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Population Aging, Pensions, and Health

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Editorial

For the past five years, researchers in IIASA's Social Security Reform (SSR) Project have been working on issues concerning the reform of national social security systems. The long-term goal of this work, begun in 1998, has been to improve policymaking in the areas of pension and health care reform by deepening the research base. In 2002 parts of this work came to a close, and this issue of *Options* presents several important results from the SSR Project's research.

The issues dealt with here are currently being hotly debated in several countries in the world. In recent weeks, West European nations such as France and Austria have witnessed large strikes in protest of government plans to change the existing pension systems. Other countries have not yet taken action, but are now starting public debate about the affordability of current pension schemes, the need to increase the retirement age, and the long-term feasibility of existing public health systems. IIASA scientists have been at the forefront in the search for solutions to these problems, showing that we not only address climate change but global change in a much wider sense.

Also in this issue of *Options* there is an obituary for Academician Jermen Gvishiani. Academician Gvishiani was chairman of the Institute's Governing Council for almost 15 years. He was involved in many other international activities, two of the most prominent being the Club of Rome and NASA. He was the Soviet delegate when, in the late 1960s, the United States and the Soviet Union discussed collaboration between the space programs of the two nations. Dr. Gvishiani was also very active within his own country: in addition to his long-standing chairmanship of this Institute, he founded and served as president of the Moscow Institute of Economics, Politics and Law. In addition to being a full member of the Russian Academy of Sciences, he was a member of the academies of sciences of a number of other countries. IIASA lost a great man, without whom the Institute most probably would not have been created.

The world has certainly changed since Dr. Philip Handler of the United States and Academician Jermen Gvishiani of the Soviet Union negotiated the founding of IIASA over 30 years ago. In the years that followed, connecting East and West was the driving force for IIASA and its research program. IIASA researchers benefited greatly from access to databases and models that were not known in the West. Since the early 1990s, the world situation and the focus of our research program have changed considerably. We now work on global problems such as the potential size of the forest-related carbon sinks in Russia. This is a very difficult scientific issue, but one that is also extremely policy relevant: whether certain countries sign the Kyoto Protocol might depend on these and other calculations. IIASA scientists are now also collaborating with East European scientists in the fields of flood management, population, and rural development, in addition to the continued collaboration on applied mathematics and systems analysis.

Leen Hordijk
Director of IIASA

The Graying of the Japanese Economy

Japan is in the vanguard of population aging and policies to deal with it. Policymakers in Europe, the United States, and regions of the developing world whose populations will themselves soon be aging are watching closely as Japan breaks the trail that they must follow.

Japan's bleak demographic future

While aging is most often described in terms of a rising elderly dependency ratio (the ratio of the elderly to the working-age population), the starkest picture of Japan's demographic future is obtained by looking simply at absolute change in population by age group. In the latter half of the twentieth century, Japan's population under age 20 declined while the population over 20 increased (see Figure 1a). The sum of the bars to the right-hand side of the diagram exceeds that of the bars to the left, corresponding to the fact that the total Japanese population increased from approximately 84 to 127 million between 1950 and 2000.

United Nations Population Division projections for the first half of the present century indicate that the "twist" observed in Figure 1a will move up the age ladder with a vengeance (see Figure 1b). Only the population in elderly age groups will increase, with most of this increase concentrated among the "oldest old." The sum of the bars on the left-hand side of the diagram outweighs the sum of the bars on the right-hand side, indicating that the total Japanese population is expected to decline to about 100 million over the period.

What will be the economic impact of these historically unprecedented demographic changes? In 2000, the Economic and Social Research Institute (ESRI) of the Cabinet Office of the Government of Japan approached IIASA's Social Security Reform (SSR) Project with an offer to support a comprehensive assessment of population aging in Japan. This assessment, which involved IIASA in a prestigious international network including many Japanese research institutes as well as The Brookings Institution in Washington, the Wharton School in Philadelphia, the Frisch Centre in Oslo, the Ifo Institute for Economic Research in Munich, and others, is now drawing to a close with the publication of *Economic Impacts of Population Aging in Japan* (Edward Elgar, forthcoming). In this *Options* article we describe some of the major results.

Economic impacts

Like other aspects of global change, population aging invites hyperbole and exaggeration. "There's an iceberg dead ahead. It's called global aging and it threatens to bankrupt the great powers," reads the blurb for one widely read book (Peter Peterson's *Grey Dawn*, Times Books). This sort of tubthumping—remember the wall of natural resource depletion that the world was going to crash into in the 1970s?—invites overreaction and costly policy errors. Equally dangerous, however, is complacency in the face of unavoidable emerging policy challenges. What are needed to inform the policy dialogue are methodologically defensible estimates, preferably with uncertainty bounds attached, of the magnitude of economic impacts of population aging.

In order to fill this need, IIASA researchers constructed an economic–demographic growth model articulating linkages between population growth, age structure, the social security system (pensions, health, and long-term care), and long-run macroeconomic performance. The structure and simulation properties of the model are described in detail elsewhere (see Suggestions for Further Reading on page 10), so in this article we will only review the main results obtained by applying it to the case of Japan.

The baseline model run (see Table 1 and Figure 2 on page 6) calls for economic growth per capita to decelerate from 1.8 percent per year in the mid-1990s (not shown) to 1.7 percent in 2000 to 1.3 percent per year in 2040, turning up slightly at the very end of the simulation period. Remember

that the 1990s were years of economic crisis in Japan, so a deceleration even from the rate of growth experienced in the mid-1990s represents a dismal performance compared with the decades that went before. The aggregate saving rate (net national savings over gross domestic product, or GDP, expressed as a percentage) is projected to decline from 7.2 percent in 2000 to 2.6 percent at mid-century; low savings would translate into a slow-growing, aging capital stock. The capital-output ratio rises from 2.6 in 2000 to 3.5 in 2050, indicative of a decline in the productivity of capital as labor grows scarce; the rate of return to capital declines *pari passu* from 5.6 percent in 2000 to 2.6 percent in 2050. Change in net foreign assets, a proxy for the current account balance, is projected to shift from +0.4 percent of GDP in 2000 to –0.1 percent of GDP in 2050, corresponding to a move toward deficit in the current account.

This baseline scenario corresponds to what many other researchers—from John Maynard Keynes in the 1930s to Alfred Sauvy in the 1960s to Julian Simon in the 1980s—have warned of: macroeconomic stagnation arising from unfavorable demography. Japan is already a wealthy society, one might argue, and can afford a few decades of sluggish growth. But lackluster growth is not the end of the story. Many of the problems of an aging society have to do not with the level of output, but with its intergenerational distribution, in other words, the well-being of the elderly versus that of the young. How do various indices of distribution evolve over time in our baseline scenario?

In all industrial countries, the social security system is the key determinant of intergenerational income distribution. Assuming that they stick to what elsewhere in this *Options* we call a "parametric" approach to the problem, policymakers have three ways of responding to the increased pension, health, and long-term care expenditure associated with population aging: raise social security payroll tax rates, reduce benefits, and/or subsidize the social security system with resources transferred from elsewhere in the government accounts (which generally means running larger fiscal deficits). Since today's workers pay social security payroll taxes, today's elderly receive social security benefits, and tomorrow's workers (today's children) have to pay off government debt, different strategies will clearly have differing impacts on the intergenerational distribution of income. For this reason, the results regarding intergenerational distribution represent policy assumptions as much as they do model-based insights.

Our model structure places the burden of adjustment to population aging on social security system contributors by allowing payroll tax rates to rise while not modifying benefit calculation rules or postulating greater subsidies out of general government revenue. However, we impose two specific assumptions in line with recent social security reforms in Japan. First, we assume that the pensionable age rises from 60 in 1995 to 65 in 2015. Second, we assume that only a fraction of the increases in wages are allowed to translate into higher pensions via indexation.

Taken together, these assumptions explain the decline in the relative consumption of the elderly (the ratio of per capita consumption of the population over age 60 to per capita consumption of the population aged 15–59) during the initial years of the simulation (see Table 1 and Figure 2f). If labor force participation in the 60–64 age group were to increase in response to reduced availability of pension income, the distributional shift would be moderated. However, Japanese elderly labor force participation is already very high and, in Europe and the United States, workers' response to rising pensionable age has been to accept lower benefits, rather than working longer (thus, effective retirement ages have continued to decline even as statutory retirement ages have risen). Therefore, in our baseline Japan scenario, we assumed "business as usual" regarding the labor supply of elderly persons, that is, unchanging labor force participation rates as we move forward in time.

A striking phenomenon is that after 2015 (when the pensionable age ceases to rise), intergenerational distribution is stable. This is because two opposing forces roughly cancel each other out: wages increase as labor becomes scarce while the rate of return to capital (held mostly by the elderly) declines as capital productivity falls. Both of these changes tend to favor younger persons. However, increases in social security payroll taxes bite into the disposable income of the young while having little impact on the elderly—this is why the relative disposable income of the elderly rises toward the end of the simulation, when payroll tax increases are pronounced. Given the offset between higher wages and higher payroll tax rates, we would argue, based on these calculations, that population aging need not cause radical changes in intergenerational distribution.

But there is a price to be paid. This smooth adjustment process requires steady increases in social security payroll taxes. Voters in some countries have more stomach for such increases than voters in other countries, yet there is general agreement that once total payroll taxes approach half of gross income, evasion becomes rife, economic distortions and resulting misallocation of resources become pronounced, and deadweight costs (the costs when agents decide to withhold resources from any economic activity whatsoever) balloon. In this dystopia, workers opt out of the formal economy, investors go on strike, and dodging the payroll tax becomes the national sport. Our baseline scenario suggests that, even with the assumed increase in the

Continued on page 6

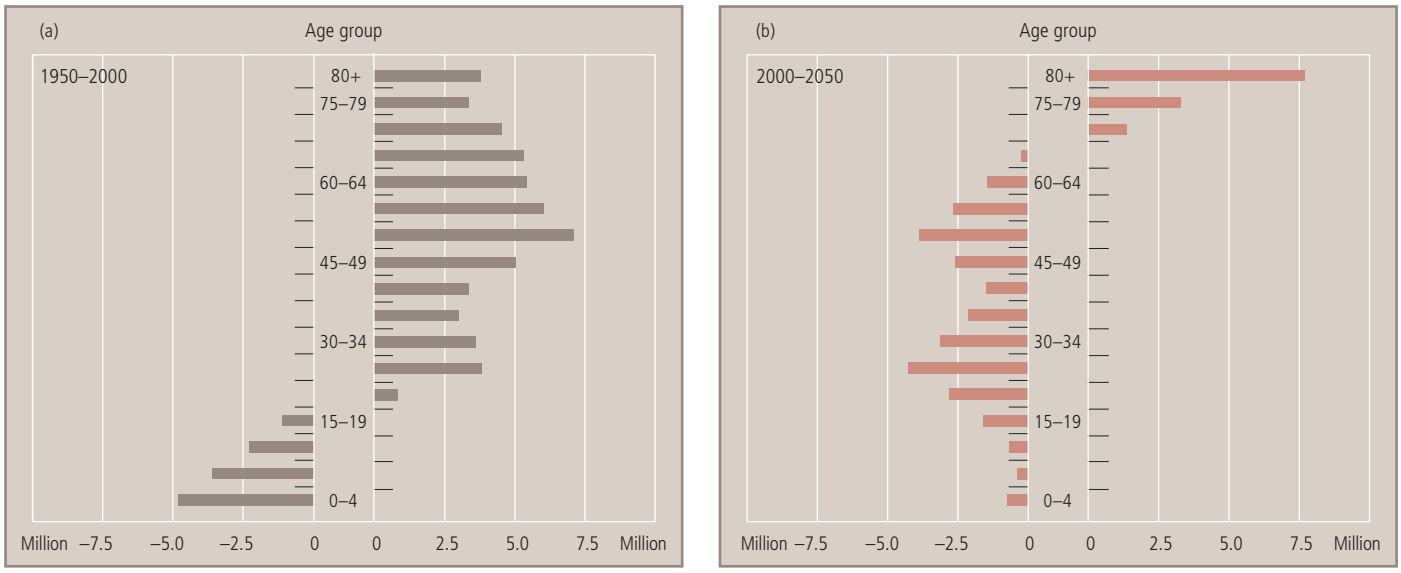


FIGURE 1: Change in total population (in millions) by age group, Japan: (a) 1950–2000; (b) 2000–2050. *Source*: United Nations Population Division.

Population Aging in Japan: Policy Lessons for Southeast Asia

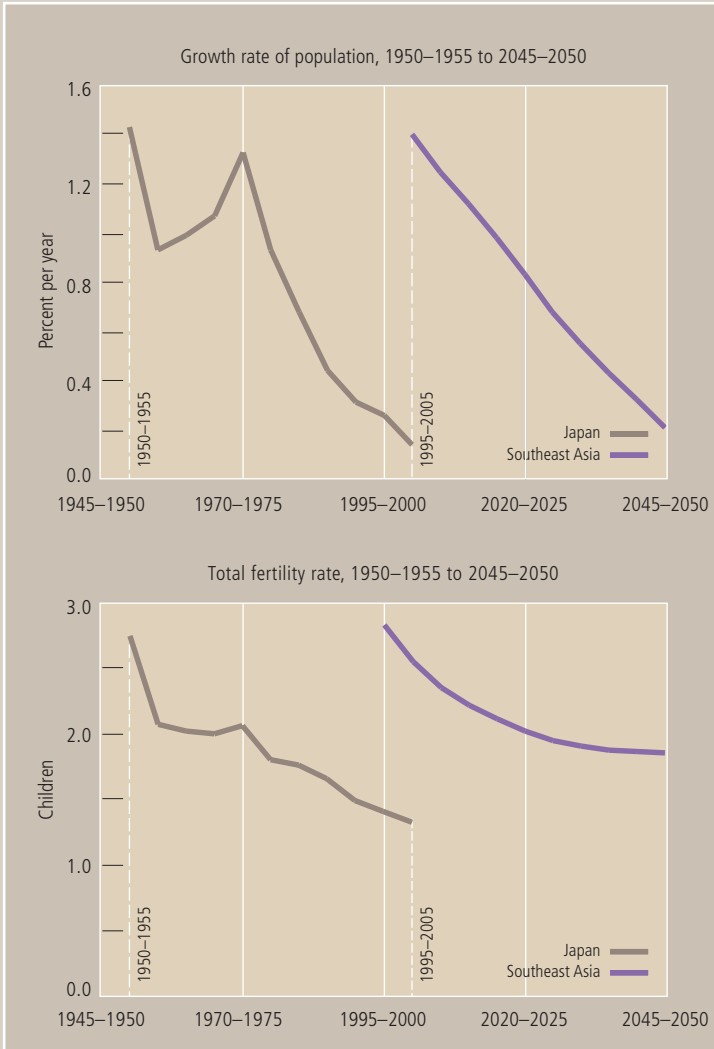
Projections from the United Nations (UN) Population Division indicate that demographic trends in Southeast Asia will closely track those of Japan, but with a 50-year lag (see figures in box). Assuming that the future economic and demographic situation of Southeast Asia will be comparable to that currently observed in Japan, what policy lessons can be learned from the Japanese experience? In June 2002, IIASA Visiting Research Scholar David Horlacher presented a paper addressing this question at the conference on "Southeast Asia's Population in a Changing Asian Context" organized in Bangkok by the International Union for the Scientific Study of Population. This paper, appearing shortly in the UN Economic and Social Commission for Asia and the Pacific's *Asia-Pacific Population Journal,* grew out of work undertaken at IIASA in the Social Security Reform (SSR) Project.

The countries of Southeast Asia (defined here as Brunei Darussalam, Cambodia, Timor-Leste, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam) vary widely in terms of culture and level of economic development. Most, however, share an important characteristic with Japan—they have experienced or are experiencing rapid fertility decline. As a result, by 2050, the demographic profile of Southeast Asia should closely resemble that of Japan in 2000, and many of the same economic issues currently facing Japan will be challenging the nations of Southeast Asia. However, the scale of these problems will be much larger in Southeast Asia, since its population in 2000 was more than 522 million, compared with Japan's population of about 84 million in 1950 (about the time that accelerated fertility decline commenced). Moreover, although the current growth rate of gross domestic product (GDP) in Southeast Asia is not dissimilar to that of Japan in 1950, Southeast Asia must begin its economic climb from a much lower base: in the year 2000, per capita income in Southeast Asia was about one-fourth that of Japan in the 1950s. Japan developed first, then aged. The countries of Southeast Asia, for the most part, will age while they are still developing. The same holds true for China (not, properly speaking, a Southeast Asian country, but one which shares many characteristics with countries in the region).

What can policymakers in Southeast Asia learn from looking at the Japanese experience? Six lessons, in particular, stand out:

■ *Pay close attention to income distribution.* In the absence of a comprehensive pension system of the type that has developed in advanced industrial societies, population aging redistributes income from older persons to younger ones, as does rapid economic growth. It also raises the proportion of the population belonging to those age groups where the distribution of income is relatively unequal (the aged) in the total population (in other words, there is much more income inequality among 70-year-olds than among 30-year-olds). In view of the already substantial degree of economic inequality in some Southeast Asian nations, policymakers should undertake efforts in other spheres to offset the increasing inequality due to population aging.

■ *Make efficient use of labor.* This lesson has three components: First, maintain a flexible labor system. Second, employ scarce labor in the most efficient industries. Third, enable women in the prime childbearing ages to combine motherhood and careers. The Japanese labor market is characterized by lifetime employment, seniority-based compensation, mandatory retirement at an early age, and widespread (though illegal) labor-market discrimination against women. The economies of Southeast Asia should try to avoid such institutions since the Japanese experience proves that, once in place, they are extremely difficult to remove, even in the face of a rapidly aging labor force. Policymakers should also resist the temptation to protect inefficient industries, which by misallocating labor to "sunset sectors" can only worsen the problems of an aging, slow-growing, or declining labor force. Specializing according to comparative advantage and opening markets to imported goods are key elements of this strategy. While there is some scope for increasing the labor input of elderly males, in Southeast Asia, as in Japan, elderly male labor force participation rates are already very high. Moreover, the experience of today's developed countries is that, as income rises, the participation of the elderly in the labor force declines steeply—this is only natural, because demand for leisure rises with income. We do not mean that egregious institutional disincentives to elderly labor force participation should be ignored, just that declining elderly labor



force participation rates should not necessarily be viewed with alarm. Potentially more serious is the inability of some women to participate in the labor market although they wish to do so. As the societies of Southeast Asia start to cope with labor force decline, they should do their utmost to eliminate the disincentives to female labor force participation. By doing so they could neutralize a very large part of the expected negative impact of demographic trends on their economies.

■ *Provide incentives for saving.* It is likely that population aging in Southeast Asia will put downward pressure on household saving rates as well as government fiscal balances. For a time, saving rates will increase in the rapidly growing nations of Southeast Asia; but after 2025, many forecasts call for the aggregate saving rate to decline. The governments of the region should offset this potential decline by providing significant incentives to savers. As Masayo Wakabayashi demonstrated in a paper she wrote in 1999 while a participant in IIASA's Young Scientists Summer Program, this challenge will be especially acute in China, where rural savings have traditionally provided large amounts of capital for (mostly urban) development. "Financial repression"—a policy that seeks to stimulate economic growth by keeping interest rates artificially low, reducing savers' menu of asset choices, and maximizing government's control over investible funds—is a thoroughly misguided policy in an aging but still developing country.

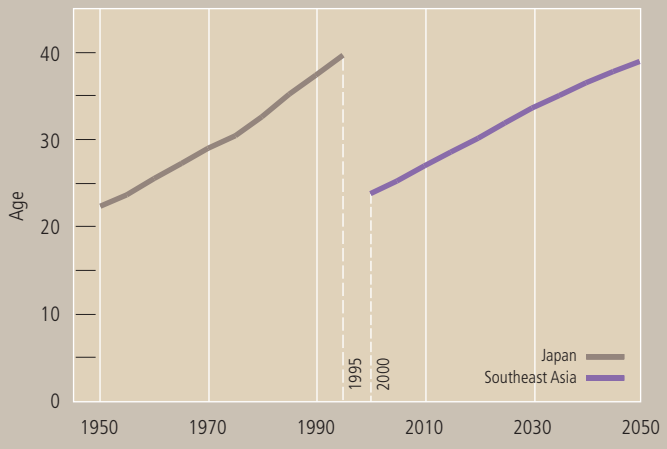
■ *Do not regard investing abroad as a panacea.* In 1995, *The Economist* wrote categorically that investing abroad was the best way to "beat" population aging. According to this argument, savings from aging countries, where labor is becoming scarce and the rate of return to capital is declining, should be reallocated to countries where labor is abundant and the rate of return is high. Japan has long dealt with low domestic rates of return by investing in relatively capital-poor countries, and there is little doubt that the countries of Southeast Asia will also be investing significant sums abroad. However, they should be forewarned that empirical and analytical studies (including joint research done by IIASA's SSR Project and the Development Centre of the Organisation for Economic Co-operation and Development) indicate that the increase in the risk-adjusted rate of return as a result of this improved portfolio allocation is likely to be modest. By depressing domestic wages, investment abroad makes it more difficult to finance national pension schemes and to generate retirement savings. Finally, who benefits most from improved portfolio allocation? Those who have portfolios to allocate, that is, the well-to-do. The lifetime poor, who depend on labor income when young and wage-based transfers (whether traditional family transfers or transfers mediated by a public pension system), gain little from international diversification.

■ *Promote the education of young people.* By making labor scarce, population aging will be accompanied by an increase in real wages. This increase might induce younger cohorts to invest in more human capital, resulting in enhanced productivity. On the other hand, there is a danger that young cohorts might eschew advanced education to take advantage of higher wages. The countries of Southeast Asia cannot assume that a slowing in the accumulation of physical capital will be offset by an increased rate of accumulation of human capital. They will have to actively promote the education of young people.

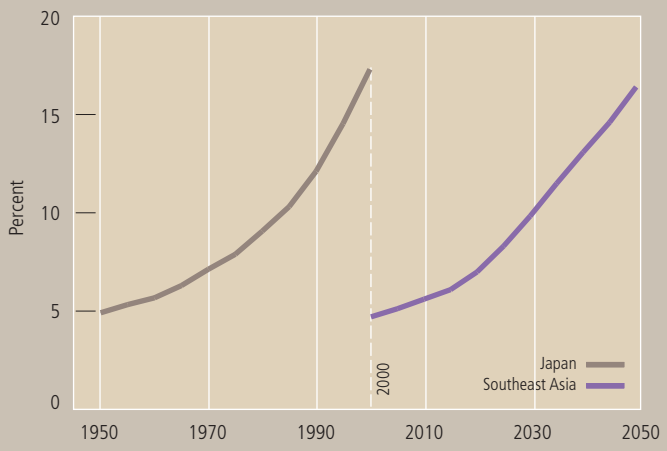
■ *Limit commitments for public pensions and health care.* The international policy landscape is littered with the broken promises of ambitious social security schemes. The lesson is clear: Do not make social security promises lightly! Breaking them is messy, disruptive, and costly! Stand firm against the efforts of politically influential groups and the "labor aristocracy" (miners, teachers, firefighters, etc.) to lay claim to resources. Do not attempt to expand imported social security approaches to settings where they may be inappropriate, for example, among the rural poor. Assess the effectiveness and broad social impact of traditional support systems: where they are working well, do not allow them to be crowded out by formal social security schemes.

Rapid population aging in Southeast Asia (and China) is inevitable, as are many of the economic challenges that accompany it. However, by heeding the lessons of the Japanese experience, policymakers can do much to avoid costly mistakes. Difficult as it is to adopt a long-term view, it is crucial that Southeast Asian policymakers, as well as those in China, start now to plan for an older society. ■

Median age, 1950–2050



Share of the population aged 65 and over, 1950–2050



Source: United Nations Population Division

TABLE 1: Baseline scenario, summary presentation.

	2000	2010	2020	2030	2040	2050
Demography						
Population (annual % change)	0.2	–0.1	–0.4	–0.5	–0.6	–0.6
Labor force (annual % change)	0.1	–1.2	–0.6	–0.8	–1.0	–0.8
Population 60+ : Population 15–59 (%)	34.7	49.0	57.1	61.9	73.1	74.9
Macroeconomy						
GDP per capita (US$)	39,943	46,253	53,435	62,399	71,317	80,249
GDP per capita (annual % change)	1.7	1.4	1.6	1.5	1.3	1.4
Capital-output ratio	2.6	2.9	3.1	3.3	3.4	3.5
Rate of return to capital (%)	5.6	4.8	4.0	3.4	2.9	2.6
Net savings (% of GDP)	7.2	6.6	5.6	4.7	3.5	2.6
Change in net foreign assets (% of GDP)	0.4	0.3	0.1	0.1	0.0	–0.1
Gross foreign investment in Japan (% of GDP)	5.9	5.3	4.5	3.7	2.7	2.0
Gross Japanese investment abroad (% of GDP)	5.5	5.1	4.3	3.6	2.8	2.1
Social insurance						
Public pension system						
Payroll tax rate (% of pre-tax wage income)	22.6	24.6	25.4	25.7	29.3	32.3
Payroll taxes (% of GDP)	8.4	9.1	9.3	9.4	10.7	11.7
Health system						
Payroll tax rate (% of pre-tax wage income)	7.3	8.4	9.2	9.7	10.1	10.4
Payroll taxes (% of GDP)	5.2	5.9	6.5	6.8	7.1	7.2
Long-term care system						
Payroll tax rate (% of pre-tax wage income)	2.4	2.8	3.1	3.2	3.4	3.5
Payroll taxes (% of GDP)	1.7	2.0	2.2	2.3	2.4	2.4
Intergenerational distribution						
Disposable income per capita, population 60+ : population 15–59 (%)	127.6	97.3	83.6	78.8	79.4	86.6
Non-health-related consumption per capita, population 60+ : population 15–59 (%)	134.5	103.4	88.9	84.5	86.8	95.2
Assets per capita, population 60+ : population 15–59 (%)	203.4	160.3	140.1	137.2	137.3	148.5

retirement age and only modest wage indexation, the Japanese social security system will be skating on thin ice by mid-century. The payroll tax rate necessary to balance the public pension system is projected to rise from 22.6 percent in 2000 to approximately 25 percent in 2015, after which it continues to increase to 32.3 percent in 2050 (see Figure 2e). The health system payroll tax rate is estimated to rise from 7.3 percent in 2000 to 10.4 percent in 2050, and the long-term care payroll tax rate, from 2.4 percent to 3.5 percent. The sum of all three payroll tax rates thus rises from 32.3 percent in 2000 to 46.2 percent in 2050. This is the price of the rather benign outlook for intergenerational income distribution in the outer years of our scenario.

How important is demographic uncertainty?

One excuse sometimes used by policymakers to avoid necessary reform measures is that the demographic forecasts may be wrong. How sensitive is the scenario we have just described to demographic uncertainty? To answer this question, we combined the baseline population scenario we used (from the United Nations Population Division) with the results of demographic uncertainty analyses done by IIASA's Population Project. In Figure 3 we display paths of selected economic variables under three demographic scenarios: a central fertility–central mortality–central migration scenario, which is our baseline; a low fertility–central mortality–central migration scenario; and a central fertility–low

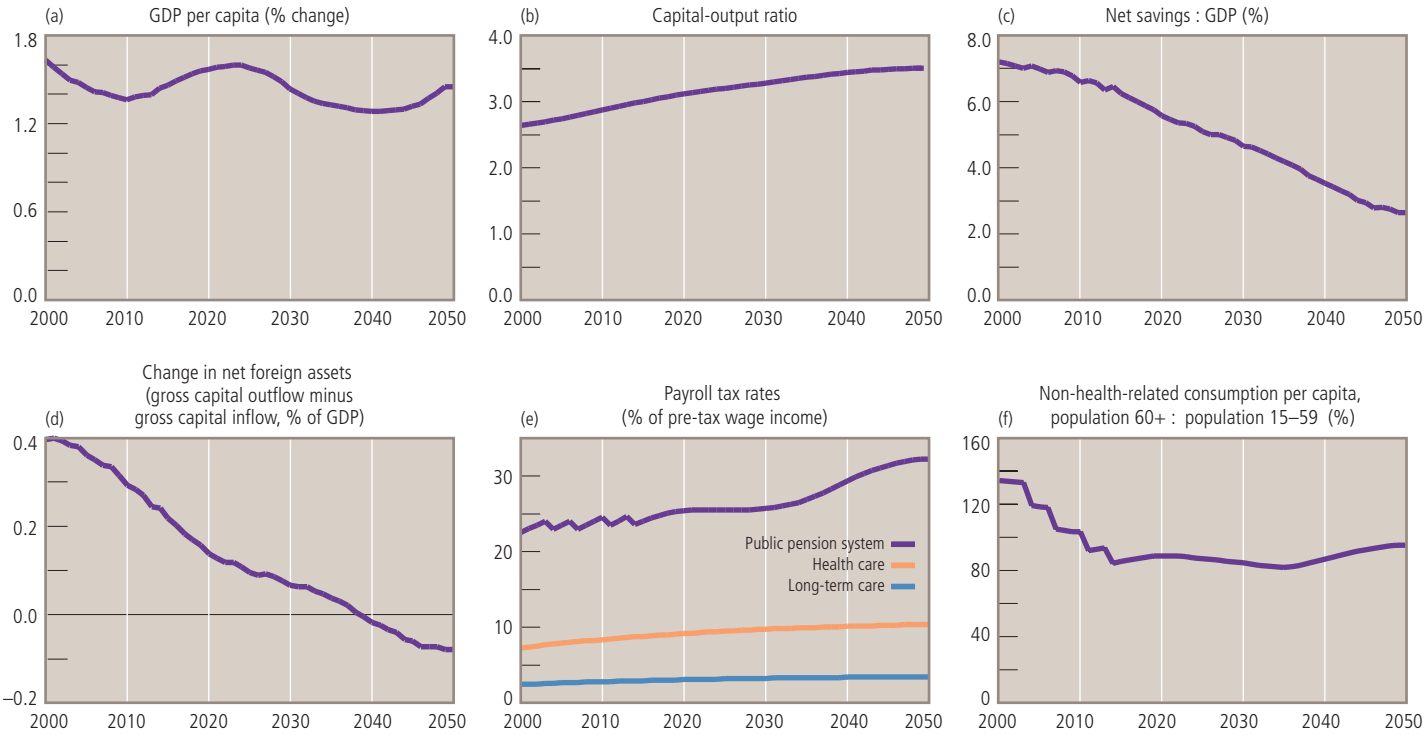


FIGURE 2: Baseline scenario, summary results.

mortality–central migration scenario. We choose to examine low fertility and low mortality because history indicates that Japanese demographers have consistently erred on the side of overestimating fertility and underestimating longevity. In fact, in every population projection undertaken since 1975, the responsible Japanese ministry has significantly revised its fertility forecast downward! We ignore alternative migration scenarios because there is not the slightest evidence that Japanese society is willing to liberalize immigration restrictions.

The variables illustrated are GDP per capita, the aggregate saving rate, assets of the private defined-benefit (DB) and defined-contribution (DC) pension systems combined (expressed as a percentage of GDP), the ratio of the disposable income per capita of the elderly population relative to that of the working-age population (expressed as a percentage), and the payroll tax rates needed to balance the public pension and combined health and long-term care systems.

The most important conclusion to be drawn from examining Figure 3 is that overall trends in these selected variables are, practically speaking, insensitive to the choice of demographic scenario. Lower-than-expected fertility might increase per capita GDP on the order of 4 percent after 50 years; lower-than-expected mortality might reduce it 5 percent (see Figure 3a). Given the long time frame, these results might be described as "significant but modest."

Both low fertility and low mortality have the effect of reducing the aggregate saving rate by increasing the share of the adult population in the dissaving elderly age bracket. The impact of low fertility is the more significant of the two (Figure 3b), because in the long run, low fertility has a greater impact on the elderly dependency ratio (defined, in our case, as the ratio of the population aged 60 and over to the population aged 15–59, expressed as a percentage) than does low mortality—a phenomenon well known to demographers.

Not surprisingly, lower-than-expected fertility and mortality both have the effect of increasing social security payroll tax rates (see Figures 3e and 3f; note that these payroll tax rate increases also contribute to the saving rate impacts described above by reducing the disposable income out of which savings are drawn). These increases amount, in proportional terms, to roughly 10–15 percent after 50 years, again, "significant but modest" would be a fair characterization. The impact of low mortality on pension payroll tax rates is more significant than that of low fertility (see Figure 3e) for two reasons.

The first reason has to do with the ratio of beneficiaries to contributors, which is practically the same thing as the elderly dependency ratio. Low mortality increases the number of old persons receiving pension benefits right away owing to enhanced survivorship, whereas low fertility reduces the number of system contributors (i.e., workers) only after a lag of 15–20 years. As mentioned above, in the long run, low fertility will have a stronger impact on the elderly dependency ratio than will low mortality. These dynamics explain why, in Figure 3e, the impact of low mortality on the pension system payroll tax rate is much greater than the impact of low fertility in the early years of the simulation, but the gap has almost closed by mid-century (and if the simulation were extended, low fertility would start to have the greater impact).

The second reason that low mortality increases pension payroll tax rates more than low fertility has to do with the differing impacts of low mortality and low fertility on the wage rate. Low mortality instantly reduces the wage rate as more elderly persons survive and participate in the labor market. Low fertility, by contrast, increases the wage rate, albeit only when a dearth of workers develops after 15 or 20 years.

Similar logic explains the impacts of low fertility and low mortality on health and long-term care payroll tax rates, which for economy of presentation we combine in Figure 3f. In the long run, low fertility increases the combined health and long-term care payroll tax rate slightly more than does low mortality because it has the greater effect on the elderly dependency ratio.

Low fertility has no discernible impact on the ratio of the disposable income of the elderly relative to that of the young (see Figure 3d) because of an offset described previously: payroll tax rates are higher for the young, but so is the wage rate. By contrast, low mortality increases the disposable income of the elderly relative to that of the working-age population. Why? Because it increases payroll tax rates paid by the young (the number of beneficiaries is higher, the wage rate is lower), and the rate of return on the assets held predominantly by the elderly is higher. Low mortality also increases the share of the elderly population in the "oldest old" category, who receive substantial transfers in the form of health and

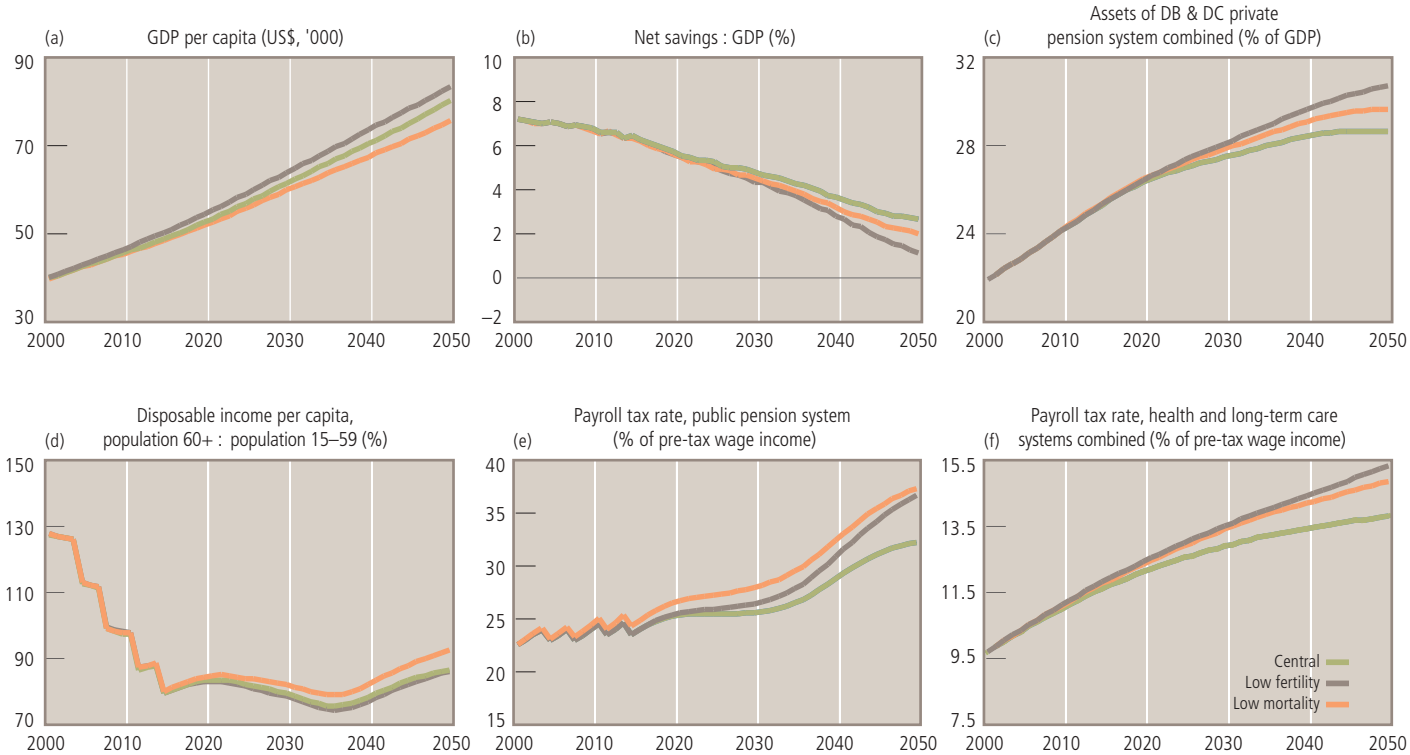


FIGURE 3: Three demographic scenarios (central, low fertility, low mortality).

long-term care benefits (counted as part of disposable income). Finally, in both alternative demographic scenarios, total private pension system assets are higher relative to GDP (Figure 3c). In mathematical terms, this reflects the fact that GDP is a fast-reacting flow variable whereas assets are a slow-reacting stock variable. A more satisfying real-world interpretation, however, is that since the population is older, on average, in each case, the ratio of pension wealth to income is higher. Low fertility has a greater impact than low mortality in this plausible story because it has the greater impact on average age.

These results tell us that even if fertility is much lower than expected, and even if longevity is much greater than expected, the general evolution of the economy will be more or less as in the baseline scenario. Given the track record of past demographic forecasts, this is an essentially upbeat conclusion—whatever downside risks are out there for Japan, adverse demography is probably not one of the more significant of them! However, by the same token, since our model is essentially linear, the less sanguine symmetric conclusion also follows: even if, unlikely as it seems based on past forecasts, demographers have underestimated future fertility and overestimated future mortality, Japan is still likely to turn in the mediocre macroeconomic performance described above. A policymaking Mr. Micawber might ignore population aging on the assumption that something, in the form of an upturn in fertility, is sure to turn up. Our uncertainty analysis suggests that this would be unwise.

Could faster productivity growth save the day? Productivity is a wild card; even its definition is hard to pin down, let alone its measurement and modeling (see the box opposite). However, we offer two observations that incline us in the direction of pessimism in the case of Japan. First, Japan is already one of the most technologically advanced nations in the world, and nowhere is there greater penetration of productivity-enhancing devices. At the same time, Japan has shown itself to be extremely slow to embrace productivity-enhancing social and institutional changes, whether they have to do with labor market institutions, financial architecture, corporate governance structures, or the political process.

Lessons for policymakers and conclusion

IIASA's work tends to confirm fears that population aging in Japan will give rise to an era of slower economic growth, reduced availability of savings, and low return on capital. With due respect to Peter Peterson (or whoever wrote the blurb for *Grey Dawn*), what we have described could in no way be interpreted as the bankrupting of a great power! However, the outlook gives cause for concern, and even this rather pessimistic scenario contains a risk factor—social security payroll taxes rising into a danger zone. "That will never happen because voters will never put up with it," some readers

Continued on page 10

Population Aging and Productivity

The impacts of population decline and aging on economy-wide productivity are largely speculative, because there are so many factors to consider. Does a declining labor force (combined with a shrinking domestic market) act as a drag on productivity because it prevents firms from exploiting economies of scale and reduces opportunities for learning by doing? Does technological innovation stagnate in a slow-growing population or, to the contrary, does labor scarcity induce innovation? These and other related questions have attracted some of the best minds in economics, and no straightforward answers have emerged. More mundane, but also important, questions have to do with the degree of substitutability between older and younger workers and the impact of population aging on the human capital investment decisions of the young.

In the presence of theoretical uncertainty, one reasonable approach is to treat economy-wide productivity as a stochastic variable. IIASA Research Scholar Tatiana Ermolieva modeled "total factor productivity" (productivity of labor and capital combined) using a so-called autoregressive conditional heteroscedastic (ARCH) process and solved the SSR Project's model in Monte Carlo fashion. In addition to reasonably-sized stochastic shocks, an exogenous 10 percent upward productivity shift was incorporated in the middle years of the simulation period. In the case of all variables calculated as a rate or a percentage, the mean and median (calculated across the runs of the Monte Carlo simulation) finished the 55-year simulation period quite close to the baseline. In the case of GDP per capita, at the end of the simulation period the stochastic mean and median were a little more than 10 percent above the baseline, a result of the persistent multiplier effect of the 10 percent intervention. As a general proposition, however, the stochastic uncertainty bands were relatively narrow and symmetric around the baseline even at the end of the simulation period. These results suggest that the baseline scenario described here is reasonably robust to unexpected impacts of population aging on total factor productivity.

Another way of approaching the problem of population aging and productivity is to confine ourselves to individual, not economy-wide, productivity and search for systematic variation by age. This was the theme of research undertaken in 2002 by Vegard Skirbekk, a participant in IIASA's Young Scientists Summer Program working in the Social Security Reform (SSR) Project. Age-productivity profiles based on three types of studies—supervisor's ratings, production records, and large-scale employer–employee datasets—suggest that labor productivity tends to stabilize and often decrease after a mid-career peak. This decrease in productivity is in contrast to almost lifelong increases in wages.

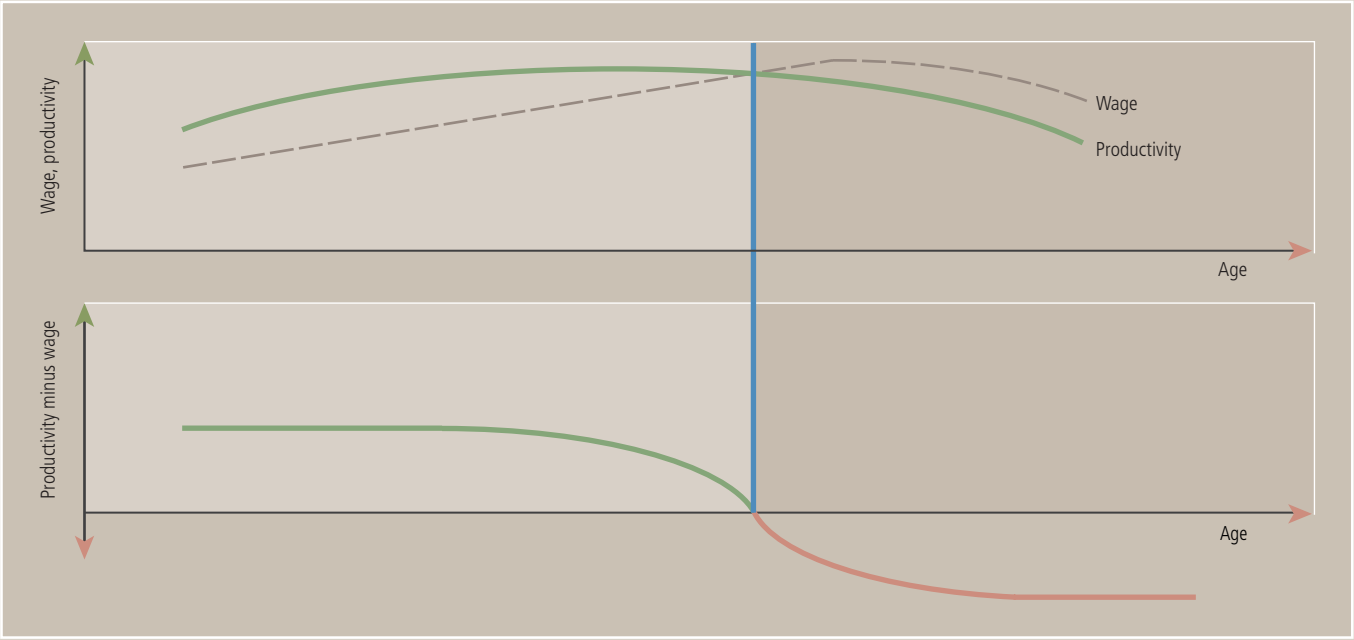
Surveys of studies based on managers' ratings of their employees tend to find no or only a weak relationship between the assessment score and the employee's age. Some of this evidence can easily be dismissed as biased: supervisors tend to inflate evaluations of senior employees because of feelings of loyalty and as an acknowledgment of past achievements. Stronger effects have been found, however, in industries with rapid technological change, where a pronounced effect of age on productivity (with peak productivity around age 30) is in evidence.

Studies based on production records analyze output measures such as the number of items produced within a given time period. In the post–World War II years, when labor was in scarce supply, many studies in what was then called "industrial gerontology" attempted to assess the productivity of elderly employees. Mail sorters and office workers were found to maintain their productivity even at advanced ages, whereas factory workers had a drop in productivity after the

age of 55. Various sampling biases may weaken such evidence, but perhaps more telling is that individual productivity (say, the number of shoes per day that an employee in a footwear factory produces) may not be as important as more diffuse characteristics. Older workers are more likely to have been sorted into the functions they perform best (vis-à-vis other employees, i.e., even though at an individual level they may not perform as well as they did when they were younger). They are also less prone to absenteeism and less likely to change jobs (job-switching significantly reduces the return to on-the-job training). Older workers may also possess firm-specific knowledge—a feeling for "the way things work around here"—which they impart to younger employees, enhancing the productivity of the latter. Not all researchers agree, though—one theory for why pension systems evolve is that the presence of older workers in the workplace drags down the productivity of young ones!

large firms that offer traditional defined-benefit pension plans: pension accrual rates often diminish rapidly just before retirement, thus reducing the net wage. However, even controlling for this, older workers still earn more than younger workers. The reason appears to be that firms make an implicit bargain with young workers: we will pay you less than you are worth now, but if you stick with us, we will make it up to you later. In this way, firms discourage younger workers from leaving (or behaving in ways that would lead to dismissal), taking their on-the-job training and firm-specific human capital with them.

In countries with "rigid" labor markets, such as Germany, France, and Japan, this institutional arrangement in the labor market is a source of trouble in an aging society. Firms that are unable to shed elderly workers or adjust their wages downward to match their productivity (i.e., rotate the age-wage profile clockwise) will face declining profitability. Pressures will rise on the



Analyses of employer–employee datasets study the impact of the age structure of a firm's labor force on the firm's output. Several of these firm-level studies found that productivity levels of older workers tend to be lower than those of their younger counterparts. However, it is difficult to isolate the effect of the age structure from all the other factors that influence the firm's output levels. Furthermore, the use of cross-sectional evidence does not reveal whether a younger age structure is the *result* of the firm's success—that is, it attracts younger workers—rather than its cause. However, some studies that control for this ambiguity confirm that most work groups past the age of 50 tend to be less productive than their younger counterparts.

If the balance of evidence, while ambiguous, tends to suggest that worker productivity declines after middle age, then why do age-wage profiles rise monotonically until retirement? In the stylized situation presented in the boxed figure, the worker's productivity levels are above his or her wage at young ages, but below them at older ages. There are several reasons why this age-wage profile is observed. First of all, the monotonic rising trend is exaggerated in state to accommodate the offloading of elderly workers through accommodative public pension arrangements (early retirement, liberal granting of disability pensions, etc.). Policies intended to increase labor market participation of older individuals may be difficult to implement because they are too expensive to employ. Motivated by increases in life expectancy and the upcoming retirement of the baby boomers, policymakers around the world put forward "active aging." But who *wants* older workers in the workplace? Not employers, for whom they are too expensive. Not unions, who find themselves locked into difficult bargaining positions to protect older workers. And, at least to believe survey evidence, not most workers themselves, who feel entitled to a substantial period of retirement.

To conclude, the relationship between the average age of the labor force and economy-wide productivity is very complicated. At the individual level, the bulk of the evidence tends to suggest that productivity declines after middle age. If so, economies characterized by rigid labor markets may be in trouble as their labor forces age. ■

will comment. Perhaps, but then benefits will have to be slashed, with severe consequences for the well-being of old people (and consequent pressures on the working population to substitute private intra-family transfers for public pensions). Alternatively, there will be a flood of red ink in government fiscal accounts. None of the alternatives is attractive.

What forward-looking policy measures are called for? Many recommendations, not all of which can be presented here, emerge from the IIASA study:

■ *Worry about labor force participation of women, not the elderly.* It is *de rigeur* for policymakers to preach the virtues of active aging, and none do so more loudly than the Japanese. But Japanese elderly labor force participation rates are *already* extremely high, much higher than in any other Organisation for Economic Co-operation and Development (OECD) country. By contrast, there are large numbers of so-called invisible workers, mostly women in child-bearing years, who report that they would like to work but do not. Among the reasons given are lack of child care, lack of elder care, social disapproval of working wives, unwillingness of husbands to help out with housework, poor status of women in the workplace—the list is long. A valuable side effect of addressing some of these problems is that marriage and child rearing would become a more attractive choice for Japanese women, giving some relief on the demographic front.

■ *Continue efforts to structurally reform the pension system…* In the early 1970s, when the Japanese pension system was first broadly expanded, policymakers declared that, having achieved remarkable economic development, Japan could now afford a first-class pension system. Like policymakers throughout the OECD, they have been trying to back off this promise almost ever since, and they need to redouble their efforts. Increasing the retirement age is a reasonable step in a country where elderly life expectancy is as high as it is in Japan. Legislation to facilitate private fully funded DC pension plans was recently put in place; this is a welcome move. Pension system disincentives to work, especially those affecting married women, need to be eliminated.

■ *…but do not give credence to assurances that household savings will be enhanced by various reform measures.* The global social security policy debate has been characterized by too many assertions about the relationship between the nature of the social security system and savings, particularly household savings. Surely a fair assessment would have to conclude that economists do not really know why households save. In no country is this truer than Japan, where factors ranging from the poor availability of consumer credit to strong bequest motives to the low quality of the Japanese housing stock to earthquake frequency have been invoked to help explain Japan's high household saving rate. Population aging redistributes households from saving years to dissaving years, and this relatively straightforward process is likely to prove stronger than other impacts on household savings mediated through changes in the social security system.

■ *Most importantly, recognize that population aging will have pervasive consequences whatever the level of state involvement in pensions and health, and however that involvement is financed.* Sometimes missed in bitter ideological disputes about pensions and health—public versus private, pay as you go versus funded, and so on—is the fact that one way or another, the working-age population must be induced to forego consumption in order to free up economic product to be consumed by the non-working elderly. If the elderly finance their consumption by divesting themselves of assets they accumulated during their working years, then younger households must forego consumption in order to buy those assets. If the elderly finance their consumption from income provided by a traditional PAYG public pension system, then younger households must forego consumption in order to pay the necessary payroll taxes. If the severely disabled elderly are cared for in public institutions, younger taxpayers must foot the bill; if the public institutions are closed, younger households will have to provide the necessary care themselves in the home or pay for care in private institutions. In population aging, as in every other area of economics, the old saying "There's no such thing as a free lunch" applies.

Looking back a half century, Japan was a poor country with a dismally overcrowded agricultural sector and an undercapitalized industrial sector producing simple consumer goods whose low quality was the butt of jokes. Japan is now one of the richest, most technologically advanced countries in the world, thanks in part to high saving rates associated with the post-war demographic transition. But the reduced youth dependency ratio that facilitated saving is now working its way up the age ladder, translating into a swollen elderly dependency ratio, with exactly the opposite effect. This is the "unwinding" of a major component of the Japanese economic miracle.

To borrow a metaphor from John Maynard Keynes, in the second half of the twentieth century, Japan tamed the Malthusian demon of rapid population growth. But now it needs to tame the anti-Malthusian demon of demographic stagnation. ■

Suggestions for Further Reading

This *Options* summarizes work in a number of areas undertaken by IIASA's Social Security Reform (SSR) Project. For a project description and full list of outputs, see www.iiasa.ac.at/Research/SSR.

The Graying of the Japanese Economy The SSR Project report to the Economic and Social Research Institute, titled *Economic Impacts of Population Aging in Japan*, by L. MacKellar, T. Ermolieva, D. Horlacher, and L. Mayhew, is available online at www.iiasa.ac.at/Research/SSR/docs/tokyo-rep.pdf?sb=11. A book by the same title will be published by Edward Elgar in late 2003. An authoritative review of the English-language literature on aging in Japan is provided by D. Horlacher (2001–2002), Aging in Japan – Causes and Consequences, Part I: Demographic Issues, Part II: Economic Issues, Part III: The Elderly, IIASA Interim Reports IR-01-008, IR-01-009, and IR-02-002. For further reading on individual age and productivity, see V. Skirbekk (2002), Variations in Productivity over the Life Span: A Review and Some Implications, IIASA Interim Report IR-02-061. The robustness properties of the SSR Project model are examined in T. Ermolieva, A. Westlund, and L. MacKellar (2001), On long-term forecasting of social security: a robustness analysis, *Quality and Quantity* **35**:33–48. D. Horlacher's conference paper "Population Ageing in Japan: Economic Issues and Implications for Southeast Asia" is available online (www.iussp.org/Bangkok2002/S17Horlacher.pdf) and will be published later this year in the *Asia-Pacific Population Journal* of the UN Economic and Social Commission for Asia and the Pacific. Policy lessons from Japan for European policymakers are discussed in L. MacKellar and D. Horlacher (2001), Population ageing in Japan: A brief survey, *Innovation* **13**(4):413–430. The question of international diversification is considered in L. MacKellar and H. Reisen (1999), A simulation model of global pension fund investment, *OECD Development Centre Technical Paper* No. 37. For the impact of population aging on saving rates in China, see M. Wakabayashi and L. MacKellar (1999), Demographic Trends and Household Saving in China, IIASA Interim Report IR-99-057. General issues of population aging and social security are treated in L. MacKellar (2000), The predicament of population aging, *Population and Development Review* **26**(2):365–97 and L. MacKellar and W. McGreevey (1999), The growth and containment of social security systems, *Development Policy Review* **17**:5–24.

Policy Pathways to Health in the Russian Federation Proceedings of the IIASA / Institute for Socio-economic Studies of Population / Independent Institute for Social Policy workshop "Policy Pathways to Health in the Russian Federation," to be held in Laxenburg on 19–20 September 2003, will be available on IIASA's Web site within a month following the workshop.

Financing Urban Health Insurance in China See Su Liu and L. MacKellar (2001), Key Issues of Aging and Social Security in China, IIASA Interim Report IR-01-004. The micro-simulation approach employed is described in M. Spielauer (2002), Dynamic Micro-simulation of Health Care Demand, Health Care Finance, and the Economic Impact of Health Behavior, Part 1: Background and Comparison with Cell-based Models and Part 2: Survey and Review, IIASA Interim Reports IR-02-032 and IR-02-036.

Parametric and Paradigmatic Styles in European Pension Reform See R. Holzmann, M. Orenstein, and M. Rutkowski, eds. (2003), *Pension Reform in Europe: Progress and Process*. World Bank, Washington, DC.

Aging and Disability: Are Our Support Systems Sustainable? See L. Mayhew (2000), *Health and Elderly Care Expenditure in an Aging World*, IIASA Research Report RR-00-021, and M. Karlsson (2002), Comparative Analysis of Long-Term Care Systems in Four Countries, IIASA Interim Report IR-02-003.

Policy Pathways to Health in the Russian Federation

With the transition to a market economy well into its second decade, there are signs that the Russian economy is on the mend. Social indicators such as gross domestic product (GDP) per capita and the incidence of poverty have recovered from the catastrophic deterioration experienced immediately following the breakup of the Soviet Union. However, levels of health have not responded to the improved economic situation as dramatically as might have been hoped for, despite reforms to the health care system and the means of financing health care. Deaths among people of working age are a particular problem, having risen from 488 per 100,000 in 1990 to 611 per 100,000 in 1998 (*Demographic Yearbook of Russia*, 2001, Goskomstat). Between 1992 and 2000, the life expectancy of Russian males dropped from 62.02 to 59.00 years, while female life expectancy dropped from 73.75 years to 72.2 years (*ibid.*). To get a more general picture of the situation, in Western European countries, self-reported health status usually remains high until the late thirties; in other words, not until survey respondents enter their forties do a significant number begin to report that they have seen better days. In Russia, a significant proportion of respondents in their early twenties already report that they are not in the best of health!

Under funding provided by the European Union's Tacis program, the Austrian Ministry for Education, Science and Culture, and the Russian Committee for Systems Analysis, IIASA's Social Security Reform (SSR) Project has collaborated with the Institute for Socio-economic Studies of Population of the Russian Academy of Sciences and the Independent Institute for Social Policy in an activity titled "Policy Pathways to Health in the Russian Federation." This collaboration will lead to a two-day, 40-participant workshop to be held at IIASA in September 2003 and, dependent on funding, a longer-term international research collaboration.

The point of departure for this activity is that the sources of excess mortality / morbidity in the Russian Federation have been well documented. What is needed to move the policy process forward is a research agenda on "the causes of the causes" and the policy levers available to influence them. For example, the detrimental effects of heavy alcohol consumption have been amply demonstrated and their magnitude has been estimated. But what studies have been done on the determinants of alcohol consumption in Russia? What is the legal framework for policy action, what institutions are responsible, and how and to what extent are programs financed? What has been the experience in Russia and elsewhere with policies to regulate the manufacture and sale of alcohol? How responsive is demand to price? How effective are responsible-drinking publicity campaigns, crack-downs on drunk driving and alcohol in the workplace, etc.? Five areas have been identified for attention:

- Alcohol
- HIV/AIDS, sexually transmitted infections (STIs), and reproductive health more generally
- External causes (accidents, suicide, homicide), particularly links with stress, depression, social (including legal) institutions, and alcohol
- Tuberculosis and, more broadly, the health of marginalized populations (prisoners, the homeless, the rural poor, etc.)
- Cardiovascular disease of young people, including the role of smoking, high blood pressure, poor nutrition, and stress

Access to health care is enshrined in the Constitution of the Russian Federation. In 1998 the Federal Program of the State Guarantees for the Provision of Free Health Care issued "guarantees" of free health care for all. However, it is widely known that the Russian health situation is poor, and in 1997 official concerns were raised about the state of Russian health as a threat to national security. There are, moreover, signs of increasing focus on the causes of poor health. The official document "Concept of Development of Public Health and Medical Science in the Russian Federation: 2001–2005," in addition to the usual goals of improving health

Simply reforming the health care system in Russia, while an important part of the transition process, will have little impact on health unless there are improvements in health-related behaviors

care delivery and finance, places a strong emphasis on prevention and programs to encourage behavioral change. A number of national programs in the field of health protection have been launched, including programs aimed at achieving safe maternity, increasing immunization, fighting tuberculosis, assisting disabled children, preventing HIV/AIDS, preventing drug abuse, etc. Several more federal target programs regarding reductions in hypertension and cancer, etc., are on the list of major future priority measures.

Official statistics indicate that almost a quarter of deaths occur during the working ages (males aged 16–60, females aged 16–55). The wider costs of this premature mortality place long-term burdens on the health and social care systems and lead to lost economic output. Alcohol consumption, for example, is implicated in other major causes of death such as road accidents, circulatory disease, homicide, and suicide; alcohol also contributes to problems that are not as well documented, like stress, depression, and lower immune resistance to infectious disease. Yet there are tensions between the revenues raised from alcohol taxes, which are substantial, and the damage that alcohol does to the economy through its contributions to high workplace absenteeism and premature death. How should the government reconcile the two, what experiences can be learned from previous clampdowns on alcohol consumption (e.g., from 1985 to 1987), and are there lessons to be learned from other countries?

Russian health was a problem even before the breakup of the Soviet system, but it is evident that the transition itself has brought some pre-existing problems into sharper relief. Moreover, in the post-transition phase new health threats are being added to the list, including tuberculosis, especially among the prison population, and HIV/AIDS, which is associated with intravenous drug use and high-risk sex. The seriousness of the problem can be seen by contrasting Russia's situation with that of Japan, which has one of the longest life expectancies in the world. At IIASA, we estimated what the incremental impact would be on Russian life expectancy by major cause of death if Japanese mortality rates were somehow transferred to Russia. We found, for example, that if accidents, homicide, and suicide were reduced to Japanese levels, Russian life expectancy would increase by 5.3 years; if deaths from circulatory disease were similarly reduced, life expectancy would rise another 7.4 years; other causes together would add a further 4.9 years.

Figure 1, which tracks the survival of a hypothetical cohort of 100,000 males, shows these results in diagrammatic form. Based on World Health Organization (WHO) life tables and mortality data, it shows how male mortality by cause would need to decline at different ages if Russian males were to achieve the same probability of survival as Japanese

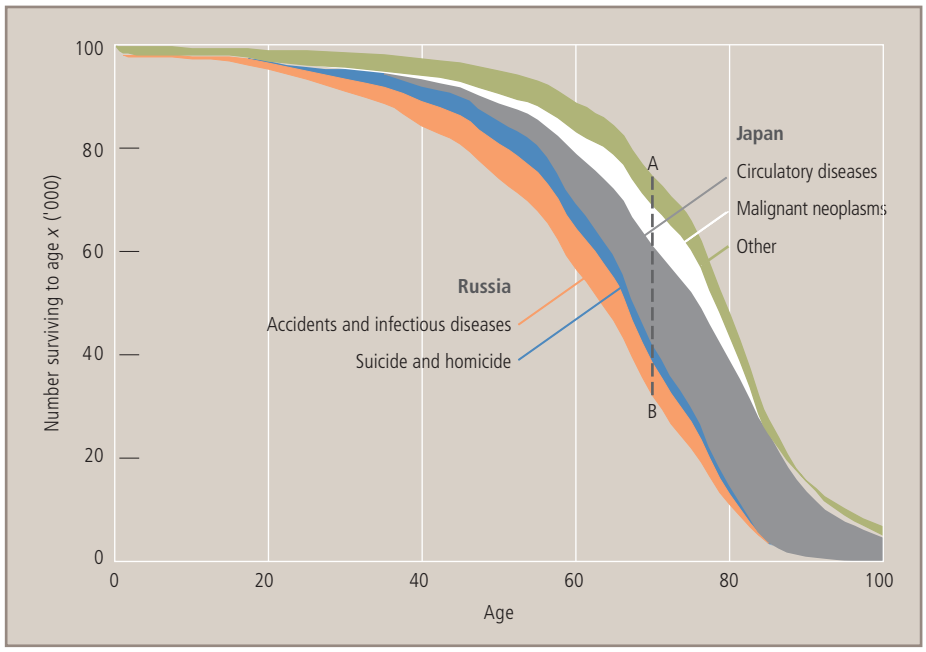


FIGURE 1: Male population survival curves for Russia and Japan based on WHO life tables and mortality data. The diagram shows which causes of death account for the better survival rates of Japanese men. At younger ages, the main causes of excess mortality are accidents, infectious diseases, and homicide and suicide; at older ages, circulatory diseases make up most of the difference.

TABLE 1: Policy domains involved in given causes of death ('■' indicates actions in the given policy domain may affect the cause of death).

Policy domain	Infectious diseases	Homicide	Respiratory diseases	Suicide	Accidents	Malignant neoplasms	Circulatory diseases
Immunization	■						
Crime		■					
Employment		■		■			■
Sanitation	■						
Road safety					■		
Health care delivery	■		■		■	■	■
Tobacco	■		■			■	■
Alcohol	■	■		■	■		■
Environmental health			■			■	
Reproductive health	■					■	
Occupational safety			■		■	■	
Mental health		■		■	■		
Housing	■	■	■	■			

males. To interpret the diagram, consider the section AB for people aged 70. In Japan, some 75,000 out of a hypothetical starting male population of 100,000 would have survived to this age (point A), whereas in Russia the equivalent number would be only a little over 30,000 (point B). The difference is due to the cumulative mortality of the causes of death shown. By age 70, for example, it is clear that circulatory diseases (gray shading) have accounted for most of the difference. At age 50, by contrast, it is accidents, infectious diseases, suicide, and homicide that are responsible for the worse mortality experience of the Russian male population.

Part of Japan's success in making health gains is undoubtedly due to its health care system, but simply reforming the health care system in Russia, while an important part of the transition process, will have little impact on health unless there are improvements in health-related behaviors. Figure 2 shows results complementary to those in Figure 1 but based on a different measure, years of potential life lost (YPLL). This measure compares the actual mortality in a country with the situation that would prevail if every person lived to some reference age, say, 100 years. The longer a particular bar in these charts, the more potential life years are lost to that particular cause of death.

The results are presented for males and females for Russia and Japan. As before, we take an initial starting population of 100,000 persons, which would give a theoretical upper limit of 10 million potential life years if everyone lived to 100 years of age. Take, for example, male deaths from circulatory diseases, the first and largest cause of lost life years. The chart shows that, in Russia, around 1.6 million life years (16 percent) would be lost to this cause, compared with around 0.8 million (8 percent) in Japan. The results show that Russia loses more life years than Japan in every category for males apart from malignant neoplasms and respiratory diseases. The reason for the exceptions is that these are causes of death typical of elderly persons—many Russian males die before they become candidates for these causes of death! Accidents, suicides, and homicides combined are second only to circulatory diseases as the main source of potential life years lost. For Russian females, almost all of the greater number of potential life years lost is accounted for by diseases of the circulatory system.

Whereas poor health and excess mortality tend to be viewed as medical problems, the behavioral roots of health mean that solutions must be sought in many policy domains, not just in health care or medical research. This necessity is illustrated in Table 1, which lists some of the policy domains involved in causes of poor health reviewed above. Some of these links are straightforward—for example, accident rates clearly reflect strengths and weaknesses of policies in the road safety domain—but others, such as the role of poor housing in lowering the body's immune response to infectious disease, are more subtle. The goal of the workshop "Policy Pathways to Health in the Russian Federation" is to set a policy-relevant research agenda to inform the design of timely, cost-effective program and project interventions to improve the health of the Russian population. Data needs, modeling needs, and fruitful areas for collaborative research are being reviewed. A range of disciplines, including health economics, demography, public health, and medicine are represented among participants, and attention is being given to attaining a good balance of researchers, policymakers, and representatives of international financial institutions and the funding community. ■

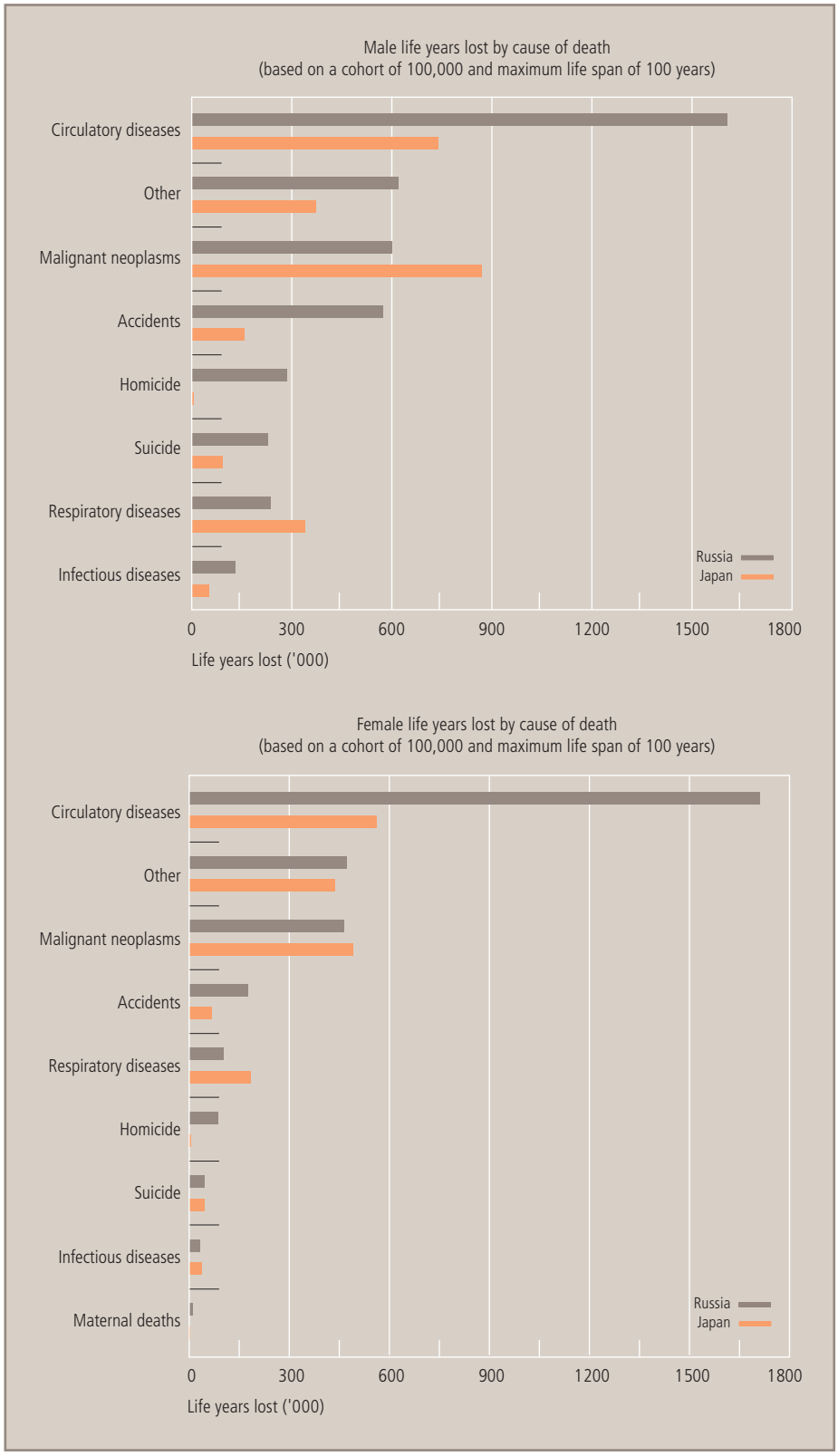


FIGURE 2: Comparison of years of potential life lost (YPLL) from major causes of death for Japanese and Russian males and females (constructed from WHO data sources).

Financing Urban Chinese Health Care

As of this writing (June 2003), the Chinese health care system is in crisis due to the severe acute respiratory syndrome (SARS) epidemic. But even disregarding SARS, structural problems too large to be ignored have emerged. In well-to-do areas such as the coastal cities, rapid economic growth has been accompanied by even greater growth in the demand for modern high-cost medical care. At the same time, necessary reforms of state-owned enterprises (SOEs), privatization of formerly public health care facilities, and other changes accompanying the transition to a socialist market economy have put an increasing share of the health care financial burden on the individual. In rural areas, the once widely praised system of "barefoot doctors" has disappeared, also shifting responsibility for health care finance from the collective to the individual. To complete the picture, the Chinese population will age faster than any population in history and is experiencing accelerated urbanization. Changing age distribution and residence patterns are causing sweeping changes in family structure, kin networks, and the informal caregiving environment.

Exploratory collaboration with the Institute for Social Insurance in Beijing

Since early 2001, IIASA has collaborated with the Institute for Social Insurance (ISI) of the Chinese Ministry of Labour and Social Security in Beijing on an exploratory activity titled "Data and Modeling Needs for Ensuring Health Security in China." Under the aegis of the collaborative project, a three-person team from IIASA's Social Security Reform (SSR) Project visited ISI in Beijing and undertook a field mission to Dalian in July 2001. The IIASA team was extensively briefed on the structure of the health system in China. Discussions centered on the health insurance system reform currently under way in urban areas of China and the problems that have been encountered (in essence, unsustainable costs). In addition to visits to relevant ministries and government agencies, the mission included visits to local insurance offices and to a large urban hospital.

The research dialogue continued with a four-person team from ISI visiting IIASA in November 2001. In addition to Dr. He Ping, director of the ISI, the Chinese team included Drs. Guan Zhiqiang, Wang Zeying, and Jiang Bin. The ISI delegation was briefed on IIASA and its range of research activities.

Following this exchange of information, the members of the two teams agreed on the pressing need for China to develop a costing and control model for the new medical insurance schemes being developed for urban workers in China so that these schemes can continue to develop and expand, thereby improving the general level of health. Modeling approaches were discussed and directions for possible further collaboration were identified.

Background

Health care planning, management, and provision in China are spread across many different actors (the Ministry of Health, the Commission of State Planning, the Ministry of Finance, the Ministry of Labor and Social Security, the Commission on Family Planning, etc.).

The urban and rural components of the Chinese health care system face very different problems (see Figure 1). In the rural region, the main problem is that the system of cooperative basic medical care has disintegrated, leaving households financing virtually all health care out of pocket. This is a massive problem, but one that was not addressed in discussions with the ISI. The Chinese urban health care system, which is today little different than it was in 1978, faces a very different set of problems.

The urban health care market currently is hierarchically structured into three tiers: street health clinics and workplace clinics providing preventive and primary care; district and enterprise hospitals and specialist clinics providing secondary care; and provincial and municipal general hospitals and teaching hospitals providing tertiary care. Health care facilities are managed by a wide range of public organizations, including the central and provincial governments, state enterprises, and public universities.

There are two well-developed public urban health insurance systems. The Government Insurance system, covering government workers and retirees, members of the military, and university students, has a total of 30 million members; the Labor Insurance program, covering SOE employees and retirees, has 140 million members. Members of these two systems enjoy unlimited coverage with low co-payments and virtually zero premiums. Not surprisingly, from 1978 onward, health expenditure for these two urban insurance systems has increased dramatically, while expenditure for the rural cooperative system has decreased continuously (see Figure 2).

High expenditures in these two components of the urban health insurance system put pressure on the government budget and impair the competitiveness of SOEs, making economic transition more difficult. The system is also unfair to the majority of the population without coverage, which is forced to subsidize the systems through taxes. In its 1997 report on health care finance in China, the World Bank urged that insurance coverage be broadened to improve the risk pool, to relieve financial pressures on government and SOEs, and to address the burgeoning health care needs of the urban population. Current policy goals include harmonization of benefits and contributions

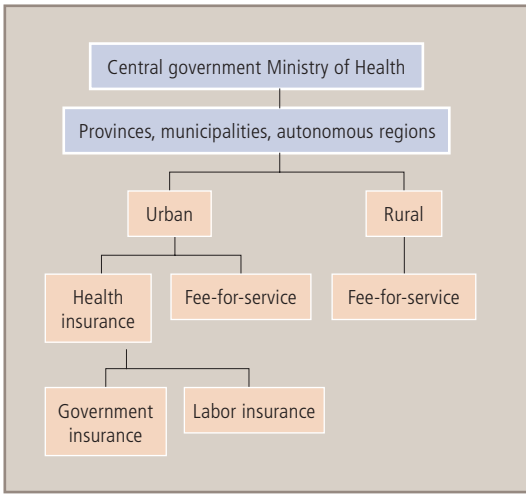


FIGURE 1: Health care structure, coverage, and problems.

and broadened coverage for workers outside the state sector, their dependants, and the rapidly increasing number of rural migrants working in urban areas. The World Bank has recommended that social health insurance be extended to cover workers employed by joint ventures, smaller collective industries, and private enterprises, and that coverage be open on a voluntary basis to all urban residents. Alongside the development of this extended social health insurance system, policymakers have also expressed an interest in the development of private insurance.

Experiments with private health insurance have been going on for some time. The Medical Insurance Scheme for Urban Workers, created in 1994, provides medical insurance benefits to reimburse scheme members for the cost of primary, secondary, and tertiary medical care, including prescription drugs. The care is undertaken by scheme-approved medical providers, including doctors, other medical personnel, hospitals, pharmacies, and clinics.

The scheme, actually a collection of local insurance schemes with considerable decentralization of decision making, covers urban workers and retired urban workers (about 20–30 percent of the membership) who work or worked for employers who have joined the scheme. Self-employed workers are also eligible to join. The scheme was piloted in a number of cities and then extended in 1996 to 57 other cities, still on a pilot basis.

Scheme membership is projected to be 200 million members in 2004, with a plan to cover all urban private-sector employees by 2030. Currently, the state pays for the administrative costs of running the scheme. The contribution rate is a percentage of salary, currently about 2 percent from the employee and 6–9 percent from the employer, depending on the area. Retired persons pay 2 percent of their income. The employee's contributions are held in an individual medical savings account (MSA). A proportion of the employer's contribution is also paid over to the employee's MSA, giving a total contribution to the employee's MSA of about 4.7 percent of gross wages. The MSA balances are recorded centrally, and each member has a "smart card," which also records the current account balance. Initially, routine minor medical costs are "spent" by the member using the credit card accessing the MSA. For more substantial medical costs, including hospitalizations, the member pays some of the cost (through co-payments and deductibles).

In practice, the scheme covers medical procedures up to the cost level of some major operations. Above the scheme limits, the employee has to pay on a fee-for-service basis. Some areas have supplementary insurance schemes that provide additional coverage beyond the basic benefit limit to partially defray the cost of more complex medical procedures. Medical costs vary in China from place to place, with big cities being more expensive than small towns. This appears to be in line with salary levels, so that financing on the basis of salary-based contributions neutralizes some of the effect of living in a high-cost medical area. While all member schemes must provide a basic framework of benefits, the local schemes can add optional additional benefits.

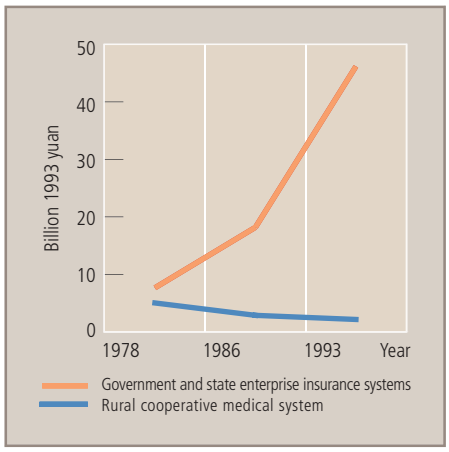
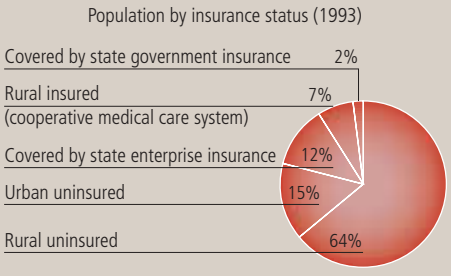


FIGURE 2: Comparison of national health expenditure on urban insurance and rural insurance. *Source*: China 2020 (World Bank, 1997).



Source: Financing health care (World Bank, 1997)

Main problems of health care system	
Level	Main issues/problems
National	Budgetary pressures
Regional	Growing disparity in access
Urban	Narrow insurance coverage
Rural	■ Shrinkage of cooperative medical care system ■ No insurance coverage
Enterprises/work units	■ Dependent on the efficiency and effectiveness of units ■ Lack of efficient cost controls
Health care providers	■ Rising cost ■ Third-party payment distortions ■ Irrational allocation and waste ■ Inefficient management

The review of the pilot schemes showed the following:

- Some member schemes have experienced difficulties where enterprises have joined but failed to make the employer contribution.
- Schemes have seen a predictable initial surge in claims above the expected level. This is due to participants' "saving up" required medical treatment until the new scheme is in place. All schemes have open enrollment and benefit access.
- The usage of MSAs has been higher than predicted; some two-thirds of scheme members have made use of the MSA funds to some degree.
- There is concern over the ability of the lowest-paid workers to create a viable balance in the MSA.
- There is a need to create a uniform costing and control mechanism as part of the planning and financial monitoring of these very large insurance schemes.

Modeling the urban health care system

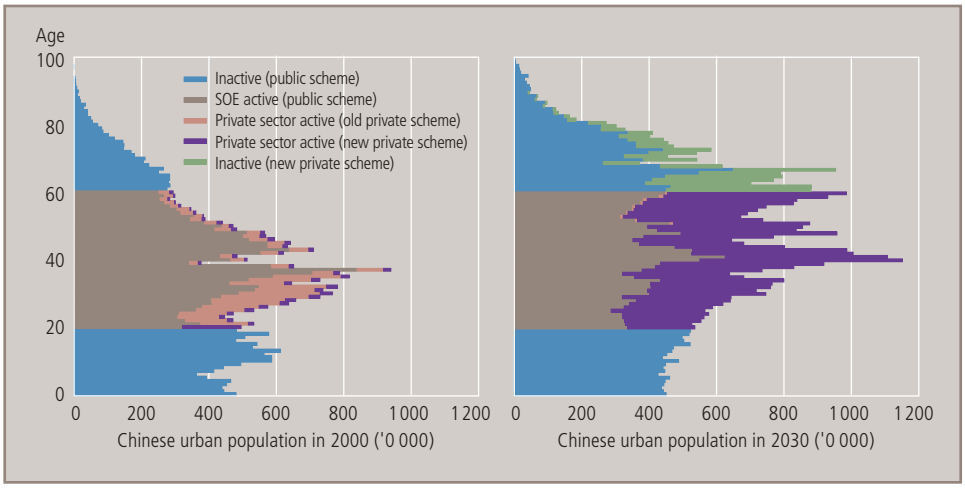
To explore modeling issues and identify major trends, IIASA Research Scholar Martin Spielauer constructed a small prototype micro-simulation model and combined it with an economic–demographic growth model similar to that used for the work on Japan described elsewhere in *Options* (only much, much smaller and simpler). The micro-simulation model was used to generate a 0.1 percent sample of the Chinese population for 1990–2075 based on projections made by IIASA's Population Project for 1990–2045 and assuming unchanged fertility and rural–urban migration rates thereafter. A scenario-based approach was used to simulate the individual activity status; that is, whether a person is employed in a private or a state enterprise, the type of health insurance, and individual health care needs. Scenarios of future health care expenditures were based on age-structure changes and assumed rates of inflation in health care costs. Assuming that medical costs increase at the same rate as the overall price level, health expenditures will increase six times between now and 2075. Assuming medical costs rise 1 percent per annum faster than the overall price level, future expenditure will be 12 times higher than today's level. In order to keep the share of gross domestic product (GDP) spent on health care unchanged, this would require an economic growth rate of 2–3 percent per year—a perfectly reasonable possibility, given China's history of accelerated economic growth.

According to the IIASA population scenario for urban China, the urban population will double from 1990 to 2050, with rural–urban migration being the driving force of this growth. By mid-century, more than half the Chinese population will live in urban areas, about double the present share. At the same time, the share of the urban population

aged 60 and over will increase from 12 percent to 32 percent.

In addition to modeling these demographic changes, Spielauer also modeled a transition process from employment in SOEs to private employment, assuming that by 2030 half the urban work force will be employed in the private sector. All persons entering the private-sector labor force (whether new labor force entrants or persons switching from SOEs to the private sector) are assumed to be covered by a new private insurance scheme similar to the Medical Insurance Scheme for Urban Workers. Moreover, every year, a fixed share of the workforce covered by currently existing private health care schemes is assumed to transfer to the new reformed private insurance scheme. The assumption is that, due to cost-containment difficulties, the existing private medical insurance scheme will need to be gradually replaced. Finally, and greatly simplifying the projection, we assume that all persons under 20 are covered by the public scheme and that the coverage breakdown for the non-working population over 20 is the same as for the working population.

Analysis of basic parameters such as the ratio of system expenditures to participants' payroll suggests that, while the new health insurance scheme is quite affordable in its early years, when members are relatively young, it will rapidly grow more expensive as participants age. Another conclusion is that, as illustrated below, even given fairly rapid transition to a new private insurance scheme system, there will be considerable persistence in the number of people insured by the existing public scheme (i.e., employees of SOEs or persons who have retired from SOEs). The policy lesson is that, even with the introduction of new health insurance institutions, the financial health and functioning of existing ones cannot be ignored. ■



Parametric and Paradigmatic Styles in European Pension Reform

Pension reform gets more attention in countries throughout Western, Central, and Eastern Europe than any other topic on the economic reform agenda, but in no area of European policy has progress been more uneven. Why has reform been greater in some countries than in others? Why has the evident need for reform not always prompted reform progress? A joint conference on the "Political Economy of Pension Reform" was held at IIASA in April 2001 to explore these issues from a range of disciplinary perspectives. The research conference was held in tandem with a policy workshop called "Learning from the Partners," which brought together pension policymakers from 15 European Union (EU) and 10 European Union Accession (EUA) countries to compare notes. Collaborating in the organization of the conference were the Social Protection Department of the World Bank and the Social Security Reform (SSR) and Economic Transition and Integration (ETI) Projects at IIASA. Additional financial support was provided by the Austrian Ministry of Finance. The results of these activities have just been published in the form of a World Bank book (see Suggestions for Further Reading, page 10).

The need for pension reform in the EU and EUA countries arises from three factors. First, the current high expenditure level and related budgetary pressure will only worsen, given the projected aging of populations. Second, ongoing socioeconomic changes, such as the decline in traditional lifetime industrial employment, rising labor force participation of women, changes in family structure, etc., are rendering current provisions inadequate. Third, European economic integration and the common currency will prompt higher levels of internal and external migration, but current retirement provisions do not support this needed labor mobility.

In light of this urgent need for reform, how do countries in Central, Eastern, and Western Europe measure up? What emerged clearly from the "Learning from the Partners" workshop was that there are two dominant styles of pension reform in Europe: a *parametric* style and a *paradigmatic* style. A parametric reform is an attempt to rationalize the pension system by seeking more revenues and reducing expenditures while expanding voluntary private pension provision. A pay-as-you-go (PAYG) pillar is downsized by raising the retirement age, reducing pension indexation, and/or curtailing sector privileges; and the development of voluntary pension funds beyond the mandatory social security system is promoted through tax advantages, organizational assistance, tripartite agreements, and/or other means of administrative and public information facilitation. These measures, among others, are being taken in Austria, the Czech Republic, France, Germany, Greece, and Slovenia.

Other countries have decided to change the paradigm in which pension systems operate—that is, to move away from the monopoly of a PAYG pillar within the mandatory social security system. A paradigmatic reform is a deep change in the fundamentals of pension provision typically consisting of the introduction of a mandatory funded pension pillar, along with a deeply reformed PAYG

pillar and the expansion of opportunities for voluntary retirement saving. Among other measures, this is what Bulgaria, Croatia, Denmark, Hungary, Latvia, the Netherlands, Poland, Sweden, and the United Kingdom have decided to do.

The distinction between parametric and paradigmatic reform cuts across the EU/EUA divide. Paradigmatic reformers, however, tend to be more widely represented among EUA countries, where, in addition to those cited above, other countries seem likely to follow soon—Romania and perhaps Lithuania and Slovakia. But why is it hard to find paradigmatic reformers among EU countries? What lies behind the differences in pension reform approach and progress across Europe? In the conference on "Political Economy of Pension Reform," six papers from different disciplinary perspectives addressed these questions. Among the insights that emerged were the following:

■ *Paradigmatic change is triggered by "new actors and new factors."* A severe financial crisis may strengthen the hand of the Ministry of Finance, and high debt may enhance the leverage of international financial institutions that advocate paradigmatic reform. However, which domestic institution takes the lead (whether the Ministry of Finance or the Ministry of Labor) and which international institution pushes reform (whether the World Bank or the International Labour Organization) is not a crucial variable in explaining the willingness to undertake reforms.

■ *Democracy advances, it does not impede, reform.* The political economy literature asserts that systemic pension reform should be extremely difficult to achieve in democracies with strong systems of interest representation and with mature pension systems. The weakness of this logic is that pension policy has never been very democratic, because small policy networks have tended to dominate pension policymaking in Europe. Operating in back rooms and excluding those without sufficient technical expertise, these networks exercised a dominance unchallenged by normal democratic procedures. The wave of pension reforms in the 1990s may be attributed, in part, to the arrival of new actors with new ideas and the breakdown of insular and cohesive pension governance networks. Far from impeding reform, as claimed by the political economy literature, democratic political processes can help break up dominant policy networks and trigger paradigmatic reform.

■ *Age-based and institutional models of reform are not all they are cracked up to be.* Models based on age structure provide powerful explanations of how systems combining high contribution rates and low retirement ages emerge. However, they provide little insight into actual reform triggers and cannot explain the extent of reform, its timing, or the shift from PAYG to funding. Nor do institutional models fare much better. Reforms have occurred equally in authoritarian and democratic countries and, among democracies, in a variety of institutional formats. The most important factor appears to be leadership, requiring the formation of a consensus in favor of reform. That means that, in most countries, a long process of coalition building is required before reform can progress. More accurate information about the costs of current policies could help trigger paradigmatic reforms.

■ *In Europe, the EU accession process makes a difference in social policy.* Countries with a greater chance of EU accession adopted social policy models that were more in tune with those of EU member states. So far, this has helped the Visigrad countries to develop better transition social policies than Russia and countries of the Commonwealth of Independent States (CIS). The danger is that continued emulation of EU policies could produce higher unemployment and slower growth in the years ahead.

■ *There are leaders and followers in pension reform, and international institutions matter.* Another weakness of the political economy literature is that it has tended to focus on domestic institutions. Yet, pension reforms should not be seen only as a result of domestic political processes, but also as a result of global patterns of ideational innovation and diffusion. During two great waves of post–World War II pension reform, in both Latin America and Europe, larger, richer, more industrialized countries reformed first and smaller, poorer countries lagged behind. International organizations such as the International Labour Organization and the World Bank have played a major role, particularly in cross-regional diffusion of ideas and models.

Taken together, the "Learning from the Partners" workshop and the "Political Economy of Pension Reform" conference provided an excellent overview of the progress and process of pension reform in Europe. They elucidated patterns of reform similarity and difference in countries facing similar pressures and began to provide a comprehensive political economy explanation of the determinants of reform, also shedding light on the role of international institutions. ■

Aging and Disability: Are Our Support Systems Sustainable?

With many ways of categorizing disability and the potential to count people with multiple disabilities more than once, official and unofficial estimates of disability vary widely and can be confusing. In practice, the methods of measuring disability vary according to purpose. A policy-driven approach, for example, needs to be able to identify beneficiaries of national policies (e.g., for financial support, rehabilitation, and training) and to identify those with rights under the law (e.g., those facing discrimination or prejudice) and eligibility for financial assistance or caring services. A medical approach, by contrast, might base itself on the prevalence of conditions leading to disability, while a functional approach would focus on the ability to perform various functions of daily living.

Basing their work on a "medical" definition of disability, researchers at the World Health Organization (WHO) and the Harvard School of Public Health have shown, for example, that

- The number of years of disability per annum totals almost 500 million worldwide spread over a large number of conditions, implying a prevalence rate of just over 8 percent.
- Disability plays a central role in the health and well-being of the population, but the problem is hidden from view in public health terms because the leading causes of disability differ from the leading causes of death.
- There is a significant burden of mental illness. Of the 10 leading causes of disability, 5 are psychiatric conditions. Altogether, these conditions account for about 28 percent of years lost to disability but only 1.4 percent of deaths.

Leslie Mayhew, an IIASA Social Security Reform (SSR) Project collaborator and member of the Faculty of Actuarial Science and Statistics at City University Business School, London, used WHO data from 191 countries to ascertain the average proportion of life that is spent in disability. The results are presented in Figure 1, which shows each country's normal life expectancy (orange line) and disability-adjusted life expectancy (DALE) plotted against its life expectancy at birth. Each point represents the DALE for a given country, with the blue line being a statistical or best-fit average. The vertical gap between the orange and blue lines therefore represents the average years of disability for any given normal life expectancy. For example, in a country where life expectancy at birth is, say, 60 years (point A), the expected years of disability would be given by length PQ (9.5 years).

Several important conclusions emerge from this analysis:

- In more developed countries with life expectancies of over 70 years, on average around 8 years are spent in disability, or around 11.5 percent of the normal life span.
- In the least developed countries with very low life expectancies, the number of years spent in disability increases to 11, a much higher proportion of the normal life span because life expectancy is low. Countries with the most serious problems in this regard include Uganda, Malawi, Zambia, and Sierra Leone.
- An improvement of one year in life expectancy equates roughly to a reduction of one calendar month of disability throughout life.

The functional approach to disability measurement is perhaps best illustrated by the excellent and still widely used survey of adult disability carried out in Great Britain in the late 1980s by the Office of Population Census and Surveys (OPCS). The approach is based on people's ability to carry out the activities of daily living in terms of mobility, dexterity, seeing, hearing, personal care, continence, and so forth.

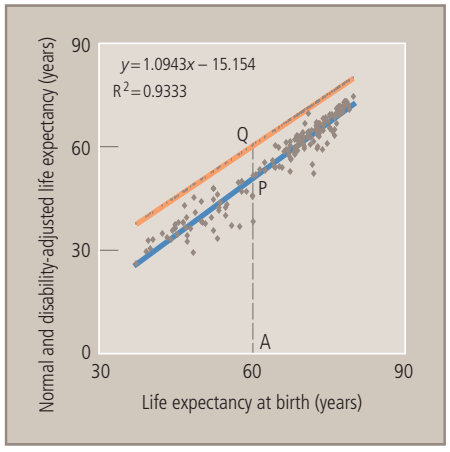


FIGURE 1: Plot for different countries showing normal and disability-adjusted life expectancy (DALE) as a function of life expectancy. The vertical gap between the orange and blue lines shows the average years of disability for any given value of life expectancy. The best-fit equation relating DALE to normal life expectancy is given by the blue line.

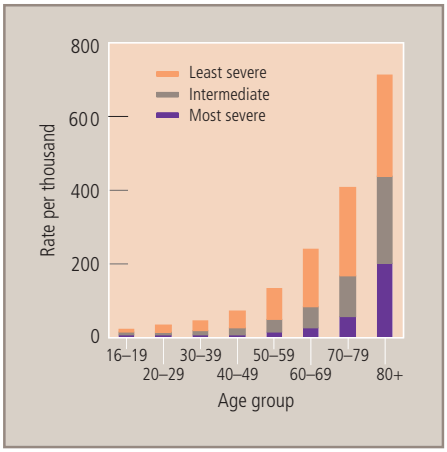


FIGURE 2: Prevalence of disability by age group and severity category in Great Britain, late 1980s, according to the Office of Population Census and Surveys.

Based on the survey, the OPCS was able to produce a disability scale ranging from 1 (least disabled) to 10 (most disabled). For example, someone who is deaf in one ear but who is otherwise able would score a 1 on the scale. On the other end of the scale, a person who has suffered a serious stroke and who cannot walk, feed himself, or perform basic personal care functions would score a 10. The prevalence of disability by age group and severity category is shown in Figure 2.

What would the OPCS prevalence figures imply in terms of the scale and incidence of disability if such rates were to apply worldwide? We know from many studies that the population is becoming older—even in less developed countries. Such age shifts would indicate probable increases in the number of disabled persons if current prevalence rates—by assumption, those observed in Great Britain—were to continue. In more developed countries, the number of disabled older persons will increase substantially, whereas the number of working-age disabled persons will level off or even

decline. Combining OPCS prevalence rates with population projections from IIASA's Population Project, we estimate that by 2025 60 percent of disabled people in developed countries will be aged 65 and over, and by 2050 this proportion will increase to 70 percent. In less developed countries, the number of disabled persons in both age categories will increase throughout the period, with the number of elderly disabled overtaking the number of working-age disabled after 2045 (effectively, there is a 50-year lag compared with more developed countries).

Disability and long-term care

Age-related chronic disability has become an important public policy issue in more developed countries, especially in the area of long-term nursing care for people close to death. Currently the main focus of debate is cost, and in particular who will pay.

Figure 3 shows survival curves for men and women combined based on a standard English life table and the disability estimates cited above. A life table does not represent the actual population, but what the population would look like if age-specific mortality were to apply to a synthetic population, conventionally 100,000 newborns, as they age, hence the values on the vertical scale. At each age, the upper curve gives the number of persons surviving and the lower curve gives the number of them surviving in a disability-free state. The shaded area of the figure represents the portion of the surviving population that is disabled according to the OPCS disability rates described above.

The average "stock" of disabled persons of a given age is found by measuring length AC; the duration of disability faced by the average person of a given age is found by measuring length AB. It is striking how the duration tends to be constant in older age but is longer if disability begins at a younger age, say, between 40 and 50 years. The overall average is 9.9 years, rather longer than would be estimated based on the WHO–Harvard data referred to above. If we were to construct the same diagram but only represent the most severely disabled group needing long-term care (OPCS categories 8–10), our shaded strip would be much narrower. It turns out that, for this group, the duration of severe disability averages 1.5 years.

A crucial question for policy analysts is whether, as life expectancy increases, added years are spent in reasonable health or in extreme dependency. To take Japan as an example, life expectancy in Japan, especially among women, has shown remarkable acceleration since the 1950s. For women aged 50 it has been increasing around 1 year every 4 years, compared with 1 year every 18 years up to 1950, when it reached 24 years. According to the Japanese Ministry of Health, female life expectancy at 50 is now 35.5 years, representing a continuation of this trend. If there is no improvement in disability prevalence rates at advanced ages, there will be explosive growth in the need for the entire spectrum of care. At the same time that need is growing, changes in family structure are reducing the availability of informal caregivers.

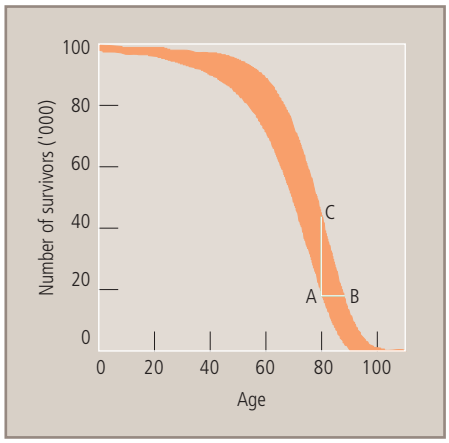


FIGURE 3: Survival curve based on an English life table and disability rates. Orange area shows population with disabilities. AB denotes average duration of disability faced by a person aged 80, and AC denotes the number of disabled persons aged 80 in the hypothetical life table population.

A simple financial rule of thumb

Regardless of who pays, the costs of long-term care are impressive. In a more developed country with a population of 50 million, we might expect, say, 500,000 deaths a year. If the average time spent in long-term care prior to death is 1.5 years and the cost of care per person per annum is US$40,000, then the total annual cost is 500,000 × US$40,000 × 1.5, or US$30 billion (US$600 per capita).

In practice, the costs of long-term care are split between the state and the individual and his or her family.

Mayhew, together with Martin Karlsson, a participant in IIASA's Young Scientists Summer Program, looked at the methods of financing long-term care in different countries. They found that in Sweden, for example, long-term care is publicly funded, with a comprehensive range of services for which users are charged only small co-payments. The system recently established in Germany is an extension of the social insurance model used for health care and pensions. And in the United States and the United Kingdom, there is a means test to qualify for long-term care benefits.

All countries facing this problem have to balance the obligations of individuals and their families to look after themselves and the public responsibility to look after the most needy. The Japanese case is an example of how internal financial pressures persuaded the government to introduce a compulsory universal scheme for long-term care insurance. The system is 90 percent publicly funded, with 10 percent coming from individuals.

One important observation from Mayhew and Karlsson's research is that long-term care arrangements tend to mirror existing social security systems, and one country's approach is not easily transferable to another country. Long-term care systems, like pensions, may be of the pay-as-you-go (PAYG) type or private or public fully funded insurance-based schemes. Their findings therefore fit neatly into the classical types of welfare states, with Germany being a "conservative" welfare state, Sweden being a "social democratic" state, and the United States being a "liberal" welfare state. On the other hand, the Japanese system seems to be harder to define, since it combines elements of (at least) the "conservative" and the "social democratic" types of welfare states.

Whether the system supporting long-term care provides good value for money is both a distributional question and a question of economic efficiency. In Sweden, for example, the internal rate of return of the long-term care system, which is financed on a PAYG basis, is positive for all cohorts born before 1990. However, if the health status of the population continues to improve, so that disability commences at ever-higher ages, the internal rate of return will be considerably lower and even negative for all cohorts born after 1960. It seems that there are pluses and minuses to all the systems studied. However, one trend is clear: if it looks like the financial burden will fall on the public purse, governments will act to widen the contribution base and/or change the eligibility rules. ■

Publications Highlights

W. Lutz, B.C. O'Neill, S. Scherbov
Europe's population at a turning point
Science **29**(28 March 2003):1991–1992

Governments in many industrialized countries are trying to deal with the problems arising from low birthrates, concomitantly aging populations, and the implications for retirement and health care policies. As the recent strikes against pension reform in Austria and France demonstrate, these are extremely important policy issues. In a recent article in *Science*, Wolfgang Lutz and his colleagues show that in the European Union, low birthrates—partly due to the current trend toward later childbearing—have now generated "negative population momentum," a tendency for the population to continue to decline even if birthrates rise in the future. If delays in childbearing continue, the support ratio of the working-age population to pensioners will decline more rapidly than is generally anticipated, further straining social programs such as the pay-as-you-go pension systems in place. Policies that make it easier for women to combine careers with raising children could halt the trend toward later childbearing, diminishing negative momentum and easing the task of providing for an aging population.

W. Lutz, M.M. Shah
Population should be on the Johannesburg agenda
Nature **418**(4 July 2002):17

Population is an extremely important component of sustainable development. With this in mind, Wolfgang Lutz and Mahendra Shah, coordinators of the Global Science Panel on Population and Environment, and their colleagues on the Panel pointed out in a widely circulated communication to *Nature* the glaring omission of population as a theme for discussion at the World Summit on Sustainable Development (WSSD), held in Johannesburg in August 2002. Clearly, the size, distribution, and vulnerability (social, environmental, and economic) of population play a major role in sustainable development questions, particularly at local, regional, and national levels. Population density has a major and direct impact on quality of life, as is evident in places where the poor are concentrated.

M. Doebeli, U. Dieckmann
Speciation along environmental gradients
Nature **421**(16 January 2003):259–264

Human populations continue to put pressure on natural habitats across the globe, posing daunting challenges for the preservation of biodiversity. Since humankind cannot artificially "freeze" the current distribution of species (natural turnover has been incessant in the past and will continue to be so in the future), the question arises as to how global change affects processes leading to the formation of new species. Addressing this question requires a deeper understanding of how speciation actually occurs. For the past seven decades, biologists have seen geographic isolation as the principal agent of speciation. In a recent article in *Nature*, Ulf Dieckmann and co-author Michael Doebeli propose a new, potentially widespread, mechanism for speciation. As their article shows, adaptation arising from the interplay between local competition and dispersal, on the one hand, and environmental heterogeneity, on the other, turns out to be a considerably more potent agent of rapid speciation than was previously understood.

M.A. Nowak, K. Sigmund
Bacterial game dynamics
Nature **418**(11 July 2002):138–139

Turning to experiments on a smaller scale, but with no less significance, Karl Sigmund and Martin Nowak report in *Nature* on progress by Kerr et al. in investigating the mechanisms that maintain biodiversity in ecosystems. The basis of the breakthrough by Kerr et al. (reported in the same issue in "Local dispersal promotes biodiversity in a real-life game of rock–scissors–paper," pp. 171–174), both in theory and experiment, is the deceptively simple analogy of the rock–paper–scissors game. Kerr and his colleagues use a similar model to evaluate the responses of several strains of *E. coli* bacteria to changes in their environment. The elegantly simple experiment shows how three strains of bacteria survive, with the boundaries between them shifting to and fro, reflecting the cyclic invasion and displacement of one strain by the next. This approach opens new vistas for understanding how biological communities are built up, especially significant since large-scale experiments in community construction are hard to come by.

C. Hauert, S. de Monte, J. Hofbauer, K. Sigmund
Volunteering as Red Queen mechanism for cooperation in public goods games
Science **296**(10 May 2002):1129–1132

In May 2002, Karl Sigmund co-authored a paper published in *Science* that shows how cooperation can subsist in sizable groups, even if interactions are not repeated, defectors remain anonymous, players have no memory, and assortment is purely random. What does this mean in real-life terms? The tragedy of the commons is a famous metaphor for a common phenomenon. How can cooperation be ensured among groups of unrelated individuals in a situation where voluntary restraint in the use of public goods (e.g., forests, environmental quality) can enhance collective well-being? Theoreticians use public goods games to explore this issue. If too many participants cheat (i.e., do not use restraint), then common welfare suffers. In such a situation, as in the land of the Red Queen in *Alice in Wonderland*, "it takes all the running you can do, to keep in the same place." In this paper, Sigmund and his co-authors show how voluntary participation avoids the deadlock of mutual defection that threatens any public enterprise in larger groups.

B.C. O'Neill, M. Oppenheimer
Dangerous climate impacts and the Kyoto Protocol
Science **296**(14 June 2002):1971–1972

Brian O'Neill and co-author Michael Oppenheimer, in a policy article that appears in *Science*, assess whether the Kyoto Protocol is consistent with long-term goals to limit global warming. They show that although implementation of the Kyoto Protocol would only marginally affect global warming, the accord should be seen as an important first step to avoiding dangerous levels of human interference in the climate system. If that first step is delayed, it may be too late to avoid some types of potentially dangerous climate change. They suggest the use of several markers of dangerous climate change, including large-scale eradication of coral reef systems, disintegration of the West Antarctic Ice Sheet, and a weakening or shutting down of the large-scale thermohaline circulation of the oceans. In the article, they connect potential long-term impacts of climate change to the consequences of choices made today concerning emissions reductions. Their precautionary approach, aimed at preserving options for future climate change outcomes, acknowledges the very large uncertainties inherent in climate change.

B.C. O'Neill, A. Grübler, N. Nakicenovic, M. Obersteiner, K. Riahi, L. Schrattenholzer, F. Toth
Planning for future energy resources
Science **300**(25 April 2003):581

Brian O'Neill and six other IIASA researchers recently published a letter in *Science* commenting on an earlier article that reviewed the prospects for the contributions of various energy technologies to climate policy. They stress that policy responses to climate change should be robust across the wide range of plausible development paths. They also recommend that an appropriate mix of investments should initially favor energy technologies with proven feasibility while exploring new energy sources for the long term.

Recent Books

Technological Change and the Environment

Much is written in the popular literature about the current pace of technological change. But do we have enough scientific knowledge about the sources and management of innovation to properly inform policymaking in technology-dependent domains such as energy and the environment? *Technological Change and the Environment,* edited by Arnulf Grübler, Nebojsa Nakicenovic, and William D. Nordhaus, is a unique, single-volume overview of the most contemporary theoretical and empirical work on technological change from a distinguished list of contributors.

Technological Change and the Environment is a copublication of Resources for the Future and IIASA. For ordering information, contact Resources for the Future (www.rff.org).

ISBN 1-891853-46-5 ■ US$49

Containing the Atom

Containing the Atom, the product of three years of research by members of the Processes of International Negotiation (PIN) network, is a comprehensive study of the theory and practice of international nuclear negotiations. Well-known experts in the field test 11 cases of international nuclear negotiations, and each case study analyzes the actors, strategies, processes, structures, and outcomes, and weighs the impact of the negotiations on security, energy, trade, and the environment.

Containing the Atom, edited by Rudolf Avenhaus, Victor Kremenyuk, and Gunnar Sjöstedt, is available from Lexington Books (www.lexingtonbooks.com).

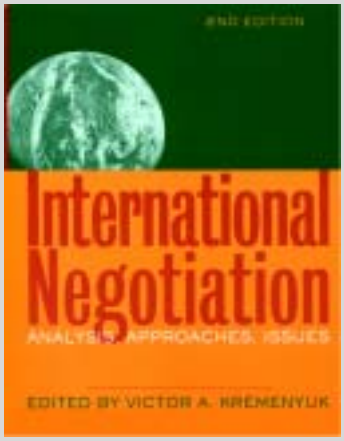
ISBN 0-7391-0387-3 ■ US$100

Environmental Foresight and Models: A Manifesto

Policymakers and the public are more interested in the possibility of nonlinear dislocations and surprises in the behavior of the environment than in smooth extrapolations of current trends. The International Task Force on Forecasting Environmental Change (all five of whose workshops were held at IIASA from 1993–1998) dedicated its work to developing procedures of model building capable of addressing our palpable concerns for substantial change in the future. This volume discusses the immense challenges that such structural change presents and investigates the potentially profound implications for model development.

Environmental Foresight and Models. A Manifesto is edited by IIASA alumnus Bruce Beck and is available from Elsevier (www.elsevier.nl).

ISBN 0-08-044086-X ■ US$120



PIN Book Receives CPR Award

On 30 January 2003, Victor Kremenyuk, a member of IIASA's Processes of International Negotiation (PIN) network, and his co-authors were awarded the 20th Annual CPR Book Award for 2002 for the second edition of *International Negotiations: Analysis, Approaches, Issues* published by Jossey Bass. The president of the Institute for Dispute Resolution (CPR), Thomas Stipanowich, called the book "nothing less than outstanding."

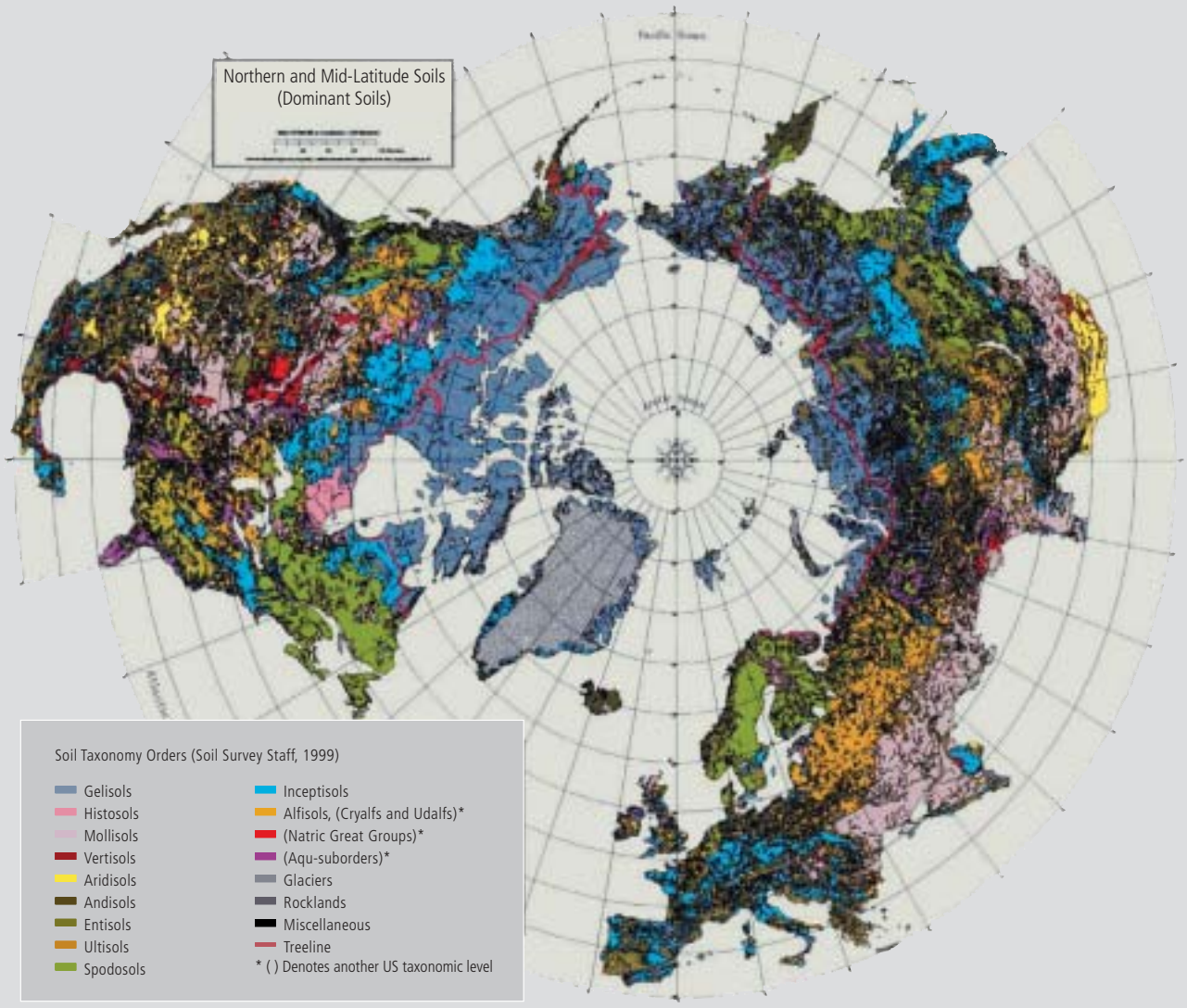
In 1998 the prize was awarded to IIASA's first director, Howard Raiffa, and his colleagues at Harvard University for *Smart Choices: A Practical Guide to Making Better Decisions.*

New Database on Soils of Northern and Mid-Latitudes Released

The cold regions of the Northern Hemisphere comprise a diversity of ecosystems including tundra, boreal and temporal forest, temperate grasslands, and wetlands. This territory covers approximately 25 percent of the globe and contains some of the world's greatest resource-consuming countries, creating high environmental stresses. As stated at the United Nations conferences in Rio de Janeiro in 1992 and Johannesburg in 2002, these stresses are a major threat to sustainable development. The pressure on the terrestrial biogeochemical cycle is of particular importance as the area contains nearly 60 percent of the global soil carbon. This contains a massive amount of incompletely decomposed vegetation in peat, litter, and muck, which is sensitive to temperature rise. The expected climate warming will accelerate the decomposition rate, which is assumed to alter the terrestrial carbon balance through increased carbon dioxide emissions, thus contributing to the higher concentration of greenhouse gases in the atmosphere. The development of these processes is uncertain owing to the lack of a common analytical basis—for example, standard datasets and standardized methods and tools.

The analysis of anthropogenic impacts on natural resources should be based on reliable and modern inventories for the region. In recent years, IIASA's Forestry Project has made substantial investments in developing standards for environmental inventories of the Northern Hemisphere. These experiences and inventories were used by an international consortium of scientists to develop the Northern Circumpolar Soils Database, spatially describing soils in the Northern Hemisphere. The database and accompanying map were recently released (Tarnokai, C., et al., 2003, Soils of the Northern and Mid Latitudes. 1:15 000 000 scale map, Research branch, Agriculture and Agri-Food Canada, Ottawa, Canada). The datasets will be presented at the International Cartographic Association exhibit in Durban, South Africa, in June. ■

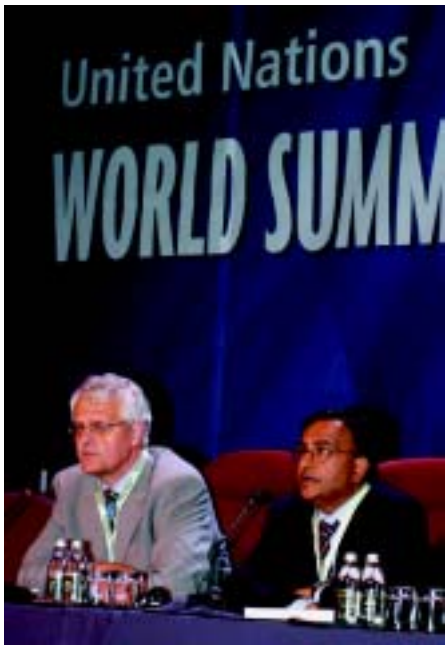
Soils of Northern and Mid-Latitudes



Contributors University of Vechta, Germany; Institute of Geography RAN, Russia; Institute of Geography, Denmark; Agriculture and Agri-Food Canada; Natural Resources Conservation Service, United States Department of Agriculture, USA; European Commission, Joint Research Center, Italy; Norwegian Institute of Land Inventory, Norway; Agrifood Research Finland; INEGI (National Institute of Statistics, Geography and Informatics), Mexico; Agricultural Research Institute, Iceland; International Institute for Applied Systems Analysis, Austria; and Institute of Geography, Mongolia

IIASA Report Presented at WSSD in Johannesburg

IIASA's report on "Climate Change and Agricultural Vulnerability," by Günther Fischer, Mahendra Shah, and Hariij van Velthuizen, a study commissioned by the United Nations (UN), was distributed to all government delegations at the World Summit on Sustainable Development (WSSD). At an official UN press conference during the Summit, IIASA Director Leen Hordijk and Mahendra Shah (*left* to *right* in photo) made two key points. First, they recommended that adaptation to climate change be included among the issues for discussion in international negotiations. This issue was included in the opening statement of the United Nations Framework Convention on Climate Change (UNFCCC) COP 8 at Delhi two months later. They then observed that the Millennium Development Goal of halving the number of undernourished worldwide by 2015 cannot be met by "trickle-down" economic development alone, however favorable the conditions. The goal can only be achieved through targeted poverty- and hunger-reduction programs specifically directed at vulnerable segments of populations.



National delegations of several countries (Brazil, India, Kenya, and South Africa, among others) were individually briefed on the contents of the report at the WSSD. At a later UNFPA/UN/IIASA press conference during the Johannesburg Summit, Shah also reported on the attempts of the Global Science Panel to put population issues back on the agenda of the WSSD. The two press briefings generated wide media interest, with over 400 newspaper articles appearing worldwide on the two topics. As a result, IIASA's Land Use Change (LUC) Project, where the agricultural vulnerability report originated, has received several offers of collaboration for further policy research. Austria's Foreign Minister Benita Ferrero-Waldner mentioned the importance of IIASA's work in several of her post-Johannesburg speeches. ■

IIASA Scientist Speaks at UN Headquarters in New York

Nebojsa Nakicenovic of IIASA's Transitions to New Technologies (TNT) Project spoke at the United Nations (UN) headquarters in New York on 3 December 2002. He and Rajendra Pachauri, chairman of the Intergovernmental Panel on Climate Change and director-general of the Tata Energy Research Institute in India, were invited by Kofi Annan to give the third lecture in the UN Secretary-General's series on "The Interface between Energy and Climate Change." Nakicenovic, in a talk titled "Global Energy Scenarios: Mitigation Strategies and Technological Change," spoke about future energy use and climate.

Energy services are essential for sustainable development, but related climate benefits can be enormous if these services are provided in an appropriate manner. New technologies need to be developed and deployed in the market place. Despite the large uncertainties associated with technology adoption and diffusion, buy-downs along learning curves cannot occur without accumulated experience and learning, which requires time and money.

The crux of Nakicenovic's message was threefold: the time lag for replacement of capital energy stock is 20–70 years; premature replacement of existing capital by new technologies is too costly; and the time is ripe now to invest in experimentation and technological learning for future capital replacement in the energy sector.

A one-hour video of Dr. Nakicenovic's talk can be seen at www.un.org/webcast/2002.html, under the entries for 3 December 2002. ■

Tjalling Koopmans Distinguished Lecture Series 2002–2003

This special lecture series is named in honor of the late Tjalling Koopmans, Nobel Prize–winning economist at Yale University, who was involved with IIASA at its beginnings. In June 2002, Brian W. Arthur, Citibank Professor at the Santa Fe Institute in New Mexico, spoke on "A Fundamental Indeterminacy in the Economy."

Arthur is an economist best known for his theories about the economics of the high technology sectors. His work on increasing returns—in particular their role in magnifying small, random events in the economy—won him a Guggenheim Fellowship in 1987 and the Schumpeter Prize in Economics in 1990.

In Arthur's own words, increasing returns are a form of positive feedback. Very often in high technology sectors, as something gets farther ahead it gains an increasing advantage. If many people are using, say, Java, then others feel they have to install Java instead of Active X or some other equivalent. Taking this line of reasoning much further, actions taken by economic decision makers are typically predicated upon their predictions about future states of a world that is itself in part the consequence of these predictions. The result is an ecology of co-evolving, possibly ever-changing expectations. The resulting dynamics can be analyzed only by computation.

Professor Oded Stark, currently senior fellow at the Center for Development Research, University of Bonn, gave a talk in March this year on "Rethinking the Brain Drain." Professor Stark has taught at the University of Oslo and at Harvard University, where he was director of the Migration and Development Program. The thesis he put forward in his talk is that, with a well-controlled migration policy, the possibility of migration to a wealthier country raises the level of human capital in the home country.

A common concern in many countries is the loss of skilled personnel to countries that offer better pay. Professor Stark turns this concern on its head, arguing that opening an economy to migration provides an incentive to workers to better educate themselves, to improve their skills, to acquire more human capital. He demonstrates that, because not all these workers will end up migrating to the better jobs, some will remain behind equipped with a higher level of human capital than would have been the case had the migration opportunity been absent. This can have a positive effect on the welfare of all workers in such countries. ■

IIASA Workshop on Air Pollution and Climate Change

Air pollution and climate change, while closely related, have mostly been treated as separate problems. At the international level, efforts under the UNECE Convention on Long-range Transboundary Air Pollution have helped cut air pollution levels in Europe. Sulfur emissions are 60 percent lower than in 1980, nitrogen oxides are down by 25 percent compared to 1990, and other pollutants are also starting to decline. At the global scale, the United Nations Framework Convention on Climate Change has brought together more than 180 countries to agree on measures to combat climate change. More needs to be done, both to bring air pollution down to safe levels and to cut greenhouse gas emissions to halt climate change.

Taking certain climate change measures will yield additional benefits through improved local and regional air quality. Certain air pollution abatement measures will also help protect the regional and global climate. The UNECE Convention's Centre for Integrated Assessment Modelling, run by IIASA, estimates that the cost of reaching the 2010 air pollution objectives in the Convention's Gothenburg Protocol could be reduced by at least €5 billion if European countries cut CO_2 emissions in line with the Kyoto Protocol (without CO_2 trading). Substantial cost reductions have also been found in studies for China and Mexico.

A workshop on "Linkages and Synergies of Regional and Global Emission Control," organized by IIASA in January 2003 under the UNECE Convention on Long-range Transboundary Air Pollution, looked at the numerous links between air pollution and climate change. It concluded that these links are so important that they merit close cooperation. ■

IIASA Awarded Three Major Grants

Extension of RAINS Model to Greenhouse Gases

Major funding has been received from the Netherlands Ministry for Housing, Spatial Planning and the Environment (VROM) for work by IIASA's Transboundary Air Pollution (TAP) Project to extend the IIASA Regional Air Pollution Information and Simulation (RAINS) model to include greenhouse gases (www.iiasa.ac.at/~rains). The present version of RAINS addresses health impacts of fine particular matter and ozone, vegetation damage from ground-level ozone, and acidification and eutrophication. This two-year grant will enable TAP to extend the multi-pollutant/multi-effect framework of the RAINS air pollution model with an assessment of the emissions, control potentials, and control costs of the six greenhouse gases addressed in the Kyoto Protocol.

Modeling Opportunities and Limits for Restructuring Europe towards Sustainability (MOSUS)

Earlier this year, IIASA was awarded a substantial three-year funding contract from the European Commission under the 5th Research Framework Programme. MOSUS (Modeling Opportunities and Limits for Restructuring Europe towards Sustainability), coordinated by Dr. Günther Fisher of the Modeling Land-Use and Land-Cover Changes (LUC) Project at IIASA, is jointly being implemented with 11 European partner institutions.

MOSUS aims to integrate three major themes of European policies—sustainable development, competitiveness and social cohesion in the knowledge-based society, and globalization and international trade—by assessing European (EU-15 and accession countries) use of resources in terms of material flows, energy inputs, land use, and GHG emissions, reconciling long-term economic development in Europe, the promotion of international trade, and environmental protection requirements.

Policy Pathways to Health in the Russian Federation

IIASA's Risk, Modeling and Society (RMS) Project has received two grants in support of a conference on policy pathways to health in the Russian Federation (for more detailed information on this research topic, see article on page 11). The conference, led by Dr. Landis MacKellar, aims at improving the long-term health of the Russian population through a better understanding of the causes of current high levels of mortality and morbidity in the Russian Federation and the policies and means to address them. The target groups are policymakers, economists, and other researchers working in public health and health care delivery and financing, public institutions involved in health and safety at work, accident prevention, alcohol abuse, and related areas of health promotion and protection. The conference, to be held in September 2003, is supported by the EuropeAid Co-operation Office under the European Commission Tacis Seminars and Conferences Series, and the Austrian Ministry for Education, Science and Culture.

For further information please contact IIASA's Office of Sponsored Research (riley@iiasa.ac.at).

NMO News

Germany's return to active membership and the addition of two new member countries increase IIASA's potential to serve as a global bridge between science and policy.

The decision by the German National Member Organization (NMO), in November 1997, to withdraw from active participation in IIASA was a great loss to the Institute. In January of this year, the German government decided to reconstitute an NMO and rejoin the Institute as a fully participating member. This move is seen as an affirmation of IIASA's perceived relevance and the effectiveness of its research program within the European Union (EU). The German NMO is The Association for the Advancement of IIASA headed by Dr. Peter Lemke of the Alfred Wegener Institute for Polar and Marine Research.

The Egyptian government appointed an NMO to IIASA in January 2003. As a first step, two Egyptian researchers have joined this year's Young Scientists Summer Program, working on issues of environmental pollution and land-use change. IIASA's association with Egypt complements new initiatives by the EU, announced in June 2003, to attract more scientists from Arab countries into its Sixth Framework Programme on research. The Egyptian NMO is represented by Dr. Mohsen M. Shoukry, vice president of the Academy of Scientific Research and Technology in Cairo.

Estonia also became an IIASA member country this year, the first of the three Baltic states to join. The NMO is the Estonian Association for Systems Analysis, headed by Dr. Erik Terk, director of the Estonian Institute for Futures Studies.

Erna Wodak died of cancer on 15 April 2003. Ms. Wodak served as 1st vice president of the IIASA Society from its establishment in 1998 until shortly before her death, supporting IIASA's work in this capacity for almost two complete terms of office. Her association with IIASA began over 30 years ago, when her husband, Ambassador Walter Wodak, played a crucial role in bringing the Institute to Schloss Laxenburg.

In Memoriam

Jermen Mikhailovich Gvishiani

IIASA announces with deep regret the passing of Academician Jermen Mikhailovich Gvishiani. Academician Gvishiani was the Institute's first council chairman, holding the position from 1973 to 1987. In 1972, while serving as deputy chairman of the Soviet State Committee for Science and Technology, Academician Gvishiani was the key negotiator for the Soviet Union in the discussions that led to the founding of IIASA.

In recognition of Dr. Gvishiani's outstanding contributions to IIASA, the Institute named him an "IIASA Honorary Scholar and Distinguished Principal Founding Member" in 1987, a distinction he shared with Dr. Philip Handler, his American counterpart in the negotiations.

He was instrumental in the founding of the Club of Rome in the 1960s, together with Aurelio Peccei and Alexander King. Thus he played a crucial background role in the appearance of *The Limits to Growth*, the book by Donella Meadows et al. that went on to sell over 12 million copies and made the Club of Rome a household name.

Dr. Gvishiani was a member of many prestigious institutions; he received a number of Russian and foreign government decorations and won the Golden Mercury International Prize for services to international trade.

Tributes to Academician Gvishiani

Professor Howard Raiffa, IIASA's first director, from 1972 to 1975:
I got to know Jermen Gvishiani well, and the more I knew him the more I respected his sagacity and diplomacy. He taught me a lot about the art of negotiation. As chairman of the Council, he had responsibility for the "big" decisions; as director (1972–1975), I had responsibility for the "small" decisions. But so much fell between the big and the small. Jokingly we decided that the decision to go big or small was itself a big decision. I wielded more power than Jermen had in mind in his Compromise Plan, since so many big decisions were left unresolved because (a) there was not enough time in the Council meetings and (b) votes on certain issues would be split and therefore divisive if brought to a vote. So I got to act, by default, as decision maker in realms that were not intended. However, I tried not to abuse that privilege by privately discussing with Jermen what he would like to see done.

After I returned to Harvard, I taught the art and science of negotiation, and in discussions about cultural differences, I relished reciting anecdotes of how a high-ranking Soviet official coached me how to negotiate with the Austrian foreign secretary and with governmental representatives of other countries.

IIASA was lucky that Jermen Gvishiani chose to be the first chairman of its Council and that he elected to remain in that role for so many years. I know the United States would have wanted him in that capacity even if there were not an understanding that as long as he was the chairman there would be a director from the United States to "balance the ticket." I know as director how wonderful a man he really was. He had a tough role to play and he did it masterfully.

Dr. Roger Levien, director of IIASA from 1975 to 1981:
IIASA would not have been created and would not have survived its early years without Jermen Gvishiani. Because of his authority within the Soviet Union, his interest in Western management, and his associations with business and government leaders on both sides of the "Iron Curtain," he was uniquely qualified to participate in the creation of the Institute as the Soviet negotiator. Because of his sophisticated understanding of the ways of both the East and the West, his native intelligence and natural diplomacy, and his commitment to the Institute's success, he was uniquely qualified to guide it through the often turbulent Cold War years as chairman of the Council. Although IIASA was the child of many "fathers," Jermen Gvishiani was the indispensable one.

I had the good fortune to collaborate closely with Jermen Gvishiani for the seven years that I served as the director of IIASA. Our backgrounds could hardly have been more different, but our goals for IIASA could hardly have been more similar. I cannot remember an occasion, even some very difficult ones where US and Soviet interests might have appeared to diverge, where we did not agree on the course of action that was in IIASA's interest. As chairman of the Council, he exercised discreet leadership, building agreement among 17 members from East and West through the exercise of quiet authority and sophisticated diplomacy. Every decision during his tenure was taken by consensus after lively discussion in the meetings and quiet conversations in the corridors. His hand was firm, but his style was graceful, and his goal was always the success of IIASA.

IIASA National Member Organizations

Austria The Austrian Academy of Sciences
*Bulgaria** The Ministry of Environment and Waters
China The National Natural Science Foundation of China
Czech Republic The Academy of Sciences of the Czech Republic
Egypt Academy of Scientific Research and Technology (ASRT)
Estonia Estonian Association for Systems Analysis
Finland The Finnish Committee for IIASA
Germany The Association for the Advancement of IIASA
Hungary The Hungarian Committee for Applied Systems Analysis
Japan The Japan Committee for IIASA
*Kazakhstan** The Ministry of Science—The Academy of Sciences
Netherlands The Netherlands Organization for Scientific Research (NWO)
Norway The Research Council of Norway
Poland The Polish Academy of Sciences
Russian Federation The Russian Academy of Sciences
Slovak Republic The Executive Slovak National Committee for IIASA
Sweden The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS)
Ukraine The Ukrainian Academy of Sciences
United States of America The American Academy of Arts and Sciences

*Associate member

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