in each of the bend points when calculating the benefit. They are saying lowering that to 21.4% and 10.1%, to create enough so that we can put a mandatory individual savings of 2% into a person's account. Then the actuarial balance would still be maintained. Time will tell whether some of these proposals would be accepted. Time will also tell whether this would actually keep everything in balance for a long time, but that is what they are proposing. Let's now open the floor to questions.

From the Floor: I've heard that the idea of saving the system because the fund is adequate is a bit like talking about moving Jello into a different shape. The bonds that are invested in are really just things that have to be redeemed via new taxes at the time of retirement. So nothing really has happened. There's a need for new taxes, but it would just be called Social Security taxes. Could you comment on that, please?

Ms. Rappaport: The government bonds that are in the trust fund are the same as any other government bonds, and the overall level of national debt is either reasonable or unreasonable. The money is in government bonds, and that will eventually have to be repaid. Government debt has been much higher at other times in the past.

Mr. Sze: This question is heavily debated these days, and there are studies going on, just like this person is suggesting, that say it's just trading different types of investment. Yes, you may not get anywhere, but a lot of people, however, are believing that allowing some money to go into stocks, for instance, would be able to help get some of the higher returns; therefore, in the long term, it would help the financial funding of the CPP in Canada and the Social Security system in the U.S. In Canada, just because of that, they have increased the real return assumption to be over 1% higher than before to 3.8%. Isn't that true?

Mr. Dussault: Yes. Before the changes, all excess funds were invested in government bonds, and new money, starting in 1999, will be invested in a diversified portfolio. The average earnings of bonds, on a real basis, was about 2.5%. We expect or project that on the diversified portfolio, this 2.5% will be increased to 4%.

Mr. Sze: The final results have not come in yet, but people's expectations, at this time, across the border, on both sides, is there might be some increase.

Mr. Robert L. Brown: I'd like to continue commenting on the last question. I believe that you have to be a little bit careful with illustrations on pieces of paper that are using projections based on rates of return that are also numbers on pieces of paper. I think the reality is that that's what they are. They're numbers written on pieces of paper. If you're going to have a healthy Social Security system, the debate between the financing system (pay-as-you-go) versus the funded system requires that funding creates new real national savings, and those national savings must be invested in a way that enhances economic growth and productivity. That's the real linkage. The rest of it is as valuable as the piece of paper that it's on. That seems to be where the debate needs to go.

There was one comment that Anna made that I thought slipped by way too rapidly. We're becoming very comfortable with the fact that there's a strong correlation between life expectancy and income levels. That's true on a gross national economic level, or country-by-country. If we graph countries by per-capita gross national income, we'd see the wealthier countries have the better life expectancy. If you do a bit of a regression on that curve, you'd find some anomalous results. For example, as many of the graphs showed, Canada has better mortality than the U.S.,

but it has lower gross national income. Japan is anomalous, at least relative to the United States. In fact, the anomaly is the United States. One of the ones that really stands out like a sore thumb is Costa Rica. It has marvelous life expectancy for a mid-range country in terms of gross national product. Some studies have been done to try to explain these anomalies, and the one that comes out with the strongest statistical base is the distribution of income or the lack of disparity of income. The more disparity there is, the farther you fall below the regression line that you should be on. The more equitable redistribution of wealth there is, the further above the regression line the country tends to be. I think we need to think about that. We, as actuaries, can't just let it slip by. It's very important. So I guess I'd conclude by saying that Social Security recipients live longer because they receive Social Security.

Mr. David M. Knox: I have a comment and a question. I think Anna raised the question as to whether income causes mortality rates or vice versa. There's a relationship there, just to follow up Rob's comment. One of the issues that's been raised at discussions I've been at is that if you think about people in poor health, during their so-called working years, they will earn lower income. They might have part disability, or whatever. That part disability will not only affect their income, but also affect their subsequent mortality. If you are just looking at their income, then they are lower income earners, and they will be inclined to die earlier. But in fact, their lower income was partly caused by their inherent disability. So we have to be a little bit careful at that point.

My question is about the population pyramids that were used. They stopped at 95 to 99. We've heard about the possibility of us living to 130. I wondered if any futuristic work had been done on projecting a significant proportion of the cohort living out to 120 or 130?

Ms. Rappaport: I'm not aware of any, but one of our colleagues, Bob Johansen, who was a major player in this study that we talked about, is very anxious to have us do a study on that. As far as I know, that hasn't been organized yet.

Mr. Warren R. Luckner: That is correct.

Ms. Rappaport: People who are interested in that topic might like to be in touch with Bob Johansen to talk about whether there's some way to organize such a study. There is some interest in it, and it's not exactly on the drawing boards yet, but there is a glimmer of hope.

Mr. Sze: In answer to the question about graphs, the 90 to 95 age group actually includes all people in that age group and above.

Mr. Arthur B. Kagan: This is a question for Bernard. When Canada decided to invest in equities, what decisions did you make in terms of what to invest in, and was it all Canadian equities, or was it global funds and U.S. funds? How was that decision reached, and what did you do with that?

Mr. Dussault: The final rules that will apply to the investment board have not yet been specified, but it's already been indicated that the prudent men rule would apply. So far, what has been considered is whether the 20% limit on outside-of-Canada investments should not be increased, and this has just been raised. There's another rule that will apply, which is that provinces should still get a share of total monies available. If we look at the more than 30 years of experience that we can observe regarding the Quebec Pension Plan, we know that it was implemented at the same time as the CPP. It's a similar plan. And at the outset, the Quebec Pension Plan has worked with a diversified portfolio, and its average 30 years of experience is 4%. I looked at all of these aspects, and it's why I felt that 4% would be a good projection.

Ms. Rappaport: There was some discussion at the other Hawaii meeting about Chile. It is one of the countries that has privatized. The point made about Chile was made that all of the investments were in equities in their local home equity market. Somebody asked the presenter if that was bad for the participants. And the answer to the question was that the purpose of the thing is to help the economy of the country. It's more important to help the economy of the country than to make sure the participants are diversified. Someone pointed out that if the economy of the country is helped, it will help the participants. It was rather interesting to hear that the investment decisions were not made with the immediate interests of the participants in mind, in terms of the legal structure.

From the Floor: Bernard, you mentioned that Quebec went into equities from day one—

Mr. Dussault: It was not equities. It was a diversified portfolio, and equities might have represented not more than 20% or 30% of the total fund.

From the Floor: Back in the 1940s, the Democratic Party in the U.S. tried to fund Social Security with nongovernment bonds, and the Republicans were outraged at the idea of Socialism by the back door because the government would eventually own the stock market through Social Security's trust fund. Nowadays, we're hearing

about the goodness of funding Social Security with equities again. Is there any kind of political to-and-fro within Canada on this topic? Who's on what side? I'm just curious.

Mr. Dussault: Are you concerned about the fact that the diversified portfolio administered through this Social Security program could give government too much control in investments?

From the Floor: That was one of the reasons why the Republican Party, in the 1940s, shot it down. Right now, we're talking about doing it again. I'm just curious whether that is a concern in Canada.

Mr. Dussault: Of course it's a concern, and that's why the specifications regarding how the investment board will operate have not been settled yet. Some parties have found some flaws in the original specification. There is particular concern about what you are saying. There are fears that the government might, by going through the back door, gain more control than intended on the fund. That's always a continuous risk and danger, and we're still looking at ways to avoid that. Will we succeed? I don't know, but we're trying.

Mr. Sze: Those who are interested in further questions and answers can refer to Session 41, which will be a Workshop on Social Security.