

Introduction to the Symposium: The Graying of the Developed World—The Actuarial Challenge

by James C. Hickman

1. Foundations

Taxes to support old age income systems, endless political discussions, the media, and direct observation all remind us that our nation grows older. The implications for organizations in both the private and public sectors of this aging are profound. Time for adapting to the new realities remains, but the degrees of freedom available for the remodeling lessen with each passing year.

Two graphs, both widely repeated in discussions such as this, convey the scope of the challenge for the U.S. and the world. Figure 1 is taken from the 1996 Report of the Trustees, Old Age Survivors and Disability Insurance (OASDI). A crude calculation based on Figure 1 demonstrates the impact of aging. A bundle of income and service benefits to beneficiaries with a value that, for the average beneficiary, is a constant fraction of the average real income of working lives will require a transfer rate in 2030 and beyond that is approximately 150% of the transfer rate in 1990. Higher per-capita real income, perhaps driven by investments made possible by increasing savings, is a happy scenario, but even then the relative economic position of beneficiaries would decline without a higher transfer rate.

Figure 2 is taken from *Averting the Old Age Crisis: A World Bank Policy Research Report*. The figure provides evidence that the U.S. is not alone in growing older. The fact that the bars in Figure 2 extend farthest to the right for the Organization for Economic Cooperation and Development (OECD) countries is the reason for

directing this symposium to the economically developed world. Ultimately, however, the challenge is worldwide.

China is an especially interesting case. Approximately 20% of the world's population is in China, and it is one of very few nations that recently has had a GDP growth rate in excess of 10%. Taken together, these facts imply that whether one is discussing economic, political, or military affairs, China deserves attention. Reduced fertility, achieved by means that have offended human rights advocates, and improved mortality have combined to give China's age distribution a middle-aged bulge. The demographic crunch will come to China with a lag of 15 to 20 years after it occurs in OECD nations.

Some have attributed the remarkable growth of the GDP in China to bringing on stream human and physical resources underemployed during the communist years. According to this view, the challenge will come when resources are fully employed, and basic changes in management and technology must be made to boost productivity. This view would influence the role of investments in developing nations, such as China, at a time of dissavings in the developed world.

2. Insights from the Classics

The challenge has been stated in macroeconomic terms. Yet most of us direct our own affairs and help manage micro-organizations. One of the prerequisites for actuaries before discussing the challenge of aging is to shift from micro- to macro-models. Then, after the

FIGURE 1
NUMBER OF WORKERS PER BENEFICIARY

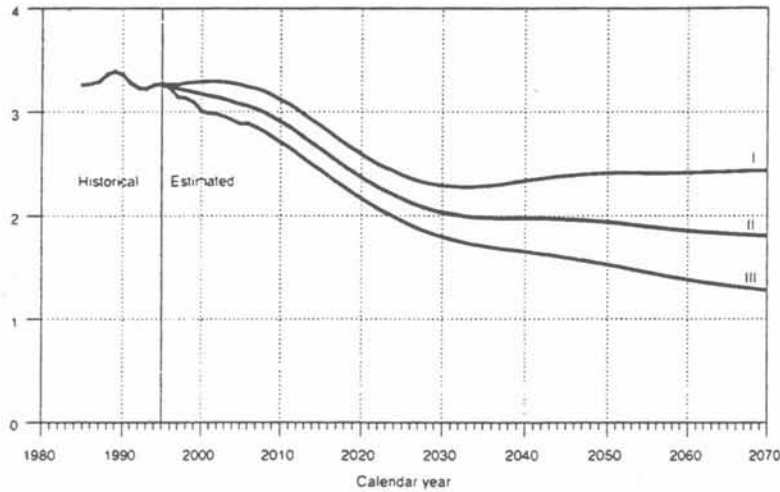
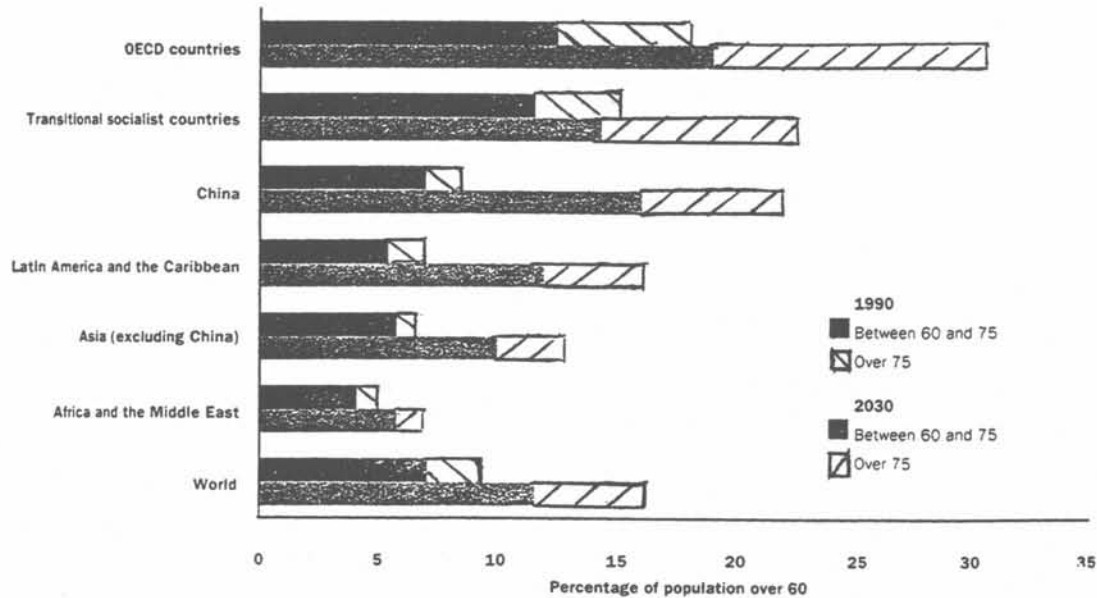


FIGURE 2
PERCENTAGE OF THE POPULATION OVER 60 YEARS OLD, BY REGION, 1990 AND 2030

Percentage of the Population over 60 Years Old, by Region, 1990 and 2030



discussion, they must take the information and incorporate it into their personal and business decisions.

For insights into the fundamentals, there is no better source than the classical economist. The first three paragraphs of Adam Smith's *An Inquiry into the Nature*

and Causes of the Wealth of Nations state the basics more clearly than have subsequent authors:

The annual labour of every nation is the fund which originally supplies it with all the necessaries and conveniences of life which it annually consumes, and which

consist always, either in the immediate produce of that labour, or in what is purchased with that produce from other nations.

According therefore, as this produce, or what is purchased with it, bears a greater or smaller proportion to the number of those who are to consume it, the nation will be better or worse supplied with all the necessaries and conveniences for which it has occasion.

But this proportion must in every nation be regulated by two different circumstances; first, by the skill, dexterity, and judgement with which its labour is generally applied; and, secondly, by the proportion between the number of those who are employed in useful labour, and that of those who are not so employed. Whatever be the soil, climate, or extent of territory of any particular nation, the abundance or scantiness of its annual supply must, in that particular situation, depend upon those two circumstances.

The ideas of a second classical economist create a boundary on the dynamics of population and economics. Thomas Malthus's "Essay on the Principle of Population as It Affects the Future Improvement of Society" is a combination of deductive reasoning and empirical analysis. Two of the postulates for the deductive portion can be verified by observation: (1) "food is necessary to the existence of man" and (2) "the passion between the sexes is necessary and will remain nearly in its present state."

Malthus set lofty goals for his investigation in the first paragraph of his essay. He stated that his goal is "to investigate the causes that have hitherto impeded the progress of mankind toward happiness; and to examine the probability of the total or partial removal of these causes in the future." He clearly states his principal finding: "the cause to which I allude is the constant tendency of all animated life to increase beyond the nourishment prepared for it."

Malthus underestimated the rate of growth in agricultural production. He missed the impact of the land in the New World coming into agricultural production, and the influence of new crop varieties, fertilizers, pesticides, and herbicides were far in future. Yet his proposition that exponential growth of population cannot be sustained remains an ultimate reality. Experience in our century indicates that the boundary on population growth created by environmental and quality-of-life factors may be more constraining than agricultural production on populations.

Consult the masters in any discussion. Smith sweeps away the financial details. The force that creates the wealth of a nation is regulated by "the skill, dexterity and judgement with which labour is generally applied"

and "by the proportion between the number of those who are employed in useful labour, and that of those who are not so employed." To increase wealth requires more workers or improved technology and management. Malthus constantly reminds us that population growth must be bounded, but he does not establish a bound on "skill, dexterity and judgement."

3. Pure Strategies

In game theory, explicit rules and complete knowledge are assumed, and there is the idea of a pure strategy. A pure strategy is a complete enumeration of the actions to take at each step of the game. In business and public affairs, the assumptions of game theory are seldom realized. Rather than pure strategies, business and government decisions are usually made through an adaptive or sequential process. Nevertheless, clarity is promoted by our identifying the two main classes of strategies available in managing the aging challenge.

We will use Adam Smith's classification system. One class of strategies is based on *labor force adaptations*. Increasing the natural growth of the working population or encouraging immigration would be examples of such strategies. Shifting the distribution of retirement ages upward or the distribution of the age of entry into the workforce downward would be other examples. A second class of strategies involves *increasing productivity*, in Smith's words "the skill dexterity and judgement" involved in production. Productivity increases usually require investment in improved plant and equipment or investment in education and research. This investment requires savings, the deferral of the consumption of current production.

A free society is defined as one in which decision making is not centralized. As a result, pure strategies are seldom observed in free societies. Democracies tend to produce mixed strategies.

My thesis is that meeting the challenge of the aging population will involve a mixture of a labor force strategy and a program of savings and investment. Activating strategies, within each of the two broad classes of strategies, provides opportunities for actuaries.

4. Macro-metersticks

There is a simple symmetric relationship between measurement and management: What gets measured gets managed, and measurement is a prerequisite for good management. Examples of this relationship

abound. Benefits under the U.S. OASDI system are indexed to the Consumer Price Index and the wage histories, and the benefit formula for which the histories are inputs are both functions of average wages. It is said that the Board of Governors of the Federal Reserve System looks at the sum of the rate of increase in the labor force and the rate of productivity improvement in deciding whether the growth rate of GDP in the U.S. is above or below the level at which price inflation becomes a threat. In modern words, these are closely related to the factors that influence the wealth of nations identified by Adam Smith.

Macro-metersticks are not precise. Single numbers that summarize the operations of an entire economy inevitably also obscure. The technical issues of adjusting the CPI for quality improvements are an example of how difficult it is to maintain a meaningful time series of macroeconomic measurements.

Similar macro-metersticks exist for thinking about retirement issues. The first is the by now familiar growth rate of the labor force. The second is the growth rate of real wages, which is related to the growth of productivity. The third is the annual effective rate at which there is indifference between current and future consumption. When the sum of the growth rate of real wages plus the growth rate in the workforce is greater than the rate of converting present into future consumption, planning retirement income programs is easy. This is true, with suitable restrictions on the definitions of the three key rates, of private, public, or social insurance pension plans.

5. Changing Demographics and the Republic

The machinery of a republic permits evolutionary adaptations of public policy rather than requiring a revolution to make necessary course corrections. An open market with many participants is a related mechanism for economic adaptation. A duopoly in a market may exhibit stability until a stimulus from the outside creates erratic behavior. A republic, sharply divided into two classes with directly opposing interests, can also exhibit instability rather than compromise.

If a society wants the efficiency of open markets, it must prevent a few players from dominating the markets. Likewise, a society seeking the advantages of a republic must work to avoid divisions among its citizens that cannot be bridged.

Democracy in the U.S. thrived, according to Frederick Jackson Turner's frontier hypothesis, because of the equality and opportunity available along the frontier. The Homestead Act of 1862 was a public policy decision that used the public lands to avoid unbridgable divisions. The threat of a society split along the crack of those who commanded technology and those who did not was managed by the Morrill Act, establishing the land grant colleges, also enacted in 1862, designed to make technological education broadly available. The split along racial lines spawned constitutional amendments and a number of civil rights laws and decisions. The bridges that span these chasms must continually be repaired and occasionally rebuilt.

Incorporated into the challenge addressed by this symposium is the task of building a bridge across the split along age lines. I argue that a combination of a labor force and economic or productivity responses to the challenge of the aging of the developed world will also help retain the benefits of a republic by creating greater commonality of interests across generations.

6. Actuaries and Labor Force Responses

a. Professional Services

One of these services would be to extend financial planning services to individuals. It may not be economical to provide individual advice, but technology provides a mass alternative to convey personal objective information. Built into this opportunity is the educational challenge to develop better ways to transmit a sense of the range of outcomes with probability indices that may result from a particular decision. Ethical lapses can destroy this opportunity.

The mire that has engulfed some life insurance organizations provides evidence that it is necessary to pay attention to the needs of the customer and to improve methods for communicating a sense of the uncertainty in financial projections.

The second class of suggested services is somewhat untraditional. These services are built on some traditional intellectual actuarial tools and are in accordance with the move of some consulting firms to provide general compensation advice. The task is essentially cost accounting. Actuaries have estimated the cost of compensation systems that include current wages, contingent current benefits, and contingent deferred benefits. The challenge is to improve the measurement of the

productivity so that the value an individual's production is better matched with the cost of producing value.

Unless the match between productivity and compensation costs is better understood, the aging of our population may increase our costs. The result would be a noncompetitive position vis-à-vis developing nations with younger populations. Of course, employee benefits, supported by saving and investments, already exist to smooth real income over a life cycle. The blending of direct wages, related to productivity, and retirement income based on past savings and investment are the key to a labor force response to the aging challenge. This will require reengineering benefits. This response may require a restatement or reinterpretation of age discrimination laws.

b. Financial Security Products

Financial security products are intended to do what their name implies: reduce the fluctuations of real income due to contingent events across a life cycle. Consequently the goal in developing financial security products will not change, but if we are to use a labor force response to the aging challenge, the products must be much more flexible. Multiple decrement models have been used in most financial security products. In a life insurance product the time and amount of benefits depend on the smaller of the time of death or withdrawal. Typical pension plan benefits depend on which of the time of death, disability, withdrawal, or retirement occurs first. Even in health insurance, following withdrawal, an insured becomes a new entrant. A labor force response to the aging challenge will require multiple-state stochastic models with random movements among states such as employed, partially employed, disabled to one of several degrees, and absent for retraining. Income will come from a shifting mixture of wages based on current productivity and income derived from past savings and investment.

The financial security products of the future should relate to real needs. These needs are shifting as a result of the new demographic realities of smaller families, high divorce rates, lengthening life expectancies, and multiple family members in the work force. With smaller or nonexistent families to produce old age services, the security products of the future may be long-term care insurance needs, continuing-care retirement communities, or pensions indexed to the loss of the ability to perform activities of daily living.

The recent enactment of the Kennedy-Kassebaum bill in the U.S. is an example of revisions that will be necessary. To promote productivity, as well as close gaps in financial security, expect public pressure to knock down barriers to labor mobility and retraining.

7. Actuaries and the Savings Response

The savings and investment response, with the hoped-for induced increase in future production, would be the traditional actuarial response to the challenge of an aging society. The response is already being made. The spectacular growth in annuity premium income relative to insurance premium income of life insurance companies is one measure of the importance of this response. The growth of pension assets is another such measure, and even the growth of the OASDI trust fund provides further evidence.

Several considerations must enter the planning process in designing a savings response.

a. Inflation

Inflation is a monetary phenomenon, a monetary response to an economic disequilibrium. One of the arguments for a universal social insurance retirement income system is that government, with its taxation power, can provide inflation-indexed benefits when many financial savings programs would erode. The challenge is to create the political will to avoid inflation, or to insure the threat, for a price, with a system of futures contracts probably traded throughout the world.

b. Concentration of Economic Power

A savings response to the aging challenge would require a significant increase in the savings rate and the accumulation of large pools of capital. Under some proposals, part of this capital would be accumulated through the OASDI system. Would the size of these pools be a threat to the efficient markets that allocate capital to maximize returns? The conventional answer is that the use of index funds would reduce the economic power of fund managers. Yet index funds work because of armies of financial analysts, each with small influence, digging through mountains of economic

information and by their interaction in capital markets creating a consensus allocation of capital. If more capital is tied up in massive index funds, who would do the multiple analyses that make efficient markets work?

One of the driving forces of capitalism is the creative tension between owners and managers. Whether that creative tension would survive in capital markets dominated by passively managed index funds is another question that needs to be considered.

c. Foreign Investment

To those favoring a savings response to the challenge, foreign investment is the analogue of increased immigration for those favoring a labor market response. If growth rates in developed nations are low, perhaps investments in developing nations currently enlisting underemployed human and physical resources into production would permit a savings response to the aging challenge and would, indirectly, speed world economic development. This line of reasoning is attractive and has already been used by many pension funds. Because of the similarity of the distribution of population by age in most developed nations, an additional factor would enter foreign asset allocation decisions. Portfolio theory would suggest seeking investments in nations with a young age distribution to minimize risk.

d. Physical or Human Capital

Adam Smith talked about the "skill, dexterity, and judgement [of] labor." Modern economics has found that increases in production cannot be fully explained by increases in labor, raw materials, and capital. The hidden factor has been identified as technology and management. Will capital markets emphasize investment in plant and equipment and underinvest in education and research, the foundations of technology and good management?

None of the four considerations listed, considered individually or collectively, argues against a savings response. They do, however, indicate some of the risks inherent on a response that adopted a pure savings strategy.

8. Actuaries and Social Insurance

There is a simple actuarial theorem that provides a framework for examining social insurance systems

funded on a current cost basis. The theorem is about an average participant, earning average real wages, paying a fixed proportion of these wages on a current cost basis to support retired lives at a fixed fraction of real wages for active members. If the sum of the growth rate of the labor force and the rate of real wage increases exceeds the rate at which current consumption translates to future consumption, then the system increases the economic welfare of the average member.

The theorem is supported by intuition and, as is true of many theorems, is based on simple and unrealistic assumptions. Yet it does provide a plausible explanation for the public questions about social insurance.

The conditions for a current cost social insurance system to increase welfare were met in many developed nations following World War II. The workforce was growing, real wages were growing, and real interest was low. The theorem would predict that Social Security would be perceived as increasing welfare.

Higher real interest rates, lower rates of growth of the labor force, and lower rates of productivity were associated with increasing questions about the ability of Social Security to increase welfare.

Several papers at this symposium examine ideas for making social insurance an instrument to increase the growth of productivity by increasing forced savings and by investing Social Security trust funds more efficiently. Unless such programs would increase productivity more rapidly than alternative uses of these funds, one could not expect a continuation of almost unanimous political support of the Social Security program.

9. Conclusions

My thesis is that a mixed strategy, involving both savings and labor force components, for the challenge of the graying of the developed world is a good public, corporate, and individual strategy. The thesis is supported by conventional arguments in favor of diversification. A supporting argument is based on the political desirability of keeping some commonality in the interests of the young and the old. A bundle of potential threats to complete reliance on a savings strategy also supports the diversification strategy. These threats include the concentration of economic power, underinvestment in human capital, inflation, and the massive changes in behavior needed to achieve the size of savings that would be needed.

The mixed response that is advocated will provide a new set of actuarial opportunities. Basic models will

likely be multiple-state stochastic processes with many recurring states and only a few absorbing states. New financial security products will concentrate on stabilizing income from a broader range of contingencies, and the stabilization goal will recognize other sources of income. New service opportunities in providing both financial advice and cost accounting and productivity matching advice will arise.

10. Notes and References

Section 1

The changing age distribution in the U.S. did not sneak up on us. *The Reports of the 1971 Advisory Council on Social Security*, Washington, D.C.: GPO, 1971, called attention to the long-term deficit attributable to this change.

The principal sources used in this section are the following: *1996 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance Trust Funds*. Washington, D.C.: GPO, 1996.

Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth. World Bank policy research report. New York: Oxford University Press, 1994.

Starting in July 1995, the Trustees of the OASDI Trust Funds included two public members. One of these members is S. G. Kellison, F.S.A.

Section 2

A guided tour of Adam Smith's two books, *The Theory of Moral Sentiments* (1759) and *Wealth of Nations* (1776), is found in *The Essential Adam Smith*, edited by R. L. Heilbroner. New York: W. W. Norton, 1986. The full version of *Wealth of Nations*, with margin notes by Edwin Cannon, was published by Random House (New York), 1937.

Segments of Malthus's famous essay can be found in the second volume of J. R. Newman, *The World of Mathematics*. New York: Simon and Schuster, 1956.

Section 3

Students of game theory will object to the statement that the assumptions of game theory are seldom realized in the world of business and public affairs. Advances in non-zero-sum, cooperative, and sequential

games make my statement too harsh. These advances have been recognized with a Nobel prize to J. F. Nash.

Section 4

Another macro-meterstick is the misery index defined as the sum of the unemployment and the inflation rate. One of the criticisms of the misery index and the action rule of the Federal Reserve Board is that they implicitly assume an additive model. Statisticians are educated to search for interactive terms. At one time some economists believed that unemployment and inflation rates are inversely related. In a similar fashion, perhaps rapid growth of the workforce draws unskilled workers into employment, and the rate of productivity growth would go down.

Section 5

The political aspects of the aging challenge have been addressed by many commentators. Two recent contributions are: P. G. Peterson, "Will America Grow Up Before It Grows Old?" *Atlantic Monthly*, 277 (May 1996):55-86. L. C. Thurow, *The Future of Capitalism*. New York: William Morrow, 1996.

Section 6

The need to match the age incidence of productivity with compensation is an idea that Nathan Keyfitz has developed: N. Keyfitz, "Technology, Employment, and the Succession of Generations." *Insurance, Mathematics and Economics*, 3 (1984): 219-30.

The expectations of workers and labor law and regulation will have to change to improve the match between wages and productivity. The challenge is to blend wages and pension incomes to achieve incentives for productivity.

The idea of requiring vesting of defined benefit pension plans as a device for promoting labor mobility, and hence total production, was discussed in the 1960 presidential campaign. The action did not come until the 1974 enactment of ERISA.

Section 7

The *Life Insurance Fact Book* issued by the American Council of Life Insurance provides statistics on

time trends in the premium receipts of U.S. life companies.

The report of the 1994–95 Advisory Council on Social Security Technical Panel on Trends and Issues in Retirement Savings is a mother lode of facts and options.

Section 8

The theorem mentioned in this section has been around for many years. For example:

- Henry Aaron, “The Social Security Paradox.” *Canadian Journal of Economics and Political Science*, 32 (1966):371–74.
- J. C. Hickman, “Funding Theorems for Social Security.” *Proceedings of the Casualty Actuarial Society*, 55 (1968):303–11.
- Paul Samuelson, “An Exact Consumption–Loan Model of Interest with or without the Social Contrivance of Money.” *Journal of Political Economy*, 66 (1958):467–82.

The theorem looks at a hypothetical average worker. Examination of the “money’s worth” question for the OASDI system has been done by many experts. For example: R. J. Myers and B. C. Schobel, “An Updated Money’s Worth Analysis of Social Security Benefits.” *Transactions of the Society of Actuaries*, 44 (1992): 247–70.

The recent interest in generational accounting is relevant to a discussion of financing and accounting for a social security system. A critical review of these ideas by Robert H. Haveman is found in *The Journal of*

Economic Perspectives, 8 (1994):95–112. A related measurement tool, “A Generational Equity Index,” was developed by Yuan Chang, *1989 Centennial Celebration Proceedings*, Vol. 2 (1990):985–99.

It is interesting that the third president of the U.S. was cautious about one generation binding another. After carefully calculating the life expectancy at age 21, Thomas Jefferson wrote, “Then 19 years is the term beyond which neither the representatives of a nation, nor even the whole nation itself assembled, can validly extend a debt.”

Section 9

A recent article by Betsy Morris, “The Future of Retirement,” *Fortune* (Aug. 19, 1996), addresses the topic of this symposium on an individual level. After providing estimates of the savings rate needed to maintain a standard of living in retirement reasonably related to postretirement income, it is concluded that “so might a lot of baby-boom professionals do the same, becoming free agents marketing their own service on a project-by-project basis.” The tough assignment is not to activate a mixed strategy for professionals; rather it is to operate the strategy with skilled and unskilled workers. Labor shortages may help ameliorate the implementation difficulties.

The use of multiple-state stochastic processes as models for financial security systems has many advocates. An introduction with a valuable reference list is B. L. Jones, “Actuarial Calculations Using a Markov Model.” *Transactions of the Society of Actuaries*, 46 (1994):227–50.