

Education will be at the Heart of 21st Century Demography*

While changes in population size have been a dominant focus throughout the history of demography, a marked shift in interest occurred in the late 20th century toward age structure. In the industrialized world aging concerns took center stage and even in the high-fertility developing countries the emphasis has been shifting to the Demographic Dividend paradigm, which relates economic growth and societal wellbeing to the changing relative sizes of age groups. In the 21st century yet another paradigm shift may follow, emphasizing the "quality" dimension through the explicit incorporation of education (and health) as core constituents of our demographic models.

Continuously increasing life expectancy is also challenging the conventional definition of age and aging (see *Science* reprint, pp. 6–7) and the common saying that "40 is the new 30" or "60 is the new 50" has strong scientific backing. While age is losing some of its self-evident nature, educational attainment is gaining ground as the single most important clearly measurable source of population heterogeneity (after age and sex). Educational attainment influences a wide spectrum of key concerns, including human health, economic growth, and the functioning of modern democracies. Recently, new sets of reconstructed data by age, sex, and level of educational attainment for most countries have facilitated new analyses demonstrating the key role of improved education for development, in particular the entry of the better educated younger cohorts into the decisive age groups.

Integration of this "quality dimension" into the main body of demographic methodology will make demography far more relevant in terms of addressing some of this century's key problems. The analytical tools—in the form of multi-state demography, already exist. They now need to be applied to a wide range of important research questions—and it is this work that awaits us at the new Wittgenstein Centre. **WL**

*The 2010 issue of the *Vienna Yearbook of Population Research*, focusing on "Education and Demography," includes a commentary by W. Lutz with this title. Free download of all papers under www.oew.ac.at/vid/yearbook.

IIASA, the Austrian Academy of Sciences, and the WU–Vienna University of Economics and Business recently signed an agreement to jointly establish the

Wittgenstein Centre for Demography and Global Human Capital

The Wittgenstein Centre has been made possible by the substantial research funding associated with the Wittgenstein Prize—the highest Austrian science prize—which, for the first time in its history, went to a social scientist: Wolfgang Lutz. This collaboration aims at merging the existing strengths in the Vienna area in the fields of demography, human capital formation, and analysis of the returns to education in order to establish a globally leading centre in this field.

Our main goal is to better understand the role of human capital—the human resource base in terms of the number of people and their changing structure by age, gender, place of residence, level of education, health status, cognitive skills, and participation in the "production" of human wellbeing. In particular, as we strive for sustainable development, we seek to improve our understanding of human capital vis-à-vis financial and natural capital, through improvements to the analytical toolbox and our empirical database.

The focus of the Wittgenstein Centre will be global. ■



THE ARCHITECTURE OF THE WITTGENSTEIN CENTRE

Building on the foundations (steps) of science, three very different institutions plan to collaborate synergistically in the Wittgenstein Centre. IIASA, founded in 1972 as a global think tank to address issues of planetary scale, is an international body with currently 19 scientific National Member Organizations (NMOs) from around the world (including the four BRIC countries). The *Austrian Academy of Sciences*, the time-honored national academy and the largest research carrier outside the university system, is organized into various research institutes, of which the *Vienna Institute of Demography* is the largest in the social sciences and humanities section. The *WU–Vienna University of Economics and Business*, Europe's biggest business school, is currently seeking to strengthen its research component and graduate teaching in strategic areas; it recently opened a new section on demography and a research institute on "Human Capital and Development." The Wittgenstein Centre is not a separate legal entity; employment and funding will go through one of the three pillar institutes (currently led personally by Wolfgang Lutz), but it will have a coordinated research agenda, a common logo, and speak with a single voice to the outside world.

From Demography through Education to Human Capital

The Directors, Leaders, and Research Focus of the Wittgenstein Centre



WOLFGANG LUTZ
Founding Director
Team Leader “Theory of Human Capital Formation & Socioeconomic Change”

Wolfgang Lutz founded the Wittgenstein Centre to apply the powerful methodological tools of demography to the analysis of human capital formation, thus introducing the “quality” dimension into demography and heightening the relevance of demography to almost all aspects of global development. Twenty-five years of work in the interdisciplinary environment of IIASA convinced him of the importance to long-term sustainable development of investments in education and health. With a focus on Europe in his nine years with the Vienna Institute of Demography, the insight matured that population aging could be tackled better through more education and the resulting increased productivity rather than by simply increasing fertility. Finally, this new school of thought will produce its own human capital through a new training and research program at the WU—Vienna University of Economics and Business. Wolfgang’s role as leader of the three pillars unites the separate parts.



BILL BUTZ
Director of Coordination and Outreach

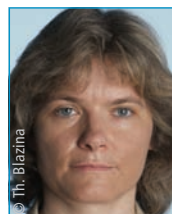
Bill will work with Wolfgang and Heike to build and administer the Centre and assure the coordination of its teams. He will also lead our outreach programs to the Centre’s varied constituencies. These include policymakers in the developing countries, Europe, and international organizations; national and international media; and public and private funding organizations. In these efforts, he will work with colleagues to translate our data and technical research into language and formats that successfully inform and motivate policy change. He will also bring to the team activities his own research experience in economic demography and human capital.



JESUS CRESPO CUARESMA
Director of Economic Analysis
Team Leader “Economic Returns to Education”

Jesus’ function is to guide the different efforts being carried out within the Wittgenstein Centre in the field of economics to ensure the highest level of scientific quality. Jesus will also work to identify unexplored niches in interdisciplinary approaches to the role of human capital as a determinant of economic performance. Emphasis will be given to answering research questions with the highest impact and usefulness for policymakers.

The research efforts of the “Economic Returns to Education” team will concentrate on identifying and measuring the effects of human capital on economic outcomes, understood in a broad sense to include not only private returns to education and economic growth, but also poverty alleviation and institutional change.



ALEXIA FÜRKRANZ-PRSKAWETZ
Director of Research Training
Team Leader “Education & Labour Market”

The Wittgenstein Centre will act as an important institution for continued training in advanced demographic and economic methods. Teaching will be conducted by senior scientists of the Centre and by lecturers invited from its partner institutions. The task of the Director of Research Training is to organize and coordinate research training and to build up the link between the Wittgenstein Centre and international training programs such as the European Doctoral School of Demography.

Population aging, caused by decreasing fertility and increasing survival to an older age, will imply a pronounced change in the age and educational composition of the workforce. Imperfect substitutability of workers at different ages, together with increasing demand for educated workers and technological progress, are key factors explaining the relation between demographic change and labor market outcomes. Within the research program “Education and Labour Market” we will study how educational and labor market policies will need to adjust to these demographic challenges.



SERGEI SCHERBOV
Director of Demographic Analysis
Team Leader “Population Dynamics & Aging”

Demographic analysis will have a very prominent role among activities of the Wittgenstein Centre, as the size, composition, and structure of populations affect almost every aspect of our lives. Demographic analysis is about methods of measuring dimensions and dynamics of population. Development of population size and its composition to a large extent defines the whole subject of demography. To deal with future population dynamics, we will apply conventional demographic methods and advanced methods that include multi-state and stochastic approaches. We are planning to contribute to the further improvement of existing methodologies as well as to the development of new methodologies related to demographic analysis.



BILAL BARAKAT
Team Leader “Education Policy & Planning”

The “Education Policy and Planning” team will focus on the creation of human capital—as opposed to its consequences—and the way its emergence can best be monitored and influenced. The team consists of Bilal Barakat, Rachel Durham, and Clarissa Guimarães Rodrigues, three education policy analysts from different disciplines. Medium-term objectives are to combine statistical techniques and expert judgment to specify country-specific long-term education scenarios for use in human capital projections; to find ways to reconcile global education statistics on attainment, enrollment, and quality; to define new indicators; and to investigate the extent to which the future diffusion of higher education can be expected to follow the examples of schooling.



ANNE GOUJON

Team Leader "Human Capital Data Lab"

The laboratory team will aim to collect data on population by levels of educational attainment and literacy for the 20th century, including data mining, adjusting, reconstructing, validating, and analyzing. This will serve two main purposes. The recent estimate for the 21st century will provide the population basis for human capital projections; the estimates for earlier times will offer scholars a solid, consistent, and detailed base upon which to study the impact of education and literacy on most of the demographic, economic, and development processes of the last century. Roman Bauer and Michaela Potančoková will join the team on 1 March 2011. **DATA NEEDED!** If you have historical data on levels of educational attainment and/or literacy for a specific country or group of countries, please share it with us and send an E-mail to goujon@iiasa.ac.at. Your help is very much appreciated.



SAMIR K.C.

Team Leader "Modeling Human Capital"

The modeling group will mainly focus on developing a multi-state population projection model. Coordinating and consolidating the assumptions of the other teams regarding future mortality, fertility, migration, and educational attainment into the new model describes the central role of this team. Currently, Samir K.C. and Alessandra Garbero, both demographers, are members of the group. The team's goal for the next two years is to develop the multi-state population projection model described in order to produce population projections by age, sex, and education for all countries of the world.



MARC LUY

Team Leader "Health & Mortality"

This research group deals with several aspects of health and aging with a special focus on differentials in mortality and morbidity. These involve differences between women and men, socioeconomic status groups, migrants and non-migrants, and between countries or smaller regional units. The aim of these studies is to disentangle the various risk factors and to evaluate their absolute and relative impact on health and mortality, including their variations in different populations and sub-populations. The analyses are based on different data sources, including official population statistics, survey data, and self-collected data. Additional topics of this research group comprise technical aspects connected to the available data and methods.



NIKOLA SANDER

Team Leader "Migration & Education"

The research team on "Migration and Education" consists of researchers from Geography (Nikola Sander), Statistics (Guy Abel), Demography (Jana Vobecká), and Sociology (Raya Muttarak). The work of the team will focus on improving the modeling of international migration in global population projections. Special consideration is given to migration differentials by level of educational attainment. As the propensity to move by age, sex, and education varies considerably by country, the accuracy of projections by

level of education for countries around the world can be greatly enhanced by modeling gross migration flows rather than the corresponding net flows. The first step in the modeling of migration is to establish a harmonized dataset of inflows and outflows disaggregated by age, sex, and level of education for each country in the world. In the next step, understanding how alternative forms of international migration behavior will impact on future population dynamics at the global level is achieved by developing a set of scenarios that highlight ways in which the intensity and pattern of migration may change until 2050.



VEGARD SKIRBEKK

Team Leader "Age, Cohort & Cognitive Skills"

A range of studies emphasizes how skills (and not educational length) underlie economic growth, individual income, and socioeconomic outcomes. Human capital, however, is not yet well described by age and cohort across countries.

This Wittgenstein research team, which is part of the Age and Cohort Change project at IIASA (www.iiasa.ac.at/Research/POP/ACC), intends to describe international variation in age–sex distributions of skills and abilities. We aim to estimate life cycle variation in cognition by age and cohort using synthetic cohort approaches and compare skill development across countries.



HEIKE BARAKAT

Scientific Administration

As Scientific Administrator, Heike works closely with Wolfgang and Bill in order to support the Directorate of the Wittgenstein Centre as well as its team leaders and staff. Among her duties are project assistance as well as project and grant management, event management, public relations, and editing. To ensure a smooth workflow, close cooperation with administrative personnel at IIASA, VID, and WU is another important part of her work. She is also the first point of contact for applicants and the interested public.



TOMÁŠ SOBOTKA

Team Leader "Human Reproduction"

Individuals with a high level of education have been at the forefront of the shift to a small family size. In low-fertility countries, concerns about low fertility have been especially focused on women with tertiary education levels, who typically have the lowest fertility and highest childlessness rates. Within the Wittgenstein Centre the "Human Reproduction" team aims to provide systematic evidence on contemporary fertility preferences and fertility behavior by level of education. Five interrelated topics will be analyzed:

- Is there a systematic negative gradient in fertility level by educational attainment among men, similar to that found among women?
- Does a higher level of childlessness explain most of educational differences in fertility among women?
- Do highly educated men and women usually desire a smaller family size than their lower-educated counterparts or do they have a higher "gap" between fertility preferences and actual fertility?
- Is there evidence of the narrowing of the educational differences in fertility in the most developed countries and, if so, what are the main reasons for that?
- Do highly educated men and women have smaller unwanted fertility than their lower-educated counterparts and, if so, what are the main reasons for this?

The First Major Project of the Wittgenstein Centre

Toward a New Set of Science-based World Population Projections by Age, Sex, and Level of Educational Attainment for Individual Countries (including the Provinces of India and China)

In collaboration with Oxford University, IIASA's World Population Program is in the process of making new science-based multi-state population forecasts by age, sex, and level of education for most of the countries of the world and the provinces of India and China. The definition of assumptions is based on a new methodology, one that is science-based, transparent, and democratic, and also allows learning and improvement over time. The methodology uses new tools of knowledge aggregation over the Internet to gather information from a large number of experts around the world who will evaluate in a peer-review manner the validity of different arguments about the forces that drive changes in fertility, mortality, and migration rates. Probabilistic forecasts by age and sex, and multi-state forecasts that include age, sex, the level of education, as well as health status and labor force participation, will be produced. It will be carried out over the course of 2011 and 2012.

Background

There is a disconnect between, on the one hand, the large number of substantive population researchers around the world conducting analyses of the differentials and determinates of fertility, mortality, and migration trends and, on the other hand, the small number of demographers making the assumptions for actual population projections—usually behind closed doors and without a transparent, publicly discussed justification.

In his Foreword to the 1994 IIASA book *The Future Population of the World: What Can We Assume Today?*, edited by Wolfgang Lutz, Nathan Keyfitz wrote:

“Forecasting is one of the oldest of demographic activities, and yet it has never fully been integrated with the main body of demographic theory and data. The fact that the public regards it as our most important task finds no reflection in our research agenda; the amount of it done is out of all proportion to the fraction of space devoted to it in professional journals.”

The new project will make a major effort to narrow this unsatisfactory gap between substantive scientific analysis and specific numerical forecasts. The problem that Keyfitz described above has not been solved. Recently, EU statistical offices were sent a questionnaire about the work on population forecasting. Of the 21 statistical offices responding, all, without exception, saw a need for improvement in the process that leads to the definition of assumptions, in particular, a need to strengthen interaction with the scientific community so as to provide better substantive justifications of the specific assumptions made. In making new forecasts that respond to these concerns by trying to fully integrate forecasting with the main body of demography, we honor the memory and wisdom of Nathan Keyfitz.

Substantive Peer Review of Alternative Arguments that Make a Difference for the Future

To base forecasts—of, for example, the likely level of the total fertility rate 20 years down the road—on specific opinions alone, whether they are qualitative or numerical, is rather unsatisfactory from a scientific point of view, even if these estimates come from highly qualified experts. By their very nature, they are subjective and cannot be validated because the underlying reasoning is unknown and the process by which they are arrived at lacks transparency. In other words, in most population projections the reasoning leading to the estimates is missing. Hence, when IIASA initially addressed the issue of substantively justifying specific forecasting assumptions for Europe and North America in 1988–1990 (Lutz 1991) and for the world in 1992–1993 (Lutz 1994), we took an important first step beyond the conventional approach by inviting leading scholars of fertility, mortality, and migration to produce chapters that combined a comprehensive overview of the state-of-the-art scientific research with the definition and justification of specific numerical assumptions about the future.

The current project makes another important step forward by greatly expanding the number of experts involved from a handful to several thousand. This can be seen not only as a way of further reducing the influence of possible subjective biases, but also as a step toward “democratizing” population projecting, which to date is still an industry with a high degree of monopoly. To involve such large numbers of experts in a substantive way there needs to be a standardized format of involvement. As it would not be feasible to expect a piece of written text (comparable to the above-mentioned book chapters) from each expert, and because the answers and views expressed need to be comparable, we have developed a standard questionnaire. It contains a comprehensive list of possible arguments showing the consequences of major forces of change that determine the future courses of fertility, mortality, and migration. Based on their research experience and substantive knowledge, experts are invited to assess the validity of arguments. Peer review, though not without its own problems and not entirely free of biases, is still the best available strategy developed by the scientific community to date for assessing the quality of research and the validity of conclusions.

The structure of the questionnaire will be discussed in detail below. Existing methods cannot be used without significant modification, due to the specific demands of the exercise. The aim to involve a very large number of experts in the assessment of arguments rules out the classical Delphi Technique, which would require several iterations with the same participants. In addition,

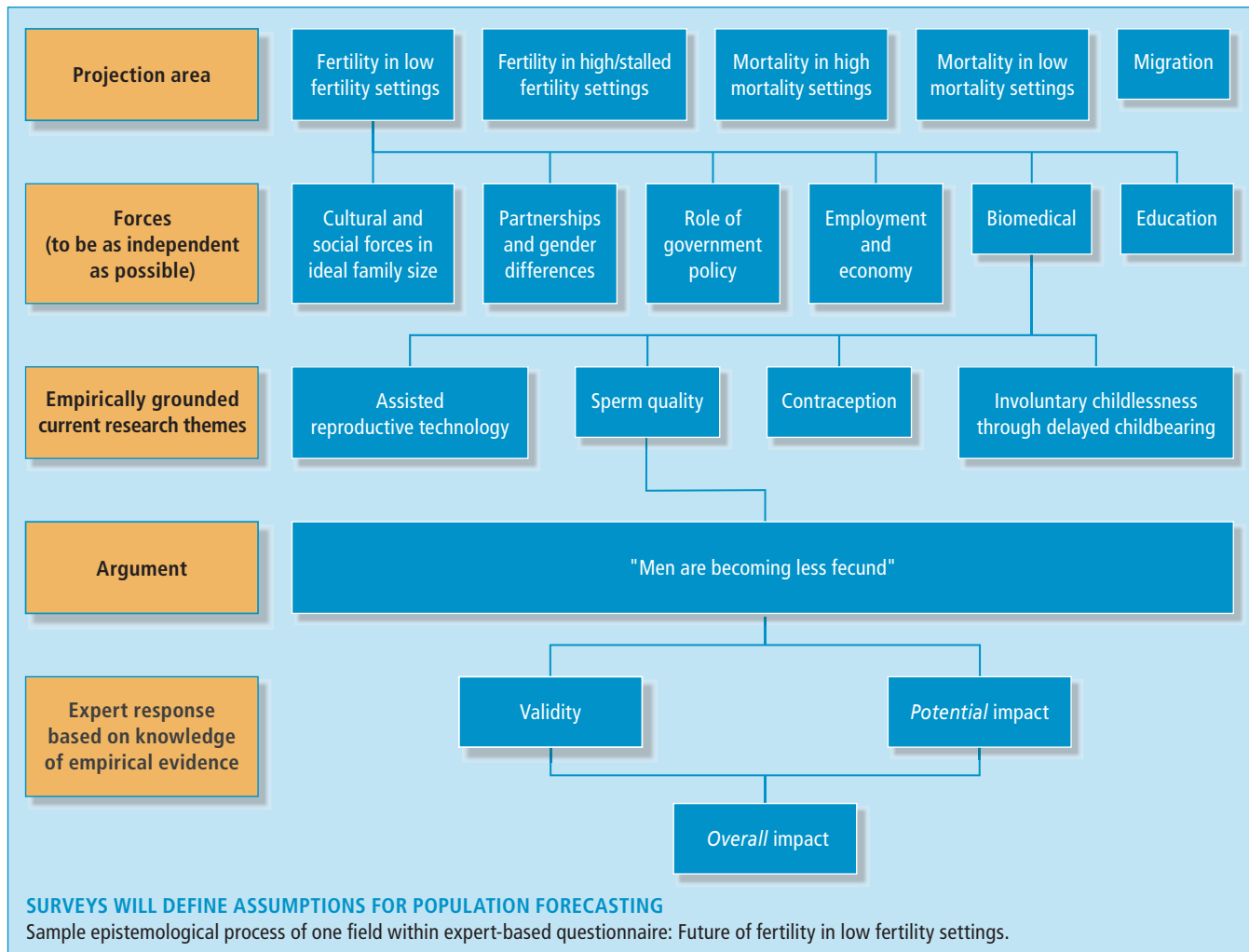
we are interested to get from each expert not only “best guesses” but also explicit estimates of the associated uncertainty ranges, which is different from the distribution of point estimates across experts.

Implementation

While the demographic dimensions of fertility, mortality, and migration are structurally similar, there will be separate questionnaires for each. In fact, for fertility and mortality there will be two questionnaires each because the dynamics in low and high fertility and mortality settings are rather different. While respondents are welcome to answer more than one set of questions, we expect only a minority will choose to do so.

generously and does include junior scholars and graduate students. Canvassing of responses is expected to begin in mid-2011.

This does not necessarily mean that all responses will be taken at face value or weighted equally. Both self-assessed expertise and inferred coherence of responses can be taken into account. In fact, in addition to extracting assumptions for demographic forecasts, we will use the data collected to further our understanding of the sociology of knowledge and the creation of epistemological frameworks on a hitherto unprecedented sample size of experts. We expect that the analysis of the data that we collect will begin in early 2012, initially in separate meetings for each module.



The overarching structure of the exercise is to gauge the validity and impact of a wide set of arguments that could affect the future of a given projection area. For example, voluntary childlessness is currently observable in many contemporary societies, and we would like to know whether or not this is likely to increase, and what the overall impact upon fertility might be. Around 30 to 40 such arguments are included for each module, grouped thematically into six or so forces. The structure of the survey is presented schematically above.

Participation in the survey exercise will be solicited chiefly from members of relevant professional associations. While the survey is directed at those with some expertise specifically in demography rather than a general scientific public, this is interpreted

This task will be supported by state-of-knowledge reviews for each field commissioned specifically for the project. Together, these reviews will become background chapters in a book presenting the outcomes of the exercise, to be published in 2013.

The European Research Council’s Advanced Grant “Future Societies,” awarded to Wolfgang Lutz for the 2009–2014 period, will enable IIASA’s World Population Program to carry out this major project in collaboration with its partners. ■

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DEMOGRAPHY

Remeasuring Aging

Warren C. Sanderson^{1,3*} and Sergei Scherbov^{2,3}

Population aging is an international concern, in part because of consequences of coming age-structure changes, e.g., growth in the number of elderly, decline in the number of youth, and accompanying economic and social costs (1–4). These expectations are based on conventional measures of aging that link expected phenotypes to fixed chronological ages. But as life expectancies increase and people remain healthy longer, measures based solely on fixed chronological ages can be misleading. Recently, we published aging forecasts for all countries based on new measures that account for changes in longevity (5–8). Here, we add new forecasts based on disability status. Both types of forecasts exhibit a slower pace of aging compared with the conventional ones.

Limits to Chronological Age

One advantage of aging forecasts based on fixed chronological ages (1, 9, 10) is that the United Nations (UN) computes them consistently for all countries of the world. These include the proportion of the population 65 and older, and the old-age dependency ratio (OADR), which considers people dependent upon others when they reach the age of 65 (often calculated as the number of people aged 65 or older, divided by the number of people of working age, 15 or 20 to 64). When using indicators that assume fixed chronological ages, it is implicitly assumed that there will be no progress in important factors such as remaining life expectancies and in disability rates. But many age-specific characteristics have not remained fixed and are not expected to remain constant in the future (11). In 1950, for example, 65-year-old women in Canada, Sweden, and the United States could expect to live an average of around 15 more years. By 2000, that had risen to about 20 (12), and the UN foresees further

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increases. Other forecasts also assume continuation of trends in life expectancy growth seen in the last decades (8, 13), although the UN forecasts assume that the speed of life expectancy increases will slow.

Disability-free life expectancies, which describe how many years of life are spent in good health, have also been increasing, often as fast as unconditional life expectancies, because of decreases in age-specific disability rates (14). For example, in the United States, the proportion disabled in the age group 65 to 74 declined from 14.2% in 1982 to 8.9% in 2004–05 (15). Thus, fixed chronological ages do not work well in evaluating the effect of age structure changes on health care costs, because most of those costs occur in the last few years of life, which happen at ever later ages as life expectancies increase (16, 17).

Life-Expectancy Adjustments

Defining old age by using life expectancy instead of chronological age was first suggested in (18), and expanded upon in (19). The more general point that ages could be adjusted for life-expectancy change much as financial variables are adjusted for inflation appeared first in (20). Forecasts of aging that take life expectancy into account are relatively easy to compute, but several issues contributed to their remaining underexplored. For example, concern about aging was less a priority until relatively recent years. And

Adjusting aging forecasts to incorporate increases in longevity and health can provide better tools for policy-makers.

before publication of (21), life-expectancy adjustments were not available in a consistent format for all countries, and people were not trained in their use.

Alternative measures that account for life-expectancy changes show slower rates of aging than their conventional counterparts (5, 8, 21). For example, an alternative to the OADR is the prospective old age dependency ratio (POADR, defined as the number of people in age groups with life expectancies of 15 or fewer years, divided by the number of people at least 20 years old in age groups with life expectancies greater than 15 years). Effects of aging are evident in both measures, but when forecasted increases in life expectancy are taken into account, the POADR increases less rapidly than the OADR (see the table). Similar patterns are seen for many countries of the world (table S1).

Disability Adjustments

Disability-adjusted aging measures are another alternative [e.g., (22, 23)]. But consistent disability-adjusted aging measures from many countries have not previously appeared in the literature. To investigate the effects of disability, we define a measure analogous to OADR, the adult disability dependency ratio (ADDR, defined as the number of adults at least 20 years old with disabilities, divided by the number of adults at least 20 years without them) (see the table and table S1).

FORECASTING DEPENDENCY OF THE ELDERLY POPULATION

	Old-age dependency ratios (OADR)			Prospective OADR (POADR)			Adult disability dependency ratios (ADDR)		
	2005–10	2025–30	2045–50	2005–10	2025–30	2045–50	2005–10	2025–30	2045–50
Switzerland*	0.27	0.41	0.48	0.15	0.18	0.24	0.09	0.10	0.11
Czech Republic	0.23	0.36	0.52	0.20	0.26	0.29	0.08	0.09	0.10
Germany	0.33	0.48	0.63	0.21	0.25	0.34	0.12	0.13	0.15
France	0.28	0.44	0.51	0.18	0.21	0.24	0.09	0.10	0.11
United Kingdom	0.27	0.36	0.41	0.19	0.20	0.22	0.10	0.10	0.10
Hungary	0.26	0.34	0.48	0.25	0.28	0.31	0.21	0.22	0.23
Italy	0.33	0.45	0.68	0.20	0.23	0.31	0.10	0.11	0.12
Japan*	0.35	0.55	0.78	0.18	0.27	0.29	0.10	0.12	0.13
Sweden	0.30	0.40	0.44	0.19	0.23	0.23	0.08	0.09	0.09
United States*	0.21	0.34	0.38	0.13	0.17	0.20	0.09	0.10	0.10
Average	0.28	0.41	0.53	0.19	0.23	0.27	0.11	0.12	0.12

*A country not in the EU-SILC survey.

Dependency ratios. Authors' calculations. OADR and POADR are based on (11). ADDR based on (11) and (28). The lower age boundary in all denominators is 20. See SOM §1 and tables S1 and S2 for more detailed methods and additional countries.

POLICYFORUM

The OADR increases much faster than the ADDRs. In the United Kingdom, for example, the OADR increases from 0.27 in 2005–10 to 0.36 in 2025–30 to 0.41 in 2045–50. In contrast, the ADDR stays constant at 0.10. Although the British population is getting older, it is also likely to be getting healthier, and these two effects offset one another. Not only does the ADDR increase less rapidly than the OADR, it also increases less rapidly than the POADR, so that adjusting for the likely future path of disability rates does not simply replicate the results of adjusting aging measures for changes in longevity.

In our forecasts for the United States, in 2023 the number of expected years of disability above age 65 is 4.1. This finding differs slightly from (22), which forecast that figure to be 3.7 years in 2022. If the number of years of disability were forecast to change as in (22), the increase in ADDRs would be even less.

Previous forecasts were made for years 2003 to 2030 of the number of people 65 and older with severe disabilities for 12 countries of the Organization for Economic Cooperation and Development (OECD) from data that were not harmonized across countries (23). Constant age- and sex-specific disability rates were applied to future populations, and the trend in age- and sex-specific disability rates between two recent surveys was extrapolated. However, age- and sex-specific disability rates are changing, and trends between two surveys taken only a few years apart can be misleading, especially in the case of age- and sex-specific disability rates, because of the noisiness of those data.

Making consistent multicountry forecasts of the disability rates underlying the ADDR was difficult in the past. Data with a consistent measure of disability, harmonized across countries, were lacking. Data available for only one country, with disability-adjusted forecasts based on self-evaluated definitions of health, could reflect cultural specificity. The European Union Statistics on Income and Living Conditions survey (EU-SILC) survey now provides harmonized data on a specific definition of disability based on activity limitations [supporting online material (SOM) §2] for a large enough set of countries. A forecasting methodology was also needed that accounted for long-term relations between disability rates and mortality rates, and relations of disability rates across ages and sexes (SOM §1).

Even with the EU-SILC data, there are still problems. The EU-SILC could be biased if it systematically omits older people with disabilities. The survey does not include people

in nursing homes (SOM §3.2 shows that this has little effect). In addition, we can currently only make disability-adjusted aging forecasts for high-income OECD countries, although we feel that this is sufficient to illustrate the potential advantages of the approach.

Better Tools for Policy-Making

Policy analysts long had little choice but to use aging forecast measures (e.g., published by the UN) based on chronological age. More recently, however, measures have been developed that do not assume that improvements in health and longevity will cease. These measures are not just different metrics for measuring the same thing. They measure different aspects of aging, ones in which biological and behavioral factors play a larger role. Other perspectives on aging are also possible, for example, in terms of prevalence of chronic diseases or of frailty, but these would also require new measures that are not based on chronological age.

The figures presented here are based on UN forecasts of survival rates. But populations are heterogeneous, and how this heterogeneity is treated influences how survival rates are forecast (24). Uncertainty in our forecasts comes primarily from two sources, (i) life-expectancy forecasts and (ii) disability rates that are conditional on those forecasts. But ADDRs are rather robust to differences in the speed of forecast life-expectancy changes and thus fairly insensitive to how heterogeneity is treated in making those forecasts (SOM §3.1). Use of ADDR could thus limit the scope for political speculation and controversy.

Such new measures of aging can help educate the public about likely consequences of improvements in health and longevity. Slow and predictable changes in pension age, for example, justified by an increased number of years of healthy life at older ages, may be more politically acceptable than large, abrupt changes justified on the basis of budgetary stringency. In 2000, the normal retirement age in the United States was 65. Today, it is 66; current legislation has it increasing to 67 in 2027 (25); and it is likely to increase further to help avoid reductions in future pension payouts. In the United Kingdom, the normal pension age is scheduled to rise from 65 to 68 by 2044 (26) and in Germany from 65 to 67 by 2031 (27). A change in U.S. legislation, for example, that would increase the normal pension age by one-half year for each year of additional life expectancy at age 65 would go a long way to ensuring the sustainability of Social Security payouts, even without further reforms. People who enjoy longer lives would finance part of their additional

years of retirement themselves.

Population aging will certainly be the source of many challenges in coming decades. But there is no reason to exaggerate those challenges through mismeasurement. We will be able to address those problems better with a larger array of measures of aging, using those that are appropriate to the task at hand.

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Supporting Online Material

www.sciencemag.org/cgi/content/full/329/5997/1287/DC1

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Demography, Education, and Democracy A Global Perspective

An international symposium to celebrate the establishment of the
Wittgenstein Centre for Demography and Global Human Capital

Thursday, 29 September 2011
Historic Assembly Hall, The Austrian Parliament

Speakers include:

- President Barbara Prammer (The National Council; The Austrian Parliament)
- Sir Partha Dasgupta (University of Cambridge; University of Manchester; Chair, Wittgenstein Centre Scientific Advisory Board)
- Directors of the Wittgenstein Centre and prominent scientists from different parts of the world

If interested and for more information
contact Heike Barakat: heike.barakat@wu.ac.at

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Announcing the Wittgenstein Centre (IIASA, VID, WU) Conference 2011 Education and the Global Fertility Transition 30 November—01 December 2011, Vienna (Austria)

This scientific meeting will assess the big picture of the global fertility transition by identifying its key drivers. It will pay special attention to the role of human capital, in particular the basic education of women. The effects of education will be compared to other possible systematic drivers such as declining infant mortality, increasing income/wealth, or changing social norms. Papers should address the whole range of fertility transitions from the onset of family limitation in historical populations to the current fertility declines in developing countries and possible future fertility patterns in post-transition societies. Both empirical and more theoretical papers are welcome.

More specifically, papers could address some of the following topics: • How education relates to sexual behavior, contraceptive use, and demographic trends • Opportunity costs, changing norms and institutions, education and 'social success' versus having (many) children • The effects of literacy, skills, and female empowerment on the relationship between partners • Education, culture, religion, and fertility • Differential access to family planning and use of family planning by level of education • Identifying causal relations between education and fertility • Links between the length of female education, skill levels, labor markets, and childbearing • Demographic simulations and counterfactual projections of the effects of different education pathways.

The conference will be coordinated by Wolfgang Lutz and Vegard Skirbekk. It is planned to publish the best conference contributions (after scientific review) in a thematic issue of the *Vienna Yearbook of Population Research* in 2012. The Yearbook will be widely circulated in hard copy and is freely available on the Web (www.oeaw.ac.at/vid/yearbook). This rather young journal already has a high impact factor.

Please send your expression of interest, abstract, and/or submission to
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