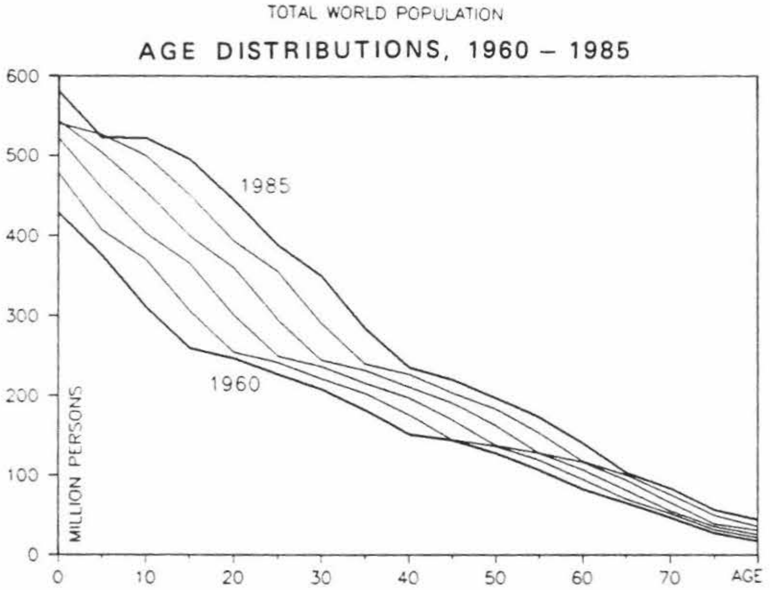
IIASA CONFERENCE

on

Future Changes in Population Age Structures

Sopron, Hungary, 18–21 October 1988

Conference Information, Invited Papers, Abstracts



The conference is co-sponsored by the European Association for Population Studies, the Hungarian Central Statistical Office, and the Ford Foundation.

Organizing Committee: **Nathan Keyfitz, Andras Klinger, Wolfgang Lutz.**

IIASA

International Institute for Applied Systems Analysis □ A-2361 Laxenburg □ Austria

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Dear Participant,

WELCOME to the IIASA-Conference on "Future Changes in Population Age Structure". In this brochure we tried to include all the material that is of general interest to you: the agenda, the programs of the sessions, the organizers' survey statements, one invited paper per session, the abstracts of the contributed papers that were sent to IIASA by 10 October 1988, and finally the list of participants.

For any questions on the scientific program, please contact the session organizers or me. For practical questions you will get help at our registration desk by Susanne Stock, Judith Hüll, and Tibor Asboth. IIASA will carry the cost of your accommodation and regular meals; other expenses (e.g. long distance calls, extra drinks) should be paid directly to the hotel. Breakfast is generally served between 7:00 and 9:00; lunch and dinner will be after the sessions or as indicated in the agenda.

For tonight (Monday) after dinner you are all invited to a welcome party ("POPNET-Mixer") in the conference room.

Hoping that you will have an interesting and enjoyable time at this conference.

Yours,

Wolfgang

Wolfgang Lutz
for the Organizing Committee

NOTES

AGENDA

Monday	17 Oct.	21:00–23:00	P	"POPNET-Mixer" (Welcome Party)
Tuesday	18 Oct.	9:00–10:15	P	Opening Session (Keyfitz, Klinger, Calot, Lutz)
		10:30–12:30	P	The Future of Reproduction (Session 2, Part A)
		14:00–18:00	S2	Future of Reproduction (Session 2, Part B)
			S1	Models and Methods to Project the Future Population Composition (Session 1)
Wednesday	19 Oct.	9:00–12:00	P	The Future of Mortality (Session 4, Part A)
		13:30–16:30	S1	The Future of Mortality (Session 4, Part B)
			S2	Analysis of Discontinuities in Age Patterns (Session 6)
		17:00		Tour of Sopron, organ concert, reception
Thursday	20 Oct.	9:00–12:00	S1	Future Structures of Families and Households (Session 3, Part A)
			S2	The Youth Cohort: Economics, Sociology, Politics (Session 7)
		14:00–17:00	S1	Future Structures of Families and Households (Session 3, Part B)
			S2	The Future of Regional Differentials in Growth and the Composition of the Population (Session 5)
		17:30–18:00	P	Closing of Conference
Friday	21 Oct.	8:30		Busses from Sopron to IIASA, Laxenburg
		11:00–12:00		(at IIASA) Survey of Research Activities at IIASA's Population Program
		12:30		Lunch in the Schloss Restaurant
		14:00		Tour of Laxenburg Castle and Park, Presentation of the "Dialog" – Multistate Model
		about 16:30		Departure of busses to Vienna and Budapest

P = plenary; S1, S2 = separated rooms

10.10.88

Scientific Program

Session 1:

Models and Methods to Project the Future Population Composition

Organizer:	Shunichi Inoue Population Division United Nations New York, NY 10017 USA	**Invited paper:**	Nico Keilman NIDI P.O. Box 11650 2502 AR The Hague The Netherlands

Name and address	Title of contributed paper
John F. Long Population Division US Department of Commerce Bureau of the Census Washington, D.C. 20233 USA	The relative effects of fertility, mortality, and migration on projected population age structure
Anatoli Yashin Institute for Control Sciences USSR Academy of Sciences Profsoyuznaya 65 117806 Moscow USSR	Heterogeneity and prediction: how individuals' variety influences population forecast
Janina Jozwiak Institute of Statistics and Demography Al. Niepodleglosci 162 02-554 Warsaw Poland	Application of the fundamental matrix to analyzing population structure
Oleg Staroverov Central Economic and Mathematical Institute (CEMI) Krasilova Street 32 117418 Moscow USSR	Problems of population simulation
V.I. Orlov Academy of Sciences of the USSR Institute of Economics and Forecasting of Scientific and Technological Progress 32, Krasikova Str. 117418 Moscow USSR	Migration models and estimation of uncertainty for projections of population age structures in different regions

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Name and address	Title of contributed paper
Istvan Monigl Central Statistical Office Demographic Research Institute Semmelweis u. 9, Pf. 78 H-1364 Budapest V Hungary	Main characteristics of long-term population trends in Hungary between 1880 and 2050
Tomas Kucera Faculty of Sciences Albertov 6 128 43 Praha 2 Czechoslovakia	On the structure of inaccuracy problem in population forecasting and possibilities how to solve it
Wolfgang Lutz Sergei Scherbov Babette Wils Doug Wolf Population Program IIASA A-2361 Laxenburg Austria	Scenarios for future population patterns in Europe to the year 2000
William J. Serow David F. Sly Gabriel Alvarez Center for the Study of Population 653 Bellamy Building Florida State University Tallahassee, FL 32306-4063 USA	The oldest-old: cross national comparisons
Otto Hellwig Technische Hochschule Darmstadt Statistik und Okonometrie Residenzschloss 6100 Darmstadt GFR	Micro-analytical modeling and estimation of interhousehold mobility using cross-section micro-data

Form of the presentation of contributed papers:

Each contributed paper will be presented by the author in 15 minutes or less.

Session 2:

The Future of Reproduction

Organizer: Andras Klinger
Demographic Statistics Dept.
Hungarian Central Statistical Office
Keleti-Karoly utca 5/7
H-1525 Budapest
Hungary

Invited paper: Charles Westoff
Office of Population Research
Princeton University
21 Prospect Avenue
Princeton, New Jersey 08540
USA

Name and address	Title of contributed paper
N. Barkalov Faculty of Economics Moscow State University Moscow USSR	Fertility: from age-specific to parity progression rates
Kalif Katus Faculty of Economics Moscow State University Moscow USSR	Fertility in central Asian republics
Joop de Beer Dept. for Population Statistics Netherlands Central Bureau of Statistics P.O. Box 959 2270 AZ Voorburg The Netherlands	Methods for projecting age-specific fertility: comparison of forecast accuracy
Hans van de Giessen Dept. for Population Statistics Netherlands Central Bureau of Statistics P.O. Box 959 2270 AZ Voorburg The Netherlands	Birth expectations as a guide for fertility hypotheses in population projections
Vladimir Roubicek Laboratory of Demography Prague School of Economics 13067 Prague 3 Czechoslovakia	Cohort fertility analysis as a basis for the estimation of future

Name and address	Title of contributed paper
Gustav Feichtinger Institut für Unternehmensforschung Technische Universität Wien Argentinierstrasse 8/119 A-1040 Vienna Austria	Modeling the impact of possible Easterlin cycles
Paula Rantakallio Antero Myhrman Oulun yliopisto kansanterveystieteen laitos Aapistie 3 90220 Oulu Finland	The effect of liberal abortion law in the rate and ratio of unwanted and wanted pregnancies
Zdeněk Pavlík Faculty of Science Albertov 6 128 43 Praha 2 Czechoslovakia	General and specific features of the reproduction after demographic revolution
Fernando Rajulton Dept. of Sociology The University of Western Ontario London, Ontario N6A 5C2 Canada	Developments in nuptiality and fertility in Canada
Jaroslav Kraus Population Division Federal Statistical Office Sokoloska 142 Praha 8 Czechoslovakia	The future of reproduction — comparison of Czechoslovak projection in Mid-European region
Peter Zvidrins Latvian State University Chair of Statistics and Demography 19, Rainis Boulevard Riga 226098 Latvian SSR	Patterns of population reproduction in the countries of the Baltic region
Griffith Feeney Population Institute East-West Center 1777 East-West Road Honolulu, Hawaii 96848 USA	Comparative structure of low fertility in Japan and the United States
Charlotte Höhn Bundesinstitut für Bevölkerungsforschung Gustav-Stresemann-Ring 6 6200 Wiesbaden 1 GFR	The role of population-relevant policies on future fertility in aging societies

Name and address	Title of contributed paper
Charles A. Calhoun Population Program IIASA A-2361 Laxenburg Austria	Do excess and deficit fertility really offset one another? Some econometric evidence from the United States

Form of presentation of contributed papers:

Short presentations by the authors. An exact timing schedule will be given by the organizer later on.

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Session 3:

Future Structures of Families and Households

Organizer: Louis Roussel
INED
27, rue du Commandeur
75675 Paris Cedex 14
France

Invited paper: Hervé LeBras
INED
27, rue du Commandeur
75675 Paris Cedex 14
France

Name and address	Title of contributed paper
Pavel Kitsul Institute of Control Sciences USSR Academy of Sciences Profsoyuznaya 65 117806 Moscow USSR	Conditional Markovian model to forecast the family dynamics
Robert A. Horvath Nyul u. 13/a H–1025 Budapest II Hungary	Future structures of families and households – the point of view of a population economist
Laszlo Cseh-Szombathy Hegyalja Street 5 H–1016 Budapest I Hungary	Survival of kinship relations in the industrialized countries
King-Mei Tsay Institute of American Culture Academia Sinica Nankang Taipei 11529 Taiwan	Changes in living arrangements of Asian immigrants in the United States
Rudolf Andorka University of Economics Pf. 489 H–1828 Budapest 5 Hungary	Roles and structures of families and households in Hungary: disappearance or revival?
Klaus-Peter Möller Institut für angewandte Systemforschung und Prognose e.V. Königstrasse 50A D–3000 Hannover 1 GFR	Long-term population trends in northern Europe: simulation of future household formation in West Germany
Marta Sougareva Bulgarian Academy of Sciences Institute of Sociology Moskovska, 13-a Sofia Bulgaria	Desire for children and the future of the family

Name and address	Title of contributed paper
Jan Nelissen Ad Vossen Department of Sociology Tilburg University P.O. Box 90153 5000 LE Tilburg The Netherlands	Applying a microsimulation model to project the future structure of families and households
Michael Bracher M.G. Santow Research School of Social Sciences The Australian National University 7 Liversidge Street GPO Box 4 Canberra, ACT 2601 Australia	Changing family composition from life history data
Jacques Légaré Nicole Marcil-Gratton Département de démographie Université de Montréal C.P. 6128, Succ. A Montréal, Québec H3C 3J7 Canada	Human network surrounding future older people: what can we expect from kinship support?
Kálmán Szabó Central Statistical Office Demographic Research Institute V. Veres Pálné u. 10 H-1047 Budapest Hungary	Changes of family and household composition in Hungary
Viviana Egidi A. Tomassetti University of Rome Via Nomentana 41 I-00161 Rome Italy	A method for projecting families: some demographic and economic consequences of Italian trends
Andrej Boozin Computing Center USSR Academy of Sciences Vavilova, 40 117967 Moscow USSR	Demographic consequences of consanguineous marriages in small populations
Michael Wolfson Social and Economic Studies Division Statistics Canada Holland Avenue Ottawa, Ontario K1A 0T6 Canada	Union formation propensities and lifecycle family structures

Form of presentations of contributed papers:

10-minute presentations by authors.

Part A: Kitsul, Horvath, Cseh-Szombathy, Sougareva, Nelissen/Vossen, Bracher/Santow, Lindgren, Szábo, Boozin, Wolfson.

Part B: Szábo, Tsay, Andorka, Möller, Légaré, Egidi, Tomassetti.

Session 4:

The Future of Mortality

Organizer: Tapani Valkonen
Department of Sociology
University of Helsinki
Franzeninkatu 13
00500 Helsinki 50
Finland

Invited paper: Gerhard Heilig
Universität Bamberg
8600 Bamberg
GFR
(after December 1988:
Population Program
IIASA
A-2361 Laxenburg
Austria)

The impact of AIDS on future mortality

Name and address	Title of contributed paper
Josianne Duchêne Guillaume Wunsch Institute of Demography Université Catholique de Louvain 1, Place Montesquieu - bte 17, B B-1348 Louvain-la-Neuve Belgium	Life tables, maximum life span, and population aging
Peter Findl Österreichisches Statistisches Zentralamt Hintere Zollamtsstrasse 2B A-1033 Vienna Austria	A cohort model for mortality projection in Austria
Otto Andersen Danmarks Statistik Sejrogade 11 2100 Copenhagen O Denmark	Reduction of mortality among the occupational active population in the Nordic countries: effect on life expectancy and number of deaths
Tuija Martelin Department of Sociology University of Helsinki Helsinginkatu 34 C SF-00530 Helsinki Finland	Trends in elderly mortality in the Nordic countries

Name and address	Title of contributed paper
Marek Kupiszewski Wiejska 9/48 00–480 Warsaw Poland	Spatial aspects of changes of life duration in the light of single- and multiregional life tables: a case study of Poland, 1977–1995
Lincoln H. Day Dept. of Demography Research School of Social Sciences Australian National University G.P.O. Box 4 Canberra, A.C.T. 2601 Australia	Upper-age longevity in low-mortality countries: a dissenting view
Ms. Eta Daróczi Centre for Regional Studies Pf. 48 H–1251 Budapest 11 Hungary	Checking the stability of spatial variations in mortality for estimating future trends of mortality in Hungary (together with Emil Valkovics)
Emil Valkovics Demographic Research Institute Central Statistical Office Veres Palne u. 10 H–1053 Budapest V Hungary	(paper with Ms. Eva Daróczi above)
Dhruva Nagnur Statistics Canada Holland Avenue Ottawa, Ontario K1A 0T6 Canada	Cause deleted entropies and future course of cause specific mortality for Canada
Thomas Klein Universität Karlsruhe Institut für Soziologie Postfach 6380 D-7500 Karlsruhe BRD	On future possibilities of extending the human life span
Aslak Herva University of Joensuu P.O. Box 111 SF-80101 Joensuu Finland	The future of cancer mortality in North Karelia Province in Finland
Peter Jozan Central Statistical Office Keleti Karoly u. 5-7 H-1026 Budapest Hungary	The national health promotion programme and the future trends in mortality in Hungary

Form of presentation of contributed papers:

20 minutes (including discussion for each presentation).

Part A: Klein, Day, Duchêne/Wunsch, Martelin.

Part B: Kupiszewski, Daróczi/Valkovics, Andersen, Nagnur, Herva, Findl, Jozan.

Session 5:

The Future of Regional Differentials in Growth and the Composition of the Population

Organizer:	Antonio Golini National Institute for Population Research viale Beethoven, 56 00144 Rome Italy	Invited paper:	Frans Willekens NIDI P.O. Box 11650 2502 AR The Hague The Netherlands

Name and address	Title of contributed paper
Alexander Hanika Österreichisches Statistisches Zentralamt Hintere Zollamtsstrasse 2B A–1033 Vienna Austria	Projected population structure of Vienna as compared to other Austrian provinces
Wolfgang Lutz Sergei Scherbov Population Program IIASA A-2361 Laxenburg Austria	Scenarios for future regional distributions in the Soviet Union
Mauri Nieminen Hannu Hämäläinen Central Statistical Office of Finland Box 504 SF–00101 Helsinki Finland	Regional development of the elderly people in Finland
Janez Malačič B. Kidrič Faculty of Economics Kardeljeva ploščad 17 61000 Ljubljana Yugoslavia	Population age structure and the demographic transition of the population of Kosovo
W. Ward Kingkade Soviet Branch Center for International Research United States Dept. of Commerce Bureau of the Census Washington, DC 20233 USA	Differential fertility and the future ethnic composition of the USSR
John F. Long US Department of Commerce Bureau of the Census Washington, D.C. 20233 USA	Time series forecasting of interstate migration flows

Name and address	Title of contributed paper
Robert Thürmer Akademie der Wissenschaften der DDR Institut für Geographie und Geoökologie Georgi-Dimitroff-Platz 1 7010 Leipzig GDR	BEVO – a geographically oriented model to project regional differences in the composition of the population
Ch. Eichperger National Physical Planning Agency Willem Witsenplein 6 2596 BK Den Haag The Netherlands	Future regional differentials in the growth and composition of the population in the Netherlands
Mária L. Rédei Central Statistical Office Demographic Research Institute Semmelweis u. 9, Pf. 78 H-1364 Budapest V Hungary	The main results and characteristics of the regional estimation for Hungary
George N. Tziafetas National Technical University of Athens Stenon Portas St. 6 Athens 161 21 Greece	Regional population projection: the case of Greece

Form of presentation of contributed papers:

Six papers will be selected by the organizer for a presentation; the others will be summarized by the organizer.

Session 6:

Measuring and Projecting Discontinuities in Age-specific Growth Patterns and Decomposing them into Fertility and Mortality Effects

Organizer: Nathan Keyfitz
Population Program
IIASA
A–2361 Laxenburg
Austria

Name and address	Title of contributed paper
Alicia M. Bercovich Alameda Lorena, 1041 Apto. 114 Cerqueira Cesar 01424 Sao Paulo - SP Brazil	Age-sex structure in Brazil: apparent contraditions
Karol J. Krotki Department of Sociology The University of Alberta Edmonton, Alberta T6G 2H4 Canada	Quasi-stability is still valid for LDCs
Roberto Ham-Chande P.O. Box L Chula Vista, CA 92012 USA	Age structure and other differentials at the US-Mexico border
Ching-lung Tsay The Institute of Economics Academia Sinica Nankang, Taipei 11529 Taiwan, ROC	The changing pattern of age structure in Taiwan
Shiro Horiuchi Population Division United Nations New York 10017 USA	Measurement and analysis of changes in cohort size
Yeun-Chung Yu Population Division United Nations New York 10017 USA	The estimation of past age distributions using age-specific growth rates
Feng Shan Dept. of Automatic Control Research Institute of Systems Engineering Huazhong University of Science and Technology Wuhan, Hubei P.R. China	Age distribution changes in China

Name and address	Title of contributed paper
Jean Bourgeois-Pichat CICRED 27, rue du Commandeur 75675 Paris Cedex 14 France	The age distribution of the world as a whole (1950–2025)
Zenji Nanjo Kasumasa Kobayashi Fukushima Medical College Fukushima City, 960 Japan	A method of measuring demographic discontinuity

Form of presentations: 15-minute statement by authors.

Session 7:

Economic, Social, and Political Consequences the Youth Cohort has had and will have on Societies: Country Case Studies and General Considerations

Organizer: Nathan Keyfitz
Population Program
IIASA
A–2361 Laxenburg
Austria

Name and address	Title of contributed paper
Henk J. Heeren 10 Vogelsanglaan 3571 ZM Utrecht The Netherlands	Cohorts or generations: the absence of a youth cohort in the Netherlands
Felicia R. Madeira Av. Prof. Francisco Morato, 1565 Caixa Postal 11478 05513 Sao Paulo - SP Brazil	Youth cohort in Brazil: demographic dynamics and new approaches to the analysis of its economic, social and political consequences
Paida Ramachandran D. Usha Rani Population Studies Center Sri Venkateswra University Tirupati – 517 502, A.P. India	Socio-economic and demographic implications of youth in India
Mesbah-us-Saleheen Department of Geography Jahangirnagar University Savar, Dhaka 1342 Bangladesh	The present trends of youth cohort and its socio-economic consequences in Bangladesh
Ashish Bose Population Research Centre Institute of Economic Growth University Enclave Delhi 110007 India	Some aspects of the economic, social and political implications of youth cohorts in India
Goran Penev Demographic Research Centre Institute of Social Sciences Ul. Narodnog fronta 45 11000 Belgrade Yugoslavia	Social and economic consequences of demographic explosion in Kosovo (Yugoslavia)
Howard Wriggins 5249 Sycamore Avenue Bronx, New York 10471 USA	Marked changes in age cohort size and political stability: hypotheses on intervening variables

Form of presentations: 15-minute statement by authors.

NOTES

SESSION 1

Models and Methods to Project the Future Population Composition

Organizer: Shunichi Inoue

August 1988

MODLES AND METHODS TO PROJECT THE FUTURE POPULATION COMPOSITION

Shunichi Inoue

United Nations Population Division*

Introduction

If we limit our attention to the "realistic" projection of population compositions, as against purely theoretical or hypothetical population projections or projections of a total population without age-sex sub-divisions, available models and methods for this purpose are limited to two broad categories: variants of the cohort component projection method and those of the micro-simulation method. The word "realistic" to describe a certain group of population projections was used by the United Naitons in 1973 to differentiate them from "benchmark" projections and "analytical" projections. 1/ Benchmark projections are designated to illustrate the demographic consequences of certain events which are admittedly not expected to happen during the period covered by the projections. "Analytical" projections are used to study the influence of changes in the components of growth on the structure of the population regardless of the extent to which these changes are related to reality. The "realistic" projections thus represents assessment of future demographic change that demographers are trying to predict.

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* The views expressed in this paper are of author's and not necessarily of the United Nations.

Some demographers seem to be uncomfortable with the use of the word prediction or forecast and prefer to stick to the word "projection" because of the fear that a forecast will never be possible. Despite strong demands for a reliable forecast of future population and its composition from policy makers, administrators of governments, business circles, researchers and so on, a population forecast is only possible to a limited extent, for a limited span of time and with a certain margin of errors. Examples of forecast errors in the areas of whether, economy and politics are too familiar to everyone, but population forecasts have not been too much better either than the other areas of forecast, if the time scales involved are adjusted for comparability. Recent development of the theory of chaos indicates that precise forecast of events are impossible when many factors are involved in the whole process, like in the case of population changes. However, population projections have not yet been a total failure because some of the demographic changes are fairly predictable. For example, if we have an accurate data on the current population structure and the prevailing mortality conditions, it is not too difficult to project with a certain degree of confidence the structure of surviving population in the near future under the "normal" circumstances. From this projection, we can predict fairly accurately when the next babyboom will begin due to the increase in the number of women in the reproductive ages or when the elderly population will begin to swell or shrink due to the different chohort sizes, etc.

Methods of population projections adopted by the developing countries are not precisely known. (More information is available for developed countries and that will be the thesis of Dr. Keilman's paper). At present only less than a half of developing countries report to the United Nations

Statistical Office on their current population estimates. It is not known, however, what kind of method was used to derive the current population estimates in those countries. Presumably, it is a mixture of various methods including a simple extrapolation of the past growth trend, estimation based on the demographic equation (adding the number of births and subtracting the number of deaths from the benchmark population), or projections by a component method, etc. In any case, the choice of the method of projection is largely determined by the available data and computational resources, if not by the insufficient knowledge of demographic dynamics.

In the following, some of the problems of poulation projections for the developing countries will be discussed referring to the methods used by the United Nations Population Division and the World Bank respectively, both of which are continuously making population projections for developing countries despite the severe constraints of available data as the countries themselves must be facing.

Types of projections

In the cohort component method of projection, future fertility, mortality and migration, among others, must be provided as the input assumptions. The success of a "realistic" projection largely depends on the goodness of the assumptions on these components of population changes. In other words, the critical element needed to accurately project the future population structure is how better to project the future trends of fertility, mortality and migration (in addition to the assessment of current population structure).

Generally speaking, a projection is a extention of the observed trends into the future. It can be done either mechanically or more methodically by taking the major determining factors of the trends into consideration. Although the complexity of the methodology does not guarantee the success of a projection, a mechanical projection of a component of demographic dynamics often errors becuase (1) the observed trends are not well established and/or (2) assumptions tend to be influenced too much by the recent fluctuations of data, especially when sound theoretical understanding is lacking. When observed demographic trends are not clear enough to enable us to make mechanical extraporations or when there are reasons to question the validity of such a mechanical extraportation, a more complex method can provide better solutions. As fertility, mortality and migration are determined through different ways and can be projected differently, projections of the each component will be discussed separately below.

It should be mentioned here about the question of whether or not we can forecast a sudden change of demographic dynamics which will cause, among other things, a discontinuity in population structure. When a declining fertility will hit the bottom before turning to increase? When some medical breakthrough will take place, suddenly raising the life expectancy of population? These are certainly interesting and important questions. In the report of the Club of Rome, for example, a collaps of population growth trends was projected due to the environmental constraints. However, there are too many unknown factors in the model that the conclusions drawn should be taken as a speculation. For the purpose of making a "realistic" projections, it seems but impossible to predict the unpredictable.

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Fertility projections

In many instances of preparing fertility assumptions for a projection, including the early practices at the United Naitons, the past trend of fertility is firstly assessed and then projected into the future by more or less mechanical mannor. The indices used are either crude birth rate, total fertility rate, gross reproduction rate, net reproduction rate, or general ferility rate, etc. Depending on the situation, projected future paths may follow a straight line at a fixed level or with a fixed amount of change, or a non-linear line with an assumed rate of change, or following more sophisticated curves. The general guidance applicable to this approach has been to seek some analogies to demographic histories of other populations. The theory of demographic transition which was originally derived from the observations of demographic histories in the western nations has been quite useful in this respect. Experiences indicate that this simple method has not always been without some success.

However, as Leon Tabah argued some years ago, there are significant differences in demographic dynamics among different populations and therefore a simple analogy is often misleading. 2/ Suffice to say that the social and economic conditions of today's developing countries are so different from the conditions of the developed countries in the past with respect to many areas including economy, available technologies, life styles, contraceptive devices, government's policies, etc. Thus when one wants to predict the speed, timing and modes of future changes of fertility, he is left with no real precise guidelines to follow.

The natural development of projection methodology thus leads to the attempt to relate fertility changes to their determinants. The effects of rising income on fertility were studies by economists to explain the discrepancies between their generally positive correlation at the micro level and the negative correlation at the macro level. Urbanization, industrialization, education, women's status and their work participation, family planning programmes and government's population policies have also been studied as a possible factors to affect fertility changes. However, efforts to identify any one of those external factors as a major determinant of fertility and to use the relationship in fertility projections were generally unsuccessful.

For example, figure 1 was drawn in a recent study conducted at the United Nations in relation to the analysis of the relationship between population aging and urbanization. 3/ The data used were based on the joint work of the UN, ILO and FAO to produce a set of comparable estimates and projections of population, labour force and agricultural population, among others. 4/ In this study, the percentage of non-agricultural population, that was used as a proxy of the level of industrialization, was found to provide a very good explanation for the advancement of urbanization in the major regions of the world. As will be shown later, the proportion of non-agricultural population was also found to be closely related to the increase of life expectancy at birth. But it was not when it comes to fertility trends. In figure 1, the relationship between the total fertility rate and the percentage of non-agricultural population were plotted over the period of a half century for six major regions of the world separately and shown together in the same graph. It clearly shows that fertility changes are only partially related to the increasing proportion of non-agricultural population.

At a comparable level of industrialization (represented by proportion

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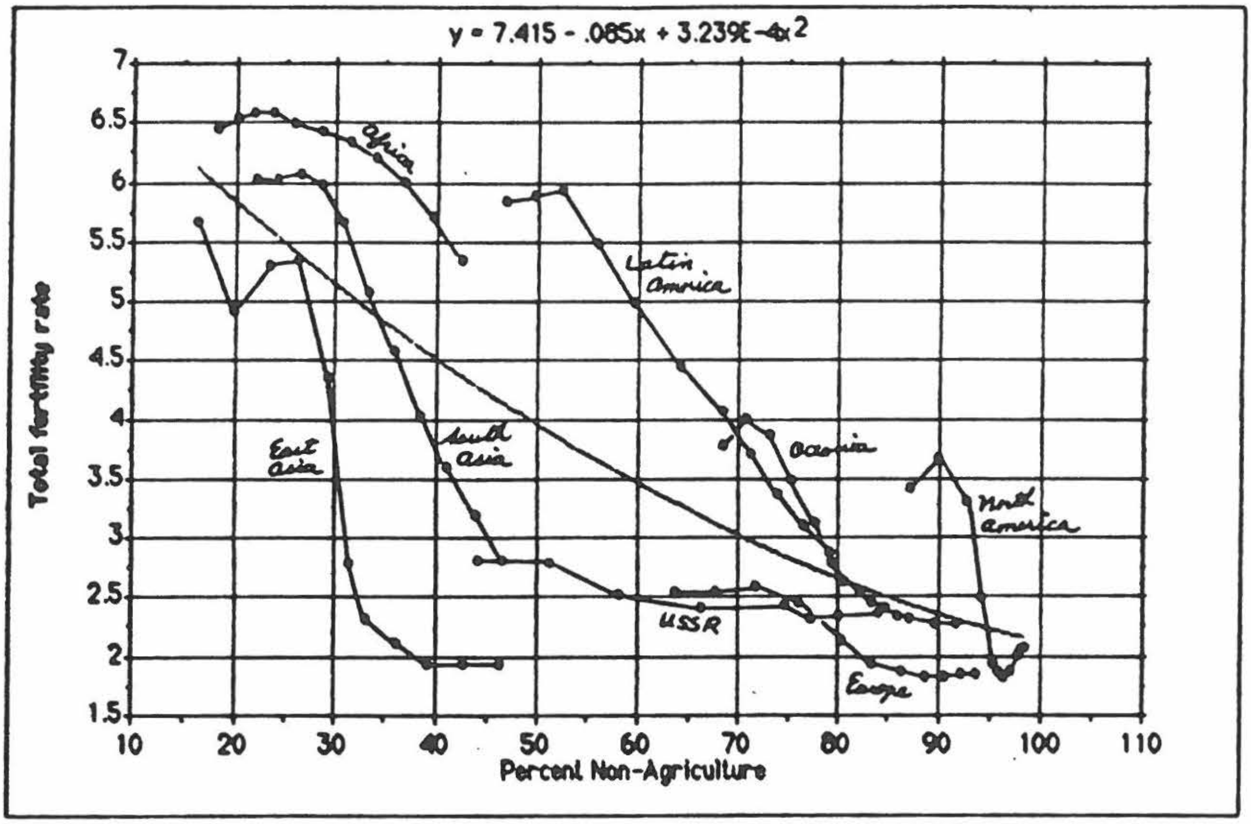
Figure 1 Regional Trends of Total Fertility Rate and

Percent Non-Agricultral population, 1950-2000



Source: United Nations, World Demographic Estimates and Projections, 1950-2025. (1988)

of non-agricultural population), Africa maintains a more or less constant high level of fertility, whereas East and South Asia show a rapid decline. Latin America and Oceania which used to have relatively high fertility are in the middle of rapid change. On the other hand, Europe including USSR has maintained relatively low fertility at successive levels of industrialization. All these "deviations" from the global average pattern indicate that more than just economic structure is at work to bring about fertility decline. Obvious factors that should be responsible are socio-cultural conditions including education, availability of family planning methods, government's policies and programmes on fertility, among other things. To be realistic, a fertility projection must take those factors into account.

The methods of fertility projection adopted by the United Nations and the World Bank are more or less similar. Although the methods are rapidly evolving from year to year, both agencies tries to estimate the year or period in which fertility level reaches the replacement level on the basis of analysis of the past trends of fertility and the current socioeconomic and policy factors. At the United Nations, several model schedules of fertility decline whose total duration of transition from the traditional high to the modern low is assumed to vary from 30 to 70 years are constructed and choices are made for each country to find a suitable model schedule (or a few for different variants of projections) on the basis of analysis on the past fertility trends and the present soico-economic development, policy and cultural background of respective countries. 5/ Similarly at the World Bank it is assumed that "in all countries the NRR will reach unity sometime during 2000-50," taking into account the level of mortality, recent levels and trends of fertility and the status of family planning programme in each country. 6/ Although soicoeconomic factors are not explicitely mentioned, mortality conditions that are emphasized by the World Bank usually reflect socioeconomic conditions of a country. The paths through which fertility reaches the replacement levels are drawn slightly differently by the two agencies but the differences do not seem to matter as much as the choice of the terminal year for the assumed fertility transition.

What paths should be followed if one wants to improve fertility projections? One thing common to the United Nations and World Bank methods seems to be its reliance on case-by-case judgements by individual projectionists on the possible demographic impacts of socio-economic and policy factors. One direction that may be followed is to make the formulation of fertility assumption more explicit and systematic in relation to the socioeconomic and policy factors. By doing so, it would become possible to review them critically and find ways to improve them. There have been several attempts to build a model comprising demographic, social and economic factors such as the Club of Rome models and BACHUE models. Though such a total model might be an ideal goal to reach, there are inherent difficulties with such ambitions.

The difficulties to relate the socio economic factors to fertility trends are due to the fact that (1) socioeconomic conditions are by itself diffcult to predict and (2) the exact relationship between such conditions and fertility is not very clear. Although the first of the difficulties may not be solved in the near future, the second difficulties may be reduced by further research. One of the areas to be investigated is the mechanism through which soicoeconomic and policy factors influence fertility. This is the second direction that might be contemplated for the improvement of fertility projection.

Level and trends of fertility are basically determined by the biological reproductive capacities of the human being and the environment that regulates them through the layers of intermediate factors. As already mentioned, the macro environmental factors that regulate fertility include economic, social and cultural factors, available technologies to control or enhance human reproduction and government's policies toward them. These macro environmental factors can influence fertility only through one or more of the intermdiate factors. Although the intermediate factors are often considered identical to the reproductive behavioral factors (such as the proximate determinants named by John Bongaarts), there is another kind of the intermidiate factors at the level of human perception that are perhaps leading the reproductive bahavior. The typical of such perceptive factors is the desired number of children, desire for additional child, desire for spacing of child births, desire to get married, etc. It seems logical to assume that external conditions will firstly affect the human perceptions about the family formation and then the latter will affect the individual reproductive behavior. After that the biology takes charge and leads to conceptions and births culminating in human fertility.

In fact, research has been progressing on both levels of intermediate factors. Empirical researches on the proximate determinants are for one, and various model building efforts on family formation are for another. Efforts are needed to utilize the relevant findings from these researches for the improvement of fertility projection.

In a recent study of the United Nations, it was found that a decline of infant mortality rate may or may not affect fertility depending on whether or not the number of surviving children is greater than the number desired. 7/ In a number of African countries, several surveys indicate that the average desired number of children, though it is on the decline, is much higher than the surviving number of children. Under such circumstances, demographers are facing a tough question: when African fertility will begin a sustained decline. One clue to answer that question is to watch the changes in the deseired number of children among African populations and study the socio-economic and policy factors that influence them.

Mortality projections

The methods of mortality projection used at the United Naitons are basically the extraporation of the average trends of life expectancy at birth among nations. Under normal circumstances a quinquennial increment of 2.5 years appears to have been what can be expected in most countries in the recent years. Despite the recent rather significant increase in life expectancy among the wetern industrialized countries, the quinquennial increment is smaller when the life expectancy moves up beyond a certain level, say, 60 or 65. Economic, social or political adversities are assumed to retard the improvement in this respect, although after the difficulty is over, the recovery appears to be quickening. Demographers at the United Nations are thus paying a close attention not only to the latest mortality statistics but also soicoeconomic and political conditions of each and every countries.

The World Bank, on the other hand, tried to apply the relationship between the increments in life expectancy and the femal primary school enrollment in their latest mortality projections. 8/ It was found that the relationship appears to differ between the group of countries with low primary school enrollment (where the relation is represented by a linear regression line) and the group of countries with high enrollment (where the relation is represented by a quadratic curve). The results seems, however, rather similar to the United Nations model.

Theoretically speaking, the life expectancy of a population can be affected by three factors: medical technologies, public health measures and individual health care. The breakthrough in the medical technologies that may eliminate or drastically reduce chances of getting and dying of certain diseases may come at anytime but it is impossible to predict when. The progress in the public health measures depends largely on the wealth of a country as well as the political will of government which decides the priority for the resources allocation among competing needs. At the individual level, the quality of health care including the provision of nutrition and personal hygiene is mostly affected by family income and education. Although it is not easily possible to separate the contributions of each factor to the improvement of mortality condition, the most predictable and basic element affecting mortality seems to be eonomic growth.

Figure 2 shows the average trends of life expectancy at birth for the eight major regions of the world for 50 year period from 1950 to 2000 (part of which is of course projections) in conjunction with the level of industrialization measured by the proportion of non-agricultural population. Data are taken from the same United Nations study quoted in the discussion of fertility projections. 9/ For the comparable levels of the proportion of non-agricultural population, East Asia has shown a remarkably rapid improvement in life expectancy in th recent past. The

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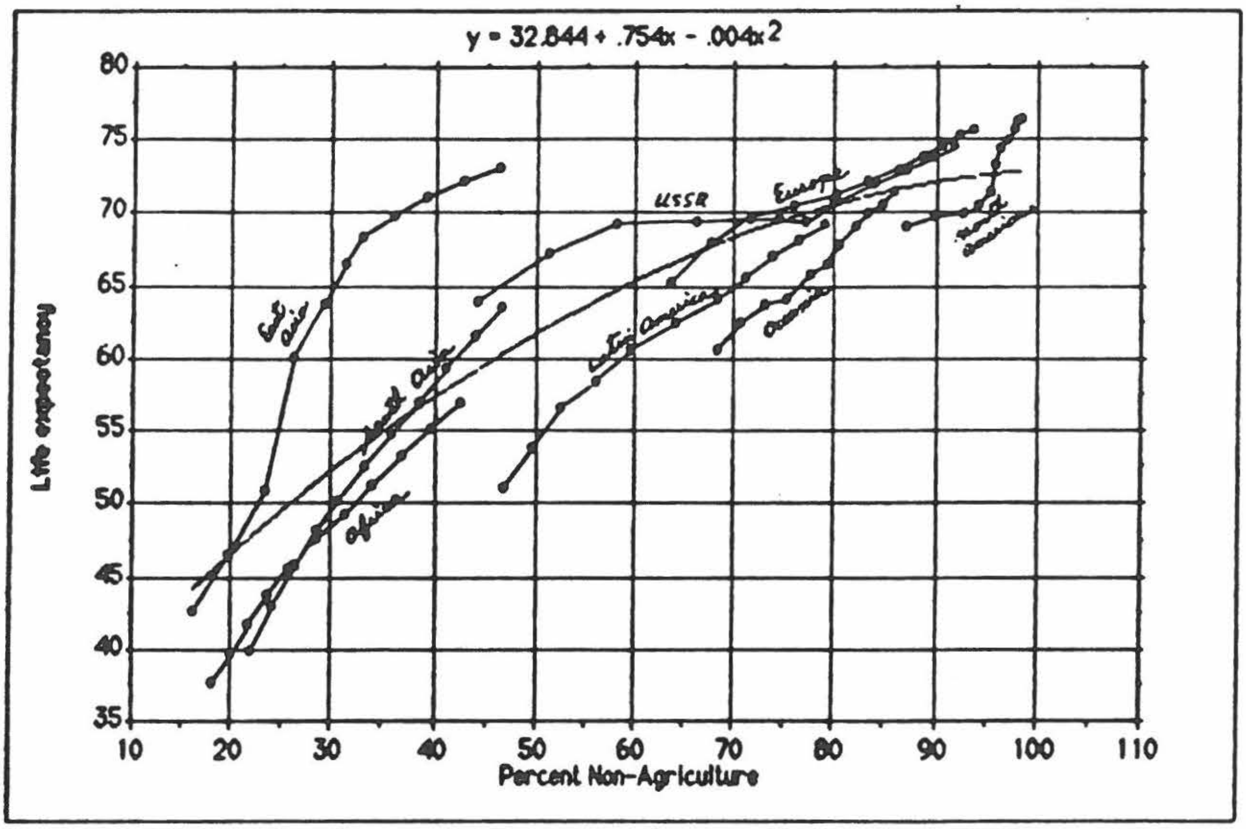
Figure 2 Regional Trends of Life Expectancy at Birth and

Percent Non-Agriculture, 1950-2000



Source: United Nations, World Demographic Estimates and Projections, 1950-2025. (1988)

progress in South Asia and Africa are also faster than what might be expected from the global experiences. Latin America and Oceania are moving fast to catch up the gap to reach the world "norm", whereas USSR has been losing its advantageous position in recent periods. In Northern America and Europe, the advancement of life expectancy appears to be taking place ahead of, or independently from, the already high level of industrialization.

This graph shows clearly that economic progress is an important, but not the sole, determinants of the inreasing life expectancy in various parts of the world. Application of modern medical technologies and political systems are apparently at work. But it is the economic progress that seems to be most responsible for the improvement of mortality conditions in the past as well as in the futrue, barring unpredictable medical breakthrough and political upheavals.

Migration projections

At the national level, it is the volume and composition of international migrantion that affects the population structure of a country. The effects of international migration on national population are negligible for most countries except for those of receiving a relatively large number of immigrants. Research on the demographic structure of migrants is limited due to the scarcity of data and the existence of large number of refugees and undocumented migrants. At the United Nations efforts have been made to collect as much data as possible and analyse the patterns. As the results, several age-sex pattern of net migration have been identified and used in the latest round of the global population projections. 10/

Particular difficulty with the projection of international migration is tha fact that it changes volumes and directions very quickly and there seems to be not clue as to the prediction of such abrupt changes. The general approach thus taken so far is, with the exception of a few countries with sustained immigration, to assume a diminishing volume of net migration in the future. This is a typical area in which a forecast is totally powerless.

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METHODS OF NATIONAL POPULATION PROJECTIONS IN DEVELOPED COUNTRIES

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July 1988

Paper prepared for presentation at the session "Models and Methods to Project the Future Population Composition" of the IIASA Conference on "Future Changes in Population Age Structures", Sopron, Hungary, 18-21 October 1988.

1. INTRODUCTION

All statistical agencies of developed countries which routinely produce national population projections apply the cohort-component method. The model involved is basically a demographic accounting framework that allows the forecaster to assess the consequences of an assumed set of cohort-specific fertility, mortality and migration parameters (Long and McMillen, 1984; Land, 1986). However, in spite of this common framework, actual practice differs widely among developed countries.

This paper discusses methodological issues of current national population projections in the 29 developed countries that participated in a survey in early 1988. [1)] The aim of this survey was to collect information on methodological aspects of national population projections in industrialized countries -information which is most often contained in local sources, unaccessible for the international scientific forum. The international comparison in this paper includes the demographic characteristics of the future populations; the various approaches to extrapolate fertility, mortality and external migration (aggregation levels in the formulation of assumptions, period or cohort approach, variant assumptions); the time horizon of the projection results; and a discussion of the projection model's equations.

Some clarification is needed on the words "projections" and "forecasts". Most national agencies claim to produce projections, that is calculations which show what would happen if certain assumptions as to fertility, mortality, and migration were borne out. By definition, a projection is conditional, and it must be correct unless arithmetical errors are made. But projections are used as forecasts, showing the most likely future population trends. Moreover, demographers don't choose unlikely future fertility, mortality or migration trends - unless they explicitly state so. No condition is implicit in this definition of a forecast, although it should be understood that each forecast is based on our present knowledge, and therefore population forecasts have limited reliability and

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1) Information on population projections was given by the statistical agencies of the following 29 countries: Australia, Austria, Belgium, Canada, Cyprus, Czechoslovakia, Denmark, the Federal Republic of Germany, Finland, France, the German Democratic Republic, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, the United Kingdom, the United States, and Yugoslavia.

durability - just like weather forecasts. Although we shall use the terms "projection" and "forecast", our interpretation for both is that attached to the latter.

2. DEMOGRAPHIC CHARACTERISTICS OF THE PROJECTED POPULATION

It is standard practice in the cohort-component approach to distinguish the projected population by age and sex. The age detail varies considerably over the 29 countries included in the survey, see table 1 [1]. First we note that five countries apply five year age classes, and 24 use one year age classes. More variation is shown in the highest open-ended age class, which falls between 85(+) and 100(+) for most countries. The age column reveals a strong preference for the psychological barrier of 100 years. Czechoslovakia and the Federal Republic of Germany apply a highest age group which is closed: no one survives beyond this one year age class.
Many countries distinguish their future population not only by sex and age, but also by region of residence. Nearly half of the countries indicated that they do so within the framework of national population forecasts. The regional detail may show considerable variation - compare, for instance, the three countries involved in the UK-forecasts (England and Wales, Scotland and Northern Ireland) and the 100 or so regions in the Norwegian forecasts. As the survey focused on projections at the national level, this regional aspect cannot be explored much further here.
Other characteristics than sex, age and region are rarely used in national forecasts. Belgium, the FRG, Luxembourg and Switzerland work with nationality, and marital status is employed by Ireland (females only), the Netherlands and the UK. The USA distinguishes the projected population by race.
Several points are important when a forecaster considers the characteristics by which the future population should be distinguished (see also Brass, 1974, 537).

1. The purpose of the forecasts and the user's requirements could indicate which population categories might be relevant.
2. Theories explaining demographic behaviour (childbearing, migration) may reveal homogeneous population subgroups, whose behaviour is relatively easy

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1) It should be noted that the tables in this paper may contain some erroneous information for some countries, because countries participating in the survey have not yet had an opportunity to check these tables.

to interpret. This could ease the extrapolation of the future behaviour of that category.

3. The available data may constrain the number and type of population categories to be distinguished.
4. Random fluctuations could occur, when too detailed a classification were to be used, and cell-counts were to become too small.

Clearly, age and sex are included in all forecasts because of the first and the second consideration given here. For the fourteen countries that work with marital status or region of residence, the reason is probably most often that of the user's needs - see, for instance, the statements on marital status for the UK (Haskey, 1988, 30) and the Netherlands (NCBS, 1984, 25). The second reason, that of demographic theory, would imply a breakdown of fertility, mortality and/or external migration by marital status, region of residence or nationality. However, table 2, which is to be discussed in more detail in section 3, reveals that among the twelve countries which break their population down by region, Belgium and the UK are the only ones that work with region specific fertility; among the three countries that use marital status, only Ireland distinguishes between legitimate and illegitimate fertility. For the characteristics of nationality and race, the corresponding proportion is two out of five.

3. THE PROJECTION OF FERTILITY, MORTALITY, EXTERNAL MIGRATION AND OTHER COMPONENTS

The cohort-component approach involves forecasting with a model without behavioural equations. All our assumptions about the (future) behaviour of the population are expressed by the trends in exogenous parameters, i.e., the fertility rates, the death probabilities, the numbers of migrants, and so on. Together with the fact that we have to select, from a whole range of alternative futures, those trends that we consider the most probable ones, this means that the stage of the selection of parameter values is the most crucial one in the entire process of population forecasting. Proper assumptions are more important for the success of a forecast than a sophisticated model (Ascher, 1978). Therefore, a great deal of attention will be given to questions related to the projection of the components of population change.

3.1. Which components?

Any national population may change due to the three basic phenomena of fertility, mortality and external migration. Fertility and mortality are routinely included in all 29 forecasts, but external migration is left out by the GDR, Greece, Hungary, Malta, Romania and Spain. Following the definition of a population forecast given in section 1 this means that a net migration of zero in all male and female age classes is regarded as the most likely future migration pattern for those countries.

Of the 12 countries that work with region of residence, 8 include the component of internal migration. Czechoslovakia, Hungary, Portugal and the United Kingdom break their population down by region without explicitly dealing with migration between these regions. For the UK probably three distinct forecasts are made: one for England and Wales one for Scotland, and one for Northern Ireland. The other three countries probably follow a ratio-type of approach.

The Netherlands and the UK, while applying a marital status breakdown of the future population, include marriage and marriage dissolution in their set of components. When marriage, divorce and transition to widowhood are treated for both males and females, this raises some technical difficulties. This so-called two-sex problem may be the reason for the fact that the third country that breaks its population down by marital status, viz. Ireland, only does so for females. Moreover, female nuptiality processes are not considered in the Irish projections.

Finally, three out of the four countries that break their future population down by nationality (FRG, Luxembourg and Switzerland), also consider changes in nationality, viz. naturalization. The fourth one (Belgium) arrives at such a breakdown without the formal use of naturalization, probably by employing a ratio-type of approach.

3.2. Levels of aggregation

Given the key role that fertility, mortality and migration parameters play in population forecasting, a systematic approach may be useful when choosing their values. It is useful to distinguish several levels of aggregation for these parameters (see also Pittenger, 1977, 365).

1. Detailed assumptions apply to the future trends in age specific fertility rates, death probabilities by age and sex, emigration rates by age and sex, numbers of immigrants by age and sex, etc.

2. Summarizing assumptions are formulated for summary indicators which aggregate the detailed parameters for fertility, mortality and migration. For instance the total fertility rate, the mean age at childbearing, the expectation of life at birth, the total number of immigrants.
3. General assumptions are statements of a socio-demographic as well as a more general (social/economic/cultural/political/legal) nature. For instance, the assumption that the role of the family will become less dominant, or that legal regulations will have a limited impact on immigration.
4. Disclaimers, which state that the forecasts are not valid in the event of war, natural disaster or major economic crises.

The discussion will be limited to levels 1-3.

In many situations, it may be useful to start the assumption making on level 3. Next, a qualitative assessment of the level 2 parameters may be given (rapid increase, stabilization and the like). After quantification, the resulting summary indicators may be disaggregated into detailed parameters at level 1, using standard age schedules.

Table 2 reveals that for the 28 countries for which we have information on fertility assumptions, one third formulates these assumption on the general level (level 3). The remaining good twenty five per cent includes those countries that keep currently observed fertility rates constant for the entire projection period. It should be mentioned that the levels given here are the highest ones obtained from the questionnaire: a country with one fertility variant's assumptions formulated at level 1, and those of two other variants at level 2, was classified as level 2.

Mortality assumptions show a much stronger concentration on level 2 than fertility assumptions. Twenty out of the twenty-eight countries for which information is available work at level 2, most often with life expectancies. General assumptions (level 3) are formulated by three countries. A somewhat less pronounced distribution than that for mortality is found for external migration.

3.3. Period approach or cohort approach?

The choice between a period approach and a cohort approach in the analysis and extrapolation of demographic components is largely an unresolved issue. Cohort figures, in particular the summary indicators, are relatively easy to interpret and they show less variation than the corresponding period figures. On the other

hand, a period analysis requires shorter time series, it results in more up-to-date information and (sometimes) in a more stable short-term trend. How are the preferences for the two approaches distributed among national forecasters?
Table 2 reveals a strong preference for a period approach when extrapolating fertility. More than two thirds of the countries stated that they adopt a period approach. Only one country, viz. the UK, applies a cohort perspective, while the remaining eight countries have a mixed period/cohort approach: five emphasize, however, the cohort perspective, and three the period perspective.
A cross-classification by type of approach (period, cohort, mixed) and level of assumption making (1-3) reveals some interesting patterns, as shown in the text-table below. Countries that apply a period approach show a more even distribution over assumption levels than average, while a mixture of cohort approach and period approach, with the emphasis on the former, is used at relatively high levels of assumption making. In other words, a cohort (type of) approach is not considered very useful at the level of very detailed age specific fertility rates.
Mortality and external migration are, almost without exception, extrapolated using a period perspective.

3.4. Variant assumptions

As early as 1933, Thompson and Whelpton published several variants of their estimates of the future population growth in the United States because they were not sure about the course the demographic components would take. Ever since, this has become common practice, stimulated, amongst other, by the United Nations.

Countries by type of approach (P, C, P/c, C/p) and level of assumption making (1-3), fertility projections

	Period	Cohort	Period/cohort	Cohort/period	Total
1	7	0	0	0	7
2	6	1	3	2	12
3	6	0	0	3	9
Total	19	1	3	5	28

Two points should be taken into consideration when choosing the components for which to formulate more than one assumption.

1. The significance of each individual component for the results of the forecasts. A 10% variation in the average number of children per woman generally results in greater fluctuations in the forecasting results than a 10% variation in the life expectancy at birth.
2. The past course of the components. The more erratic the observed development of a given phenomenon, the more difficult it is to estimate its future course.

The first consideration may be used when the outcome of a sensitivity analysis is known. The second consideration results from our ignorance about the quantitative relations between the demographic components and the underlying social, economic, cultural, political and technological factors. Here, we are interested in quantitative answers to questions such as:

- how does the increased emancipation of women influence the number of children a woman will bear?
- in which way does technological development influence mortality?
- to which extent will be demographic behaviour of ethnic minorities presently living in many western countries differ from that of the total population in the future?

In short, these questions relate to the translation of verbal level 3 assumptions into quantified level 2 assumptions.

Table 3 indicates that 23 countries compute more than one variant of their forecasts. At least 17 countries formulat several variants for fertility, and at least 11 do so for external migration.

The distance between corresponding variables in the high(est) and in the low(est) variant is indicative of the degree of uncertainty of the phenomenon in question. We computed for each country the relative range between the two extreme variants for fertility, mortality and external migration. For fertility, the relative range is defined as the difference between the TFR-values in the two extreme variants, as a percentage of the simple average of the two extreme TFR-values.

Table 3 shows a clear pattern for the range between fertility variants in the year 2000. Three groups of countries can be distinguished. One group of 9 countries displays a relative fertility range between 8% and 16%, with an average value of 12%. In these countries fertility appears to be relatively easy to predict, compared with a second group of 6 countries having relative fertility ranges between 32% and 45%, with an average value of 40%. The US and the

Netherlands forms an intermediate group, with values of 25% and 24% respectively.
The first two groups neatly reflect two common interpretations of the notion of a variant. One interpretation, wich leads to narrow relative ranges is that there is only one demographic future, for which assumptions can be formulated at level 3. However, to translate these level 3 assumptions into level 2 summary indicators (such as the TFR) introduces uncertainty, to be expressed by more than one variant. Hence such variants can be called "uncertainty variants" or "probability variants" in this interpretation. When more than just a single level 3 assumption is drawn up, we may speak of "alternative futures". In this second interpretation, the gap between the two extreme variants will be much larger than that in the first interpretation. It should be stressed that the "uncertainty variants interpretation" is much more compatible with our definition of a forecast - "... the most realistic future population trend ..." - than the "alternative futures interpretation".
A cross-classification of the 17 countries for which we computed relative fertility ranges by level of fertility range (low, intermediate, high) and extrapolation perspective for fertility (period, mixed period/ cohort with the emphasis on the former, cohort, mixed period / cohort with the emphasis on the latter) reveals that the 9 countries with a narrow fertility range are evenly distributed over the variable which indicate the extrapolation perspective. On the other hand, all 6 countries with a broad fertility range apply either a period approach, or they emphasize the period perspective in a mixed approach. Indeed, a period perspective tends to go together with difficulties in extrapolation. This, in turn leads relatively often to a broad range between the fertility variants.

The relative range of mortality, defined as the high (male) life expectancy minus the low life expectancy, as a percentage of the average of the two life expectancies shows in general much lower values in the year 2000 than the relative fertility range. This reflects the common belief among demographers that mortality is easier to predict than fertility. Similarly, external migration is thought to be much more difficult to predict than fertility, which is confirmed by the relative range of external migration in the year 2000 (defined with the aid of the net-number of immigrants).

When determining the width of the interval between the high and the low variant, one must bear in mind that a wide margin gives more reliable forecast results, but that it doesn't give as precise information as a small margin forecast. "In 1989 the TFR will be between 1 and 2.5" is a statement which will most probably come true, but for the user it will not lead to a very valuable forecast. One of the most difficult tasks facing the forecaster is to arrive at an acceptable compromise between precision - the distance between the variants - and reliability - the probability that a forecast comes true. One possibility to avoid the dilemma is to work with confidence intervals, thus expressing the chance that the true value will fall between the high and the low value.

3.5. Projection method of fertility, mortality and external migration

Participating countries were asked which method(s) they use to project (extrapolate, or interpolate between current and ultimate levels) fertility, mortality and external migration. More than one answer could be given, and the text-table below shows the distribution over the various categories. "Constant" implies that future rates (fertility, mortality) or parameters in general (external migration) are set equal to currently observed values for the entire projection period. "Age parameters" denotes the extrapolation of parameters of age schedules for the three components. "Time-regression" involves the extrapolation of relevant parameters using a regression model with time as the independent variable.
With fertility, working with age schedules is the most popular projection technique. Unfortunately, no information is available as to the type of schedule: analytical (e.g. Gamma, Hadwiger, Coale-Trussel) or relational (e.g. Brass' double log model). Some countries keep observed rates constant for one variant, and use a different technique for other variants. Formal time series methods were reported only once, and the use of explanatory models is absent.

Projection method of forecast components

	Constant	Graphical	Age parameters	Time regression	Other	Total
Fertility	12	9	17	2	4	44
Mortality	4	8	12	7	11	42
External migration	12	8	5	-	4	29

The "other" - category for mortality includes the use of model life tables (7 answers) and the logit model (1). Keeping observed mortality rates constant is rarely applied, perhaps due to steadily improving life chances in most countries in the long run.
A general conclusion that emerges is that the bulk of analytical demographic techniques that can be found in the literature has not made its way to projection techniques actually in use in official national forecasts. Keyfitz (1982) arrived at a similar conclusion for demographic theories. His analysis into the reasons for this gap between the practices of forecasters and those of other demographers should be carried out for the quantitative techniques of this section too.

4. TIME HORIZON OF PROJECTION RESULTS

The question on the length of the projection period produced a very regular pattern, see the text-table below. There is a strong preference among developed countries to project their national population 30-50 years ahead. The issue of the time horizon of the projection results raises some problems as to the realiability of these results.

In an empirical analysis of ex-post errors in total population growth rates for 1100 national forecasts made between 1939 and 1968, Keyfitz (1981, 583) came to the general conclusion that "... relatively short-term forecasts, say up to ten or 20 years, do tell us something, but that beyond a quarter-century or so we simply do not know what the population will be...". Empirical analyses of errors in fertility projections for the United States, Norway and the Netherlands tend to support this conclusion (Ahlburg, 1982; Brunborg, 1984; Keilman and Schreurs, 1988). And findings for Denmark, Norway and the Netherlands show that for the aged population (ages over 75) considerable errors arise in forecasts over a period of more than 10 years (Leeson, 1981; Brunborg, 1984; Keilman and Schreurs, 1988).

Countries by length of projection period in years

10-19	20-29	30-49	50-74	75+
4	5	12	7	1

Hence, our interpretation of a forecast as giving the most realistic future population trends can only be valid over a period of 10 to 15 years. Beyond that period, we can just speak of a mere projection. The plausibility of these long-term demographic trends can hardly be discussed. In other words, many long-term alternative futures can be drawn up, all of which would be equally imaginable at present.

In summary, most population forecasts lose their unconditional character after some 15 years ahead, and after that they gradually turn into conditional projections.

5. PROJECTION MODEL

An important feature of the cohort-component projection model is that it is based on the life table. For projection purposes, this, however, has two drawbacks.

1. The life table contains information on individuals classified by exact ages. Thus, a cohort-observational plan is employed. In such a plan, when an individual experiences an event, his cohort is recorded as well as his age in completed years at the time of the event. In the Lexis diagram of figure 1, the cohort-observational plan is indicated by the parallelogram QSVP. It extends over two calendar years. However, for a projection model, the cohort-observational plan is not very appropriate. Such a model describes the future number of persons belonging to a certain cohort and experiencing a given event between two successive points in time, not between two exact ages. This calls for a period-cohort-observational plan, of which parallelogram QRSV in figure 1 is an example. This observational plan covers two age classes.

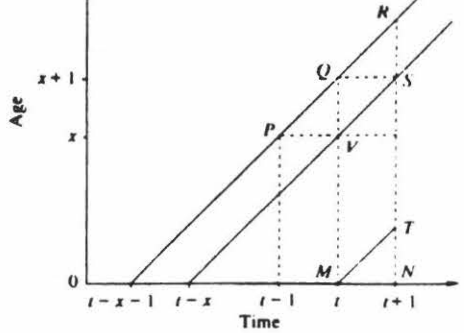

Figure 1. Lexis diagram.

Starting the construction of a projection model from the life-table approach means that the cohort-observational plan of this approach should be transformed into the period-cohort-observational plan of the model. This leads to unnecessary complications, as compared with an approach which immediately starts from a period-cohort perspective.

2. The life table contains information on the behaviour of a fixed set of individuals as they grow older (and possibly pass through several classifying states when the model includes region of residence or marital status). People may leave the system that is described by the information in the life table, because of death or emigration, for instance. But immigations are not allowed. For some countries this may be a reasonable assumption. However, other countries gain a substantial number of immigrants each year. In that case the life-table-based population projection model has to be supplemented with a variable describing immigration from outside the region in question.
   The approach frequently adopted involves two stages (see Pollard, 1973, 50). First, the population represented in the system at the beginning of the unit projection interval is assumed to 'survive' to the end of the interval. Second, a stock of immigrants is added to this result.
   With this approach, however, all immigrants are assumed to enter the country at one particular moment. Hence, they cannot experience the relevant events during the projection interval. For unit intervals of one year, or for countries where migration can be neglected, this is often probably quite a realistic assumption. But in projection models with a five year unit interval (e.g. Cyprus, Greece, Ireland, Malta and Yugoslavia), or for countries where migration is important, relative to natural growth, this assumption may be questioned.

As an alternative to the life-table based approach for the construction of cohort-component projection models, consider the aproach recently adopted in multi-dimensional projection models. This approach may be applied to multiregional and marital status population projection models. However, application of its principles to the relatively simple projection model which includes age and sex only may also solve the two problems mentioned here, that are inherent to the classical cohort-component model.
The main characteristic of the multidimensional approach is that the model's starting point is a given set of occurrence/exposure rates (fertility rates, mortality rates) defined upon a period-cohort observation criterion, and a set of corresponding accounting equations. By simply solving for the population at the

end of the interval, a completely valid projection model is constructed. This means that such a model may exactly simulate the behaviour of the population in a known period. An extensive discussion of this approach is given elsewhere (Willekens and Drewe, 1984; Keilman, 1985). Here we give a simple illustration, using one population category, and two events.

Let us suppose that K_0 and K_h denote the size of a certain population at the beginning and at the end of a particular period, respectively. The population may experience the events of death and immigration during the interval (0, h). The number of persons that die in the interval is denoted by D, m is the corresponding death rate, and I is the number of immigrants. The three variables D, m and I are all defined upon a period-cohort criterion of the Lexis-diagram. When deaths and immigrations are assumed to occur uniformly distributed over the interval, then m may be written as $m = 2D / (h (K_0 + K_h))$. The corresponding accounting equation is $K_h = K_0 - D + I$. Eliminating D and solving for K_h yields

$$K_h = K_0 \frac{1 - \frac{1}{2} hm}{1 + \frac{1}{2} hm} + I. \frac{1}{1 + \frac{1}{2} hm} . \qquad (1)$$

Expression (1) states that a proportion $p = (1 - \frac{1}{2} hm) / (1 + \frac{1}{2} hm)$ of the original population K_0 survives until the end of the interval. Analogously, a proportion $1 / (1 + \frac{1}{2} hm)$ of the immigrants survives until time h. When expression (1) is written in terms of the death probability q (defined upon a period-cohort criterion), with $q = 1-p = 2 hm / (2 + hm)$, we arrive at

$$K_h = K_0 (1-q) + I (1-\tfrac{1}{2}q). \qquad (2)$$

The factor "$\frac{1}{2}$" appears in expression (2) as a result of the fact that immigrants are assumed to enter the country evenly distributed over the period (0,h). On average, they arrive at time $\frac{1}{2}$h. Or, half of the immigrants may be thought of as having arrived at time 0, the remaining half at time h.

Expression (2) is not valid for the youngest age group (those born during (0,h)), or for the highest, open-ended age group. It only applies to intermediate ages. For the youngest age group (denoted by an upper index 0) it can be proven that

$$K_0^0 = (B + I^0) (1 - \tfrac{1}{2}q^0) \qquad (3)$$

where B is the number of birth during (0,h), I^0 is the number of children who enter the country during the period (0,h) in which they were born, and q^0 is the death probability of these children.

For the highest, open-ended age group (with an upper index z), the group of survivors K_h^z at time h z or higher at time 0, and those who belonged to the one-but-last age group z - h at time 0. Hence, we find for age group z in straightforward notation

$$K_h^z = K_0^z (1 - q^z) + I^z (1 - \tfrac{1}{2} q^z) + K_0^{z-h} (1 - q^{z-h}) + I^{z-h} (1-\tfrac{1}{2}q^{z-h}). \qquad (4)$$

Equations (2) - (4) represent a model which could be used as an alternative to the life-table based type of models. In particular, the model proposed here takes due account of the interaction between immigration and mortality.

Of the 24 countries that include external migration in their forecasts, 7 informed us about their projection model. Of these 7, Australia, the FRG, the Netherlands, the UK and the US take account of mortality among external migrants, whereas Canada and Denmark don't - probably because the latter two countries work with a unit projection interval of one year.

6. CONCLUSIONS

The previous sections have shown that, in spite of the cohort-component model as a common framework, much variation can be observed in current national forecasting techniques in developed countries. Of the 29 countries for which we have detailed information about their most recent forecasts, six exclude the component of external migration, 12 include region of residence, and four work with nationality. Fertility assumptions are formulated at several levels of aggregation. One-third of the countries involved starts at the general social and social-demographic level, and about forty per cent work with summary indicators (e.g. TFR). As to mortality assumptions, most of the countries start with the life expectancy, and break that indicator further down into mortality rates. There is a strong preference to apply a period perspective when projecting fertility. Only six countries use a cohort perspective, or a mixed cohort/perspective with the emphasis on the former. Two-thirds of the countries formulate more than one variant for the future course of fertility and eleven do so for external migration. The range between the high(est) and the low(est) fertility variant indicates the uncertainty that individual countries attach to this component in the future. About half of the countries that use more than one variant keep the interval between high and low fertility relatively narrow, thus indicating that their variants should be interpreted as "uncertainty" or "probability" variants. And about one third shows a large gap between the two extreme fertility variants, reflecting an "alternative futures" interpretation. As to the techniques that are used to project (extrapolate) fertility, mortality and external migration parameters, one may conclude that these techniques are relatively simple, compared with techniques that are described in literature on analytical demography. To what extent the latter techniques are inappropriate for forecasting, is an issue which is open for further research. Although national population forecasts give reliable results for a period of 10-15 years only, most countries compute outcomes for at least 30 years ahead and sometimes even much further. Finally some contries take account of a modelling issue often neglected in the cohort-component approach: the interaction between external migration on the one hand and mortality and fertility on the other, for example mortality among immigrants in the year of immigration. As simple alternative of the life-table based model equations was proposed.

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Table 1. Population characteristics and components of change

	Characteristics		Components		
	Age	Other 1)	External migration	Other 2)	
1. Australia	85+		yes		1
2. Austria	95+		yes		2
3. Belgium	99+	region, nationality	yes	internal migr.	3
4. Canada	90+	region	yes	internal migr.	4
5. Cyprus	75+(5)		yes		5
6. Czechoslovakia	100	region	yes		6
7 Denmark	109+		yes		7
8. Fed. Rep. of Germany	99	nationality	yes	naturalization	8
9. Finland	90+		yes		9
10. France	100+		yes		10
11. German Dem. Rep.	100+	region	no	internal migr.	11
12. Greece	85+(5)		no		12
13. Hungary	85+	region	no		13
14. Iceland	100+		yes		14
15. Ireland	85+(5)	marital status	yes		15
16. Italy	90+	region	yes	internal migr.	16
17. Luxembourg	95+	nationality	yes	naturalization	17
18. Malta	99+(5)		no		18
19. Netherlands	99+	marital status	yes	nuptiality	19
20. Norway	99+	region	yes	internal migr.	20
21. Poland	80+	region	yes	internal migr.	21
22. Portugal	85+	region	yes		22
23. Romania	85+		no		23
24. Spain	100+	region	no	internal migr.	24
25. Sweden	95+		yes		25
26. Switzerland	99+	nationality	yes	naturalization	26
27. United Kingdom	90+	region, mar. status	yes	nuptiality	27
28. United States	100+	race	yes		28
29. Yugoslavia	65+(5)	region	yes	internal migr.	29

1) Other than age and sex.
2) Other than fertility, mortality and external migration.

Table 2. Aspects of fertility, mortality and external migration

	Fertility detail		Aggregation level			Fertility by period or by cohort?	
	Age	Other	Fert.	Mort.	Ext. migr.		
1. Australia	5		2	2	2	pc	1
2. Austria	1		2	2	2	p	2
3. Belgium	1	region, nationality	3	2	2	p	3
4. Canada	1		3	2	3	p	4
5. Cyprus	5		2	2	2	p	5
5. Czechoslovakia	1		1	2	2	p	6
7. Denmark	1		3	2	2	cp	7
8. Fed. Rep. of Germany	1		1	2	3	p	8
9. Finland	1		1	1	2	p	9
10. France	1		2	2	1	pc	10
11. German. Dem. Rep.	1		1	1	-	p	11
12. Greece	5		2	2	-	pc	12
13. Hungary	1		2	2	-	cp	13
14. Iceland	1		3	2	3	p	14
15. Ireland	5	marital status	3	2	3	p	15
16. Italy	5		1	2	1	p	16
17. Luxembourg	1		2	1	2	p	17
18. Malta	5		?	?	-	?	18
19. Netherlands	1	birth order	3	3	3	cp	19
20. Norway	1		1	2	2	p	20
21. Poland	5		2	2	2	p	21
22. Portugal	5		2	2	1	p	22
23. Romania	1		2	2	-	p	23
24. Spain	5		1	1	-	p	24
25. Sweden	1		2	1	2	cp	25
26. Switzerland	1		3	3	3	p	26
27. United Kingdom	1	birth order	2	2	2	c	27
28. United States	1	race	3	3	3	cp	28
29. Yugoslavia	5		3	2	1	p	29

Table 3. Output variants, range between high and low variants and projection horizon

	No. of output variants	Relative range in 2000 (%)			Projection horizon (yrs)	
		Fert.	Mort.	Ext. migr.		
1. Australia	3	8.9	-	28.6	30-49	1
2. Austria	7	39.7	-	-	50-74	2
3. Belgium	1	-	-	-	30-49	3
4. Canada	18	44.4	-	66.7	30-49	4
5. Cyprus	2	8.4	-	-	30-49	5
5. Czechoslovakia	3	12.2	3.6	200	20-29	6
7. Denmark	2	12.5	-	-	30-49	7
8. Fed. Rep. of Germany	3	37.6	-	116.6	30-49	8
9. Finland	1	-	-	-	50-74	9
10. France	8	45.0	-	-	50-74	10
11. German. Dem. Rep.	1	-	-	-	20-29	11
12. Greece	1	-	-	-	20-29	12
13. Hungary	4	11.3	3.6	-	30-49	13
14. Iceland	3	39.1	-	?	30-49	14
15. Ireland	6(2)	12.1	-	85.7	30-49	15
16. Italy	2	-	-	?	20(50)	16
17. Luxembourg	?	31.9	-	600	50-74	17
18. Malta	1	-	-	-	20-29	18
19. Netherlands	3	24.2	1.3	35.7	50-74	19
20. Norway	2	-	-	66.7	50-74	20
21. Poland	3	11.7	0.6	-	10-19	21
22. Portugal	6	?	?	?	10-19	22
23. Romania	4	?	?	?	10-19	23
24. Spain	1	-	-	-	30-49	24
25. Sweden	6	11.6	-	100	30-49	25
26. Switzerland	3	-	-	100	30-49	26
27. United Kingdom	5	15.6	3.5	-	50-74	27
28. United States	30	25.0	5.6	90.9	> 75	28
29. Yugoslavia	3	?	?	?	10-19	29

Name: László Hablicsek and István Monigl co-author

Title of Paper: Major characteristics of the long term population development in Hungary in the period between 1880 and 2020.

Summary: In the study the authors research the long term population development in Hungary within the frame of the demographic transition, from the aspect of reproductive behaviour.In this basis they draw conclusions towards future development of the population.The basis of their calculations is a system - looking far back and having been perfected - of the general fertility and mortality parameters.

The following characteristics of the reproduction of the Hungarian population has been analysed as components of reproductive behaviour:

-the structure of the actual and the stacioner population;

-the net reproduction and the intrinsic growth rate;

-the total extent of the real and the fictitious birth cohorts (number of the years they have passed).

The interrelations of the demographic transition has been illustrated by model-calculations, starting the calculations from the end of the last century.

It is stated in the study that the low level of reproduction is a dominant feature of the demographic transition in Hungary. This feature originates from the fast decrease in the fertility level, from the given stage of the increase in the population-number, from the fact that the age-structure of the actual and stacioner population show more similarities, and especially from the low level of the net reproduction indicators of birth cohorts.

The second feature of the demographic transition in Hungary covers the relative stability of the total extent of the real and fictitious birth cohorts (number of the years they have passed) , which stability appeared rather early, in the early twentieth century. This empirical interrelation between the development of the fertility and mortality carries high importance towards theoretical works and future development as well.

On the basis of the model-calculations the future trend of the population development which is the most probable to follow in the given way of the demographic transition can be well depicted. This mentioned trend would be described by : - a lower than the current level of the population number, showing relative stability;

- a new, considerable decrease in mortality, paralel with a moderately low level of fertility;
- extension of the age-pyramid.

This picture of the future is instable and having different periods due to normal flow of the phenomena, therefore the increase of the level of the social consciousness in the near future is of high importance.

Name: Janina Jóźwiak

Title of Paper: Application of the fundamental matrix to the analysis of changing population structure

Summary:

The aim of the paper is to present a proposal for application of the fundamental matrix of the multistate population projection model to the evaluation of the population structure, Properties of the fundamental matrix allow to derive characteristics describing the multistate population system. I.a., the expected time spent by an individual in the specified states and the variance of this time may be calculated by use of the fundamental matrix. The presented in the paper application of the fundamental matrix is based on the reasoning similar to the approach of the potential demography. In the potential demography it is assumed that elements of the population are not equivalent. A weight which is numerically expressed by the expectation of life is assigned to every individual. This weight is called the life potential of the individual. In the multistate demographic analysis it seems to be justified to take into account the contribution of the individuals in different states into the population system instead of considering the number of the individuals in these states. This contribution may be measured by the time spent by the individuals in the states. This approach gives possibility of assessing the virtual value of the distinguished states for the multistate population system. The fundamental matrix is used to the numerical evaluation of this value. Consequently, the dynamic analysis of the changing multistate population structure is possible in which the sojourn time is taken into account as the weight for individuals. The numerical example refers to the two-region structure of the Poland's population /urban-rural/. It reveals significant differences between dynamics of the actual structure and the weighted one - for various migration and survivorship schedules.

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Name: William J. Serow, David F. Sly and Gabriel Alvarez

Title of Paper: The Oldest-Old:Cross National Comparisons

Summary:

This paper analyzes trends in the age and gender structure of the older population of presently developed countries for the periods from 1950 to 1985 and from 1985 to 2020. The emphasis placed in the paper is on the role which changes in mortality between these periods, coupled with past levels of fertility and immigration (leading to differences in the size of cohorts entering into the "older" population), play in determining prospective changes in the structure of the population aged 60 and, especially, aged 75 and over. All data are taken from the most recent population projections of the United Nations ("World Population Prospects as Assessed in 1984"). For purposes of this analysis, the more developed countries are considered as a whole and are further divided into the following regional groups: North America (Canada and US); Japan; Oceania (Australia, New Zealand); the Soviet Union; and Europe, both in its entirety and further divided into its Eastern, Northern, Southern and Western portions.

During the entire period under consideration there have been notable changes in the share of total population accounted for by older persons, with extremely dramatic changes most evident for the case of Japan. In all instances, relative increases in numbers were greatest among very old persons:

SHARE OF POPULATION AGED 60+ AND AGED 75+

	1950		1985		2020	
	60+	75+	60+	75+	60+	75+
Total	11.4	2.4	15.8	4.6	22.3	6.3
N.America	12.1	2.5	16.2	4.6	22.1	5.6
Japan	7.6	1.2	14.4	3.7	26.1	8.8
Europe:						
Total	12.9	2.7	17.6	5.4	23.8	6.9
Eastern	11.0	2.1	15.6	4.6	21.6	5.7
Northern	14.9	3.4	20.3	6.2	24.5	7.3
Southern	11.1	2.4	16.3	4.5	22.4	6.6
Western	14.8	3.2	18.7	6.3	26.8	8.0
Oceania	12.6	2.6	14.2	3.7	20.6	5.4
Soviet Union	8.9	1.9	13.1	3.7	19.5	5.2

Most of the increase in the number of older persons during the next 35 years is attributable to increases in the size of newly entering cohorts. However, forecast reductions in the level of mortality account for 9 percent of the increase in the size of the 60+ population and nearly 10 percent of the increase among those aged 75+. The role of mortality is appreciably greater in Japan and in the comparatively high mortality regions of Southern and Eastern Europe as well as the Soviet Union.

Name: Otto Hellwig

Title of Paper: Micro-analytical Modelling and Estimation of Interhousehold Mobility using Cross Section Microdata

Summary:

We have differentiated inter household mobility with respect to the status (household head or not) and the marital status. Through this it became obvious that most types of mobility are induced by the standard demographic processes death, birth, marriage and divorce. We concentrated on a fifth process: leaving home of single persons. Depending on the available data (panel data, sequences of cross sections, cross sections with additional time-series information, cross section data only) approaches of estimating transition probabilities were described. Of course, more assumptions are necessary for calculation, if less information are available. Using the example of marriage probabilities we demonstrated that such transition probabilites can be estimated fairly accurately, even though only cross section data are available.

An empirical investigation of the process of leaving home showed the relevance of age, sex, income and work force participation. However some results do no seem to be plausible which leads to the conclusion that additional explaining variables should be included. Furthermore small group frequencies cause some problems at estimation. Alternatively to the group approach used we suggest trying the AID method or logit regressions. While calculating probabilities of leavinghome using two different assumptions and cross section data we showed the strong impact of weak representativity of the data on the estimates.

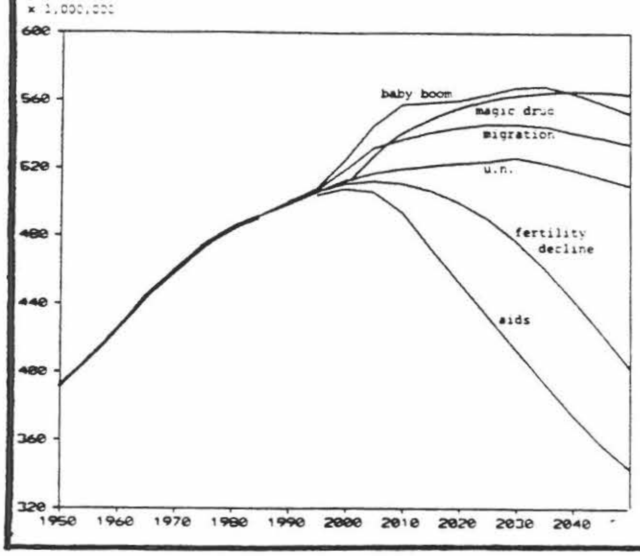
Name: D.Wolf. B.Wils. W.Lutz. S.Scherbov

Title of Paper: Population Futures for Europe: An Analysis of Alternative Scenarios to the year 2050

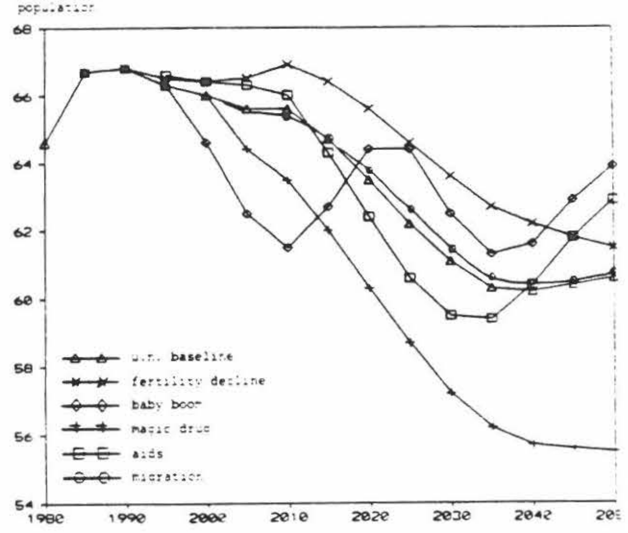
Summary:

This paper looks at not impossible future scenarios for the population of Europe (excluding the Soviet Union). The scenarios are not meant to represent the actual, or even likely, future, but are thought to be instructive about what the future may hold in store and point out the consequences of possible alternative developments. We base our alternative scenarios on the observed age-structure of the population in 1985 in four regions of Europe (source of data: UN). For these four region six different scenarios are defined, drawing from the analysis of past trends and assuming different future paths of development in fertility, mortality, and migration: the set of assumptions used for the UN medium variant is called the baseline scenario: we also assume a further fertility decline for Europe down to a TFR of 1.4 in 2025 (about 1.8 currently) and alternatively a new baby boom peaking in 2000 with a TFR of 2.8: concerning mortality we assume a "magic drug" that is introduced in 2000 and reduces mortality rates above age 60 by 50% or alternatively a new major epidemic (such as AIDS) that ultimately affects half of the population aged 30-50: with respect to migration we assume a new wave of immigration to Europe over the 10 years 1995-2005.
The consequences of these scenarios on total population size and the proportion above age 60 are illustrated below.

Total Population Size



Proportion above Age 60



NOTES

SESSION 2

The Future of Reproduction

Organizer: Andras Klinger

Page

FUTURE CHANGES IN POPULATION AGE STRUCTURE

IIASA-Conference, Sopron (Hungary), 18-21 October 1988

THE FUTURE OF REPRODUCTION

The Introduction of the Organizer

András KLINGER

Hungarian Central Statistical Office

Budapest, Hungary

Outlining the future of reproduction is perhaps the most difficult task of population projections. Even the full comprehension of the fertility processes of the past and present has not been achieved as nobody knows the motives determining the fertility behaviours of individual persons or families. Thus, we are not in a position to provide an unambiguous description of the reasons which have brought about the fertility changes over the past decades, the movements of the reproduction process in different directions during the period following World War II. It is especially during the past few years that unforseen and consequently absent from earlier projections changes have taken place making it even more difficult to form a reliable picture of the future. And no wonder, as even if the present relationships between socio-economic processes and the number of children born were known the picture of the future would remain nevertheless unsure. Namely, we do not know the ways in which the society, the economy and world policy will develop during the decades to come and even less is known about the possible impact of these uncalculable changes on the decisions of people regarding the size of their families.

Nevertheless, in spite of all these difficulties our task is to outline a picture of the future from the point of view of the expected development of fertility. This time the intention is not to assess the fertility conditions of a new population projection but to produce a summary using available projections.

Our intention is to make the subject somewhat simpler by limiting its scope to the economically developed countries as the fertility in developing countries covers even greater uncertainties. In this respect the definition adopted by the

United Nations Organization is used according to which the concept of "more developed region" relates to the European countries, the Soviet Union, the United States, Canada, Australia, New Zealand and Japan. In the presentation the usual subregional totals are also used differentiating four parts within Europe (Eastern, Northern, Southern and Western). Without singling out the countries with the least population numbers during the presentation with regard to "countries" 31 units will be differentiated.

Of the several possible measures - similarly to the practice followed in most publications on the subject - primarily one, total fertility rate (TFR) will be used. It is this measure which indicates most simply the reproduction behaviour during a concrete year (period) and in future calculations it can be abstracted practically from calendar effects as it can be regarded also as a cohort indicator. However, exactly in order to eliminate calendar effects cohort indicators - primarily the completed cohort fertility rate but also other similar indicators fashioned otherwise (such as the ultimate expected number of children calculated on the basis of sample survey results) - are also used additionally in case of countries for which such data are available.

Though past and present fertility processes by themselves do not determine the future it is nevertheless regarded as necessary to present, in th first place, the changes having taken place in more developed countries over the most recent several decades.

1. The evolution of fertility, 1950-1987

If the evolution of TFR is examined with regard to the economically developed countries as a whole over the past

25-30 years a significant general fall can be observed.[1/] The latter is caused also by the fact that in the early 1960s in a part of the developed countries - in the wake of the period of the baby-boom - fertility was still high but even more by the fact that the drop in the number of children in the families accelerated generally in the second half of the seventies and even more until now in the eighties.

On the average of the 31 countries examined TFR was still around 2,7-2,8 in the fifties and in the early sixties which by a quarter surpassed simple reproduction level. In the second half of the sixties the decrease was still only slight but it accelerated at slower rates in the seventies and at a greater pace in the eighties. At present in the developed countries TFR is, on the average, only around 1,9 which is by one child less than it was 25 years ago, i.e. now the fertility rate is, in general, by 30 per cent lower than in the first half of the sixties.

When examined by subregions the situation is not so uniform. The fall was the least - with regard to its two final points - in Eastern Europe, in the Soviet Union and in Japan; it was the most significant in the two North American countries and in two countries of Oceania where the baby-boom was still strong at the beginning of the period under survey and where now TFR is, on the average, the half of what it was at that time; but it decreased by about 40 per cent and by 36 per cent in Western and Southern Europe and, respectively, in Northern Europe.

1/ See Table 1.

When TFR values of the first half of the sixties and, respectively, of the second half of the eighties are examined again by subregions, it is to be seen that 25 years ago TFR was still higher in the Southern and Northern regions of Europe (2,7-2,8) and almost equal to that in the Northern region of Europe (2,6) while it was lower in the countries of Eastern Europe (2,3). TFR was also relatively low in the Soviet Union (2,5) and already very low in Japan (2,0). However TFR was outstandingly high in the other developed countries outside Europe (Canada, New Zealand: 3,6-3,8, USA, Australia: 3,3). As a consequence of evolutions in opposing directions this picture has turned face-about by the recent years. Now it is the Soviet Union where TFR is the highest (2,4); of the European subregions it is Eastern Europe which has the highest value (around 2 on the average); TFR is around 1,7-1,8 in the other European regions and the situation is similar to the latter also in the developed countries outside Europe.

Naturally, the individual developments of the 31 countries differ, in manycases, from the general trends and, respectively, from those characteristic of the respective subregions. If the last known TFR values are compared with the average of the years 1960-1965 there is one country where even an increase can be found. This country is Roumania where at that time a very low value was measured (from the high level in the fifties fertility had decreased to 2 and now it is again somewhat higher: 2,2); the situation is slightly similar to that in Hungary where no change can be found between the two final points (the value is around 1,8 in both cases but behind it there was a bottom of reproduction in the early sixties followed by a rise in the early seventies and by a new decline recently); but the situation is strongly similar in other Eastern European countries (Bulgaria, Czechoslovakia, Poland) and in the Soviet Union and also in Japan where reproduction level has dropped but slightly, though from a level lower already in sixties.

As it has been indicated, the greatest decline has been found in Canada (by 55 per cent) but the present TFR is hardly the half of what it was 25 years ago in still 7 other countries (New Zealand, Austria, the Netherlands, Italy, Portugal, Spain and also in Albania whose situation is completely different and where the fertility - though still high as in the developing countries - has dropped from 5,8 to 3). Considerable, over 40 per cent, is the decline in 5 further countries (Norway, Belgium, USA, Australia, FRG; but it hardly falls behind in Ireland (where it has dropped from 4 to 2,4), in the United Kingdom, Luxemburg and Switzerland.

The level of TFR, in the early sixties was still over 3 in 8 countries (and as we have seen above it was 5,7 in Albania and 3,5-3,6 in Canada and Ireland), between 2,5 and 2,9 in the major part of the countries (in 15 countries) and the lowest in Hungary (1,8). According to the available data for the most recent period, i.e. for 1987 or - if they are missing - for 1985-1986 TFR is over 3 already only in one country (Albania) being already 2,4 in the two countries following it (USSR, Ireland). The rest of the countries have strongly "slided down" as far as the fertility value is concerned: there are 8 countries where TFR is 1,5 or lower and in 1987 the lowest value was measured in Italy (1,27).

It is worthwhile considering developments in the eighties so far[1/] because they are rather different by themselves by groups of countries. In the countries of Eastern and Northern Europe as well as in the developed overseas

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1/ See Table 2.

countries the situation has stabilized: TFR has not changed since 1980. The only exception is Ireland where the strong decrease started during this period (from 3,2 to 2,4 between 1980 and 1986). However the decline is considerable in most countries of Southern Europe (with the exception of Yugoslavia where fertility is rather stable - around 2,1): fertility has dropped from 1,7 to less than 1,3 in Italy, from 2,2 to 1,6 in Greece and Portugal and to 1,5 in Spain. Some countries of Western Europe have stabilized their - already low - fertility levels (Luxembuerg, the Netherlands, Switzerland); fertility has continued to decline now at a lower pace in France, Belgium and in the GFR and at a somewhat higher pace in Austria (from 1,7 to 1,4).

If the trend of reproduction is to be examined not by TFR but by completed cohort fertility the picture is not fully identical but has similar features in many respects. Naturally, it is not possible to give a full picture from this point of view because the respective data are not available for all countries but for 23. In case of 5 countries of the latter group changes can be studied only beginning with the fertility of the female cohort born in 1930 while in case of the rest of the countries in this group they can be followed beginning with the cohort born in 1900.[1/]

If the developments between two cohorts, i.e. the changes in completed fertility between the female cohorts born in 1900 and in 1930 and, respectively, in 1930 and in 1955 (in the case of the latter assessing childbirths over the age of 30 with an error margin of 5 per cent) are to be studied, the countries examined may be divided into four groups:

1/ See Tables 10, 11.

- A significant increase between the cohorts of 1900 and 1930 but there is a decrease between the cohorts of 1930 and 1955. In four countries belonging to this group (France, Norway, England and Sweden) the increase during the first period is 12-25 per cent and the decline during the second is 10-22 per cent and, in total, for example in France completed fertility had increased from 2,1 to 2,6 and then fell back again to 2. The situation is similar in Norway and England where the initial value was the same while the maximum was only 2,5 and 2,4, respectively. In Sweden completed fertility had increased only from 1,9 to 2,1 and then dropped back to the same value. The tendency is similar also in 5 further countries (Switzerland, Denmark, Belgium, Ireland and perhaps Austria) but the increasing trend is more moderate (by 8-10 per cent) and the decline is greater (by one quarter).

- The situation is stable with regard to the changes between the female cohorts of 1900 and of 1930 and there is a decline thereafter. This situation is characteristic of 3 countries (GFR, GDR and the Netherlands). This is the most conspicuous in the Netherland: the average number of children was 2,9 in the case of the beginning cohort and then fell back to 2,7 in the case of the cohort of 1930 while the youngest females gave birth only to 1,8 children on the average.

- A gradual decrease over th whole period. It is sure that this phenomenon has taken place in five countries (Finland, Italy, Portugal, Spain and Greece) and it is probable that the same applies also to two further countries (Yugoslavia, Poland). The greatest drop in completed fertility took place in Finland and in Italy: females born in 1900 still gave birth to 3,2 children on the average while those of the 1955 cohort to only 1,7.

- Finally, a decrease in fertility between the female cohorts of 1900 and of 1930 with a stabilization of the situation thereafter. This situation is characteristic of Czechoslovakia and of Hungary. In the former the average number of children fell back from 3 to 2,4 and there has been almost no change after that while in the latter as against the average 2,7 children in the case of the 1900 cohort females belonging to the 1930 cohort gave birth to 2 children on the average and those belonging to later cohorts also to about 1,9 children. The situation is probably the same in Bulgaria and Roumania. The average number of children of the 1930 cohort was 2 in the former and 2,3 in the latter and this has not changed since then.

Summing up the developments over recent decades on the basis of the above two indicators one has to establish that - with different variations - in the majority of the developed countries fertility has gradually declined while in the rest of them low level stabilization has taken place.

2. The future of fertility, 1987-2025

In the approximation of the problem of the future of reproduction in the countries of the more developed region considering past trends and using a logical approach, generally speaking, there are several possibilities:

1/ One may assume that the decline in fertility was periodic and that the present reproduction level - much lower than simple reproduction level - cannot be lasting and that a gradual increase will take place in the countries which will reach simple reproduction level (a value around 2,1 as against the present 1,9) by the end of the projection period, i.e. by 2020-2025.

2/ Fertility will not increase in the near future but will remain essentially at its present level until the end of the twentieth century or will change only slightly (upwards or downwards) and a slight increase will start only during the first decades of the next century, especially in those countries where at present reproduction level is the lowest. Thus a certain equalization will take place among the fertility levels of the countries: the fertility of the countries who are in the middle will not change essentially while that of those with high fertility levels will even decline and, consequently, the present level of fertility will hardly rise and only its dispersion will be less.

3/ The change in fertility cannot be assessed and, consequently, the present level is projected by countries and it is only in the case of some areas with outstandingly high fertility that some decline is projected. The final result of this presumption does not show any significant change compared with the present level of 1,9 either but, according to it, the present differences - with the exception of the outstandingly great ones - will remain.

4/ The declining trend of the fertility level of the most recent period will continue and, consequently, the fertility level in every country will be lower than at present and this declining variant projects a TFR of 1,6 for the whole of the developed countries by the end of the projection period.

Each of the assumptions of these four variants figures in one or other of the population projections made during the past few years by international organizations or by individual countries.

The two official population projections recently published by the United Nations Organization[1/] depart from the assumption that the fertility of more developed regions will increase (1-assumption type). If, for example, the 1984 assessment is adopted as a basis the fertility rate of the whole developed world will increase from 2,0 in 1980-85 to 1,8-2,3 in 2000-05 (medium variant: 2,0,i.e. unchanged), but to 1,9-2,4 in 2020-25 (medium variant: 2,1, i.e. an increase to simple reproduction level).

On the other hand the 1988 UN projection corresponds to the 2-assumption type[2/] as it expects hardly any rise in fertility: the level of TFR will essentially remain at the present value of 1,9 until 2000 and will increase only a bit by 2020-25; the minimum and the maximum values at the two final points of the calculations would be 1,7 and 2,2, respectively. Thus, the assumption of the assessment projects TFRs for 2000 and 2020 by 6 and, respectively, by 9 per cent lower than the two previous variants.

1/ World Population Prospects, Estimates and Projections as assessed in 1982, United Nations, New York, 1985, (Population Studied No, 86) and World Population Prospects, Estimates and Projections as assessed in 1984, United Nations, New York, 1986 (Population Studies, No. 98).

2/ World Population Prospects: 1988, United Nation (under publication).

The assumption of constant fertility is used not generally in international assessments but the 1988 UN assessment already uses this assumption in the case of a number of countries (accordingly, in the case of already 5 of the 31 countries under survey fertility will not change between 2000 and 2020). However, this 3-assumption type is the basis of projection in the case of 7 of the 22 available national population projections for the whole period (i.e. the TFR of the year of the projection is projected unchanged) and in the case of 9 of the remaining national projections an unchanging level of fertility is assumed already for the period after 2000. The assumption is similar in the population projection made by the World Bank in which the present fertility level is prognosticated for 2000.[1/]

The use of the declining variant - 4-assumption type was proposed at the European Population Conference of 1987.[2/] Calculating it for the whole developed region in terms of TFR results in a decline of fertility to 1,7 and to 1,6 by 2000 and by 2020, respectively.

If the results of these assumptions for the developed countries as a whole are compared the differences are not so great by themselves but the values are extended along a rather broad scale. The summarized results of the different projections for 2000-05 and, respectively, for 2020-25 in diminishing order look as follows:[3/]

1/ World Development Report 1987, published for the World Bank, Oxford University Press, Table 28.

2/ M. Macura and J. Malacic: Population Prospects for Europe, European Population conference 1987, Plenaries, IUSSP-EAPS-FINNCO, Helsinki, 1987.

3/ See Tables 3, 4, 5, 6.

Projection	TFR 2000-05	TFR 2020-25
UN-84-high	2,27	2,30
UN-88-high	2,14	2,22
UN-84-medium	2,04	2,12
World Bank-87	2,00	.
UN-84-medium	1,90	1,94
National-87/8-medium	1,90	1,90
UN-84-low	1,82	1,92
UN-88-low	1,73	1,65
Declining-88	1,70	1,60

Thus, in the light of the different projections TFR, which is 2 at present, may be between 1,7 and 2,3 by 2000-05 and between 1,6 and 2,3 by 2020-25. The difference between the highest and lowest values is rather significant: 33 per cent in 2000 and already 43 per cent in 2020. However, even if the assumption of the 1984 UN assessment is overlooked - as it was actually withdrawn by the 1988 UN assessment - TFR may nevertheless be, during the period to come, first between 1,7 and 2,1 and later between 1,6 and 2,2. Thus, the difference may drop to 26 per cent by 2000 and to 38 per cent by 2020 but even in this case it will be between rather broad limits.

It is difficult to answer the question which picture of the future may be regarded as the most realistic. Perhaps, it may be taken for sure that the former assessments assuming increasing fertility were too optimistic and the UN was right in switching over to the assumption of smaller change, of almost constancy. Even in the case of it the "high" variant seems to be too high and its materialization is not very probable. One may imagine the future at best between the "medium" and "low" assumptions and the latter hardly differs from the assessment of the "declining" projection. From the point of view of realistic limits, by around 2000 TFR may be between 1,7 and 1,9 and by 2020-25 between, 1,6 and 1,9 and in this case the dispersion will already drop to 12 per cent and to 19 per cent, respectively.

The developed countries - by the development up to now and the future perspective of their fertility and on the basis of the 1988 UN medium projection - may be divided into four groups (on the basis of their TFRs):1/

1/ Most numerous (12 of 31) are the countries where over the past 25 years the decline in fertility has been rather strong and, consequently where the level of fertility is rather low also at present, in whose case the projection foretells a considerable increase by 2025. To this group belong almost all Western European countries (the Netherlands, Austria, the GFR, Belgium, Luxemburg, Switzerland), most Southern European countries (Italy, Spain, Portugal, Greece) and two Northern European countries (Denmark and Sweden).

In the case of some countries this considerable increase is rather doubtful. For example, in the case of the GFR a 25 per cent increase in the TFR (1,4 at present) is projected (to 1,7), though it is true that this prognosis is more cautious than the 1984 UN assumption which projected an increase to 2,0 by 2025. The most recent national projection assumes a stabilization at the present level. The situation is similar also in Italy, in Portugal and in Greece where national projections assume stabilization while the UN medium projections prognosticate increases of 10 and 18-19

1/ See Tables 7, 8.

per cent, respectively. In the case of the rest of the countries belonging to this group the directions of national and international projections and the assumed increases may be regarded as identical. Perhaps it is only in the case of Spain that the UN projection foretelling an increase of 28 per cent (from the present 1,5 to 1,9) seems to be exaggerated and in the case of Belgium it is the national projection which assumes a much greater rise than the UN projection does (by 2025 the national projection hopes for an increase from the present 1,5 to 2,1 while the UN projection assumes an increase to only 1,8).

2/ An other big group of countries (9 countries) - after the strong or medium decline in fertility - may hope for stagnation or for a smaller increase if the UN projection materializes in the 40 year period to come. To this group belong the greater part of the oerseas developed countries (Canada, New Zealand, USA, Australia) 3 Northern European countries (the United Kingdom, Norway and Finland), France and the GDR.

The assumed tendency is the same also in the national projections. Perhaps it is necessary to call the attention only to the differences in the size of the increases: in the French national projection TFR is assumed to rise from 1,8 to 2,1 by 2025 (an increase of 17 per cent) while according to the UN projection the French TFR will increase by 2025 to only 1,9, i.e. the rise would be smaller. The assumed increases are greater in the UN projections than in the national ones also in the case of the United Kingdom and the USA.

3/ In each of the 7 countries belonging to the third group according to the UN projection - the stagnation, resp., the low decline, which have taken place so far, will continue also during the next 40 years. Thus, in the five Eastern European countries, in the Soviet Union and in Japan fertility would but hardly decline between the 1960s and the 2020s, i.e. between the two final points of time of the period under survey. It is perhaps only in Poland and in Czechoslovakia that the declines would be greater (but their size of 20 per cent dwindles down when compared with the decline by half to be expected in some Southern and Western European and overseas countries).

In some cases the assumed slight decline during the next 40 years may, to a certain estent, be questioned. Thus, in in the Soviet Union, where fertility is now high, perhaps a more considerable decline may be expected than that prognosticated by the UN (from 2,4 to 2,1, i.e. only a decline of 10 per cent). The same idea may come up also in the case of Bulgaria and Roumania. On the other hand, the Hungarian national projection prognosticates a slight increase (from 1,8 to 2,1) as against an unchanged level assumed by the UN and the Polish national projection assumes a stagnation at the present level of 2,2 as against a decline of 17 per cent (to 2,05) prognosticated by the UN.

4/ A special group may be assigned to those 3 countries where the decline has been and will remain very considerable up to now and, respectively, during the period to come. Naturally, to this group belong those European countries where in the past fertility had been at an outstandingly - perhaps "developing" - level: Albania and Ireland. In the first TFR has declined by half since the 1960s and according to the projection it will decline by a further one third while in the latter the decline up to now has been by almost 40 per cent and the UN projects a further 16 per cent decrease for the next 40 years which is in accordance with the national projection. Yugoslavia is also near to these countries: there by now the value of TFR has decreased by 30 per cent and a further 10 per cent decline is still expected to come.

It seems that if the UN picture of the future would materialize in general the value of TFR in the countries of the more developed region would be on a somewhat higher level. There would be no single country where the value of TFR would be equal to or lower than 1,6 (at present there are 12 such countries) and in the 7 countries with the lowest value of TFR (Denmark, Italy, Austria, the GFR, Luxemburg, the Netherlands, Switzerland) TFR would be 1,7 on the average for 2020-25. It is to be noted that of these countries for the same period the national projections of the GFR and Italy and Austria assume 1,3-1,4 and 1,6, respectively, while the assumptions of the rest of the countries are similar to those of the UN. The country with the highest fertility would be Albania also in 40 years but with a TFR of 2,2. At present - besides Albania - there are still four countries with such or higher TFRs. The difference between the maximum and the minimum today is 3,4 to 1,3 (i.e. 370 per cent), in 40 years it would be 2,2 to 1,7 (i.e. 130 per cent). One may rightly put the question whether the rapprochement will indeed be so great.[1/]

Naturally, the prognosticated differences in the fertility rates have a strong impact on the sizes of the generations

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1/ See Table 9.

to be born and in this regard the results of the different projections show already much greater variations than the TFRs assessed on the basis of the yearly data of one or another hypothetical cohort.

Thus, if the more developed regions are considered as a whole - on the basis of the 1984 UN medium assessment 633 million livebirths could be projected for the period between 1990 and 2025. The 1988 UN assessment already projects 592 million livebirths, i.e. by 7 per cent less for the same 35 year period which actually represents a proportionally smaller population. However, if the assessment of the "declining" variant would be adopted the expected number of births during the 35 years would fall back already to 520 million which is by 18 per cent and by 12 per cent lower than the results of the 1984 and 1988 UN medium projections, respectively. In terms of figures it means also that if the declining tendency will remain dominant by 2025 in the developing countries as a whole by 114 million and, respectively, 72 million fewer children will be born.

If the last five years of the period of projection - 2020-25 - are considered the differences are greater. Namely, according to the 1984 UN assessment there should be 93 million livebirths during five years but according to the 1988 UN assessment the respective number is already 86 million but according to the declining variant this number will be 70 million which will be by 25 per cent and by 18 per cent lower than the results of the former and later UN assessments, respectively.

Finally, the question arises in what distribution of the number of children the average fertility values will materialize, i.e. how the change in the general level of fertility will impact the distribution of families by the number of children and, respectively, the distribution of females by the number of children born to them.

It is rather difficult to give a uniform answer to this question because already at present the differences between the developed countries regarding the types of fertility by the number of children are very great. By the same average family-size the differences between the countries are very considerable. The differences appear especially in the proportions, on the one hand of females who have given life to no child or only to one child and of those with big families on the other.

On the basis of such a differentiation it is possible to form groups of countries: by a simple approach one part of the countries - independently from the level of general fertility - are rather heterogeneous from the point of view of the fertility model: by relatively many childless females and perhaps females with one child the proportion of females with two children is relatively less but the proportion of those with three children is higher and the proportion of females with four or more children is outstandingly high. In the other group of countries childless females are fewer, those with one child are more, the proportion of females with two children is outstandingly high, that of females with three children is lower and there are very few families with four or more children. In the countries belonging to this group the family-building model is relatively more homogeneous.

It is rather difficult to present comparable data to prove that this picture is correct. However, with regard to 19 countries the age- and birth order-specific livebirth-rates are available and with their help it is possible to construct - on the basis of the data of the given year, in most cases, of that of 1985 - TFRs by birth order and to calculate the distribution of completed total fertility by the number of children. These data refer to all births and in most cases birth order also refers to all births up to now. (In some countries similar data refer only to "legitimate" fertility and, respectively, to the birth order of those born in wedlock and in the case of these countries neither completed fertility nor - consequently - calculated completed fertility can be produced.)[1/]

If now countries are to be qualified with the help of these data, according to the above, the following countries may be assigned to the two groups:

1/ The most typical representative of the heterogeneous fertility group is Ireland where by a 28 per cent proportion of childless females 36 per cent of females have four or more children and only 15 per cent of them have two children (this represents the average of 2,7). Similar to this is the situation of Portugal (at proportion of 24 per cent of childless females theh proportion of females with four or more children is 22 per cent). Less typical are already the USA and Canada but in those countries the proportion of childless females is also high (24 and 29 per cent, respectively), the proportion of females with three children is higher (17 per cent) while the proportion of females with

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1/ See Table 13.

four and more children (10 and 7 per cent, respectively) may be regarded as somewhat outstanding when compared to average fertility (1,8 and 1,6, respectively).

To this group may be assigned also those further 6 countries where- though the proportion of childless females is high (between 26 and 34 per cent) - because of low average fertility the proportion of females with four or more children is already small (4-6 per cent and only in two countries 8 per cent) but there are generally many mothers with three children (14-15 per cent but in two countries in Sweden and in Japan - 21-22 per cent). Besides three Northern European countries (Finland, Denmark, Sweden) Italy, the Netherlands and Japan are assigned to this group.

2/ Of the countries showing a more homogeneous fertility picture Bulgaria and Czechoslovakia are the most typical. Namely, in those countries the proportion of childless females is rather low (7-8 per cent), females with four or more children are hardly to be found (5-8 per cent) but the overwhelming majority have two children (59 and 48 per cent, respectively). The situation is similar also in Hungary though the proportion of childless females is somewhat higher (14 per cent).

The assignment to this group may already be only partial in the case of Poland, Roumania and Yugoslavia where - though the proportion of childless females is not very high(9-14 per cent) - because of the higher average fertility the proportions of females with three and, respectively, with four children are already higher.

The assignment to this group is also partial in the case of three other countries: the GDR and Greece (where though the proportion of chidless females is somewhat higher /16 per cent and 19 per cent, respectively/ mothers with two children are many and those with four and more children are few /5-6 per cent/) and Australia where - though the proportion of childless females is low (6 per cent), that of females with two children is not outstanding while the proportion of mothers with three and four and more children is relatively higher.

The previous picture is essentially strengthened by the cohort fertility data of the population censuses. In this respect the possibility of presentation is somewhat scarce as the number of countries inquiring after the number of children at population censuses is relatively small, (especially recently and the comparison in this field too is rendered difficult by conceptual differences (data refer mainly to the married female population).An effort was made to compare five cohort-groups whose fertility behaviour completed between 1950 and 1980. If not each of them but for 2-3 of them (sometimes for all of them) data were available from 16 countries.

The distribution by the number of children constructed this way[1/] also shows the significant differences in the family-building of the female cohorts of developed countries up to now as well as the changes which have taken place in the number of those with big families because of the decline in the fertility level.

With regard to the distribution by the number of children of last completed female cohorts born in 1930-1934 and,if these

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1/ See Table 15.

data are missing, in 1920-1924 also the differences in the äaoportions of childless females and, respectively, of females with fourand more children are the most noteworthy. There are counteies where the proportion of childless females - especially if the data refer to married females are practically approaching already the level of infertility (Bulgaria, Czechoslovakia, Hungary and Japan but similar data - referring to all females, i.e. including also the never married - were found in the GDR, in Yugoslavia and in the USA). But for example in Switzerland this proportion is 20 per cent, in spite of the fact that the Swiss data refer to "ever-married" females. As far as the proportion of females with big families is concerned in the case of the last comparable female cohorts it varies between 8 and 9 per cent (Hungary, Bulgaria) and between 25 and 37 per cent (Poland, Portugal, Spain, USA, Japan).

Besides, it is noteworthy that the differences in extreme values are reflected also by the general widespreadness of the two-child ideal. The proportions of those with two children are 55 per cent and Bulgaria and 42 per cent respectively, in Czechoslovakia and in Hungary in the case of the last observable cohorts but only 21-24 per cent in Belgium, in France (it is true that here the data of the 1910-14 cohort are available), in Poland, in the USA and in Japan.

Essentially the same results are shown by the data of the ultimate number of expected children of different fertility studies.[1/] By themselves they cannot be compared with the former picture, not only because of the sampling but also

1/ See Table 12.

because these data refer to married females and as "expectations" they hardly contain any desires to have "0" child. Thus the basic differences may be shown with regard to expecting two and, respectively, four and more children. Consequently, the two groups of countries may be constructed also with the help of these data too:

1/ Countries with a heterogeneous distribution where expectations to have two children are relatively fewer but there are more expectations to have four or more children. To this group belong France (where only 41 per cent expected to have two children but 15 per cent expected to have four and more children), Finland (45 and 14 per cent, respectively), the USA (43 and 18 per cent, respectively) and Belgium (Flemish) (43 and 13 per cent, respectively),

2/ Countries belonging to the homogeneous group where expectations to have two children are very nemerous but the proportion of those planning big families is low. To this group belong unequivocally Hungary (with 64 and 4 per cent, respectively), Czechoslovakia (with 55 and 9 per cent, respectively), Poland (with 50 and 13 per cent, respectively) and the UK (with 50 and 13 per cent, respectively).

If these great differences are considered fertility models for the future showing the distribution of certain average size families by the hypothetical number of children can be constructed.[1/] Naturally, numberless such distributions can be imagined even at a given average number of children and so the calculated and presented models are only of illustrative value and show the completed fertility distributions which can be imagined as theh most frequent and still perceived as realistic.

1/ See Table 14.

Taken at random at the present rather frequent average fertility of 1,8 it is possible to have a distribution where the proportion of the childless is 10 per cent but also one where the respective proportion is 20 per cent and the proportion of those with three and more children may vary from 15 to 25 per cent. At the value of 1,3 regarded as the lowest the two extreme distributions vary between 25 and 35 per cent and 5 and 10 per cent, respectively. But in this latter case it is still possible (though not practiced) to imagine a proportion of 45 per cent of the childless if that of those with three and more children remains at the level of 20 per cent. All this only underlines that the fertility rates figuring in the population projections may materialize in many kinds of distributions of the number of children and also show a possibility that the expected fertility averages which are thought to be the lowest may materialize in the future by a distribution of the number of children which seems to be realistic.

1. TOTAL FERTILITY RATE AS ASSESSED IN 1988 IN MORE DEVELOPED COUNTRIES

Country	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985		1985-1990	1990-1995	1995-2000	2000-2005	2010-2015	2020-2025
Eastern Europe														
								H	1,95	1,95	2,00	2,10	2,20	2,20
Bulgaria	2,50	2,28	2,19	2,16	2,17	2,25	2,01	M	1,90	1,80	1,80	1,85	1,90	1,90
								L	1,80	1,70	1,65	1,60	1,60	1,60
								H	2,05	2,10	2,15	2,20	2,20	2,20
Czechoslovakia	2,89	2,58	2,40	2,08	2,34	2,36	2,09	M	2,00	1,95	1,90	1,90	1,90	1,90
								L	1,95	1,80	1,70	1,65	1,60	1,60
								H	1,75	1,80	1,90	2,00	2,10	2,10
German DR	2,37	2,25	2,45	2,29	1,71	1,81	1,83	M	1,70	1,65	1,70	1,75	1,80	1,80
								L	1,60	1,50	1,50	1,50	1,50	1,50
								H	1,83	1,95	2,05	2,10	2,10	2,10
Hungary	2,72	2,21	1,82	1,97	2,08	2,11	1,80	M	1,75	1,75	1,80	1,80	1,80	1,80
								L	1,70	1,60	1,55	1,50	1,50	1,50
								H	2,25	2,25	2,25	2,30	2,30	2,30
Poland	3,62	3,29	2,65	2,27	2,25	2,26	2,33	M	2,20	2,10	2,05	2,05	2,05	2,05
								L	2,10	1,95	1,85	1,80	1,80	1,80
								H	2,25	2,10	2,05	2,05	2,15	2,20
Romania	2,87	2,62	2,01	3,06	2,63	2,55	2,22	M	2,15	2,00	1,90	1,85	1,90	1,90
								L	2,10	1,90	1,75	1,65	1,60	1,60
								H	2,09	2,08	2,11	2,16	2,20	2,22
Total	2,95	2,67	2,33	2,37	2,23	2,25	2,13	M	2,02	1,94	1,91	1,91	1,93	1,94
								L	1,94	1,80	1,72	1,67	1,65	1,65

Country	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980 1985		1985-1990	1990-1995	1995-2000	2000-2005	2010-2015	2020-2025
Northern Europe														
								H	1,48	1,60	1,70	1,80	2,00	2,10
Denmark	2,53	2,53	2,58	2,24	1,96	1,70	1,42	M	1,45	1,50	1,55	1,60	1,70	1,70
								L	1,40	1,40	1,40	1,40	1,40	1,40
								H	1,73	1,80	1,90	2,00	2,10	2,10
Finland	2,98	2,78	2,58	2,06	1,62	1,64	1,69	M	1,65	1,65	1,70	1,73	1,78	1,80
								L	1,60	1,55	1,50	1,50	1,50	1,50
								H	2,60	2,50	2,40	2,35	2,30	2,30
Ireland	3,37	3,67	3,96	3,86	3,80	3,46	2,87	M	2,50	2,35	2,20	2,10	2,05	2,05
								L	2,40	2,20	2,00	1,85	1,80	1,80
								H	1,73	1,85	1,95	2,05	2,10	2,10
Norway	2,60	2,84	2,90	2,72	2,25	1,81	1,69	M	1,69	1,69	1,73	1,75	1,80	1,80
								L	1,65	1,60	1,55	1,50	1,50	1,50
								H	1,70	1,80	1,90	2,00	2,10	2,10
Sweden	2,21	2,23	2,33	2,12	1,89	1,65	1,66	M	1,65	1,65	1,70	1,73	1,78	1,80
								L	1,60	1,55	1,50	1,50	1,50	1,50
								H	1,83	1,90	2,00	2,05	2,15	2,20
UK	2,18	2,50	2,82	2,52	2,04	1,72	1,80	M	1,80	1,80	1,82	1,85	1,90	1,90
								L	1,75	1,70	1,65	1,60	1,50	1,50
								H	1,82	1,89	1,98	2,04	2,14	2,18
Total	2,32	2,55	2,78	2,49	2,07	1,78	1,79	M	1,78	1,78	1,80	1,82	1,87	1,88
								L	1,73	1,68	1,62	1,58	1,51	1,51

Country	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985		1985-1990	1990-1995	1995-2000	2000-2005	2010-2015	2020 2025
<u>Southern Europe</u>														
								H	3,15	3,00	2,85	2,70	2,50	2,40
Albania	5,60	5,98	5,76	5,11	4,66	4,20	3,40	M	3,00	2,70	2,55	2,40	2,25	2,20
								L	2,80	2,40	2,25	2,15	2,00	2,00
								H	1,75	1,75	1,80	1,80	2,10	2,20
Greece	2,29	2,27	2,20	2,39	2,32	2,32	1,97	M	1,70	1,65	1,70	1,75	1,85	1,90
								L	1,65	1,60	1,60	1,60	1,60	1,60
								H	1,50	1,60	1,70	1,80	2,00	2,10
Italy	2,32	2,35	2,55	2,49	2,27	1,92	1,55	M	1,45	1,50	1,55	1,60	1,70	1,70
								L	1,40	1,40	1,40	1,40	1,40	1,40
								H	1,80	1,80	1,90	2,00	2,15	2,20
Portugal	3,05	3,04	3,09	2,86	2,76	2,42	1,99	M	1,75	1,70	1,75	1,80	1,90	1,90
								L	1,65	1,60	1,60	1,60	1,60	1,60
								H	1,75	1,75	1,85	1,95	2,15	2,20
Spain	2,57	2,75	2,89	2,93	2,89	2,63	1,83	M	1,70	1,65	1,70	1,75	1,85	1,90
								L	1,60	1,60	1,60	1,60	1,60	1,60
								H	2,00	1,95	1,95	2,00	2,16	2,20
Yugoslavia	3,69	2,82	2,70	2,49	2,32	2,20	2,08	M	1,95	1,87	1,82	1,82	1,90	1,90
								L	1,90	1,80	1,70	1,65	1,60	1,60
								H	1,72	1,76	1,84	1,92	2,10	2,17
Total	2,69	2,62	2,72	2,66	2,52	2,26	1,81	M	1,67	1,68	1,69	1,73	1,82	1,84
								L	1,60	1,57	1,56	1,55	1,54	1,55

Country	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985		1985-1990	1990-1995	1995-2000	2000-2005	2010-2015	2020-2025
<u>Western Europe</u>														
								H	1,55	1,60	1,70	1,80	2,00	2,10
Austria	2,09	2,52	2,78	2,53	2,01	1,64	1,61	M	1,50	1,50	1,55	1,60	1,70	1,70
								L	1,45	1,40	1,40	1,40	1,40	1,40
								H	1,60	1,75	1,95	2,05	2,10	2,10
Belgium	2,34	2,51	2,66	2,34	1,94	1,71	1,59	M	1,55	1,60	1,70	1,75	1,80	1,80
								L	1,50	1,50	1,50	1,50	1,50	1,50
								H	1,88	1,93	2,00	2,05	2,15	2,20
France	2,73	2,71	2,85	2,61	2,31	1,86	1,87	M	1,85	1,84	1,85	1,87	1,90	1,90
								L	1,82	1,75	1,70	1,65	1,55	1,50
								H	1,40	1,50	1,65	1,80	2,00	2,10
German FR	2,08	2,32	2,48	2,33	1,62	1,44	1,36	M	1,38	1,43	1,50	1,60	1,70	1,70
								L	1,36	1,36	1,36	1,36	1,36	1,36
								H	1,48	1,60	1,70	1,80	2,00	2,10
Luxemburg	1,97	2,22	2,38	2,22	1,96	1,54	1,48	M	1,45	1,50	1,55	1,60	1,70	1,70
								L	1,40	1,40	1,40	1,40	1,40	1,40
								H	1,51	1,55	1,65	1,75	1,95	2,10
Netherlands	3,06	3,09	3,12	2,74	1,97	1,58	1,51	M	1,45	1,47	1,50	1,55	1,65	1,70
								L	1,40	1,40	1,40	1,40	1,40	1,40
								H	1,58	1,65	1,70	1,80	2,00	2,10
Switzerland	2,28	2,34	2,51	2,27	1,82	1,52	1,53	M	1,55	1,55	1,57	1,60	1,70	1,70
								L	1,50	1,45	1,40	1,40	1,40	1,40
								H	1,61	1,69	1,80	1,91	2,06	2,14
Total	2,39	2,53	2,68	2,47	1,94	1,63	1,58	M	1,58	1,60	1,65	1,71	1,78	1,79
								L	1,55	1,52	1,50	1,49	1,45	1,44
								H	1,78	1,83	1,91	1,99	2,12	2,18
EUROPE	2,59	2,59	2,63	2,50	2,19	1,98	1,81	M	1,74	1,72	1,75	1,78	1,84	1,86
								L	1,68	1,63	1,59	1,56	1,54	1,54

Country	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985		1985-1990	1990-1995	1995-2000	2000-2005	2010-2015	2020-2025
								H	2,40	2,35	2,35	2,35	2,30	2,30
USSR	2,82	2,81	2,54	2,42	2,44	2,34	2,35	M	2,38	2,30	2,25	2,20	2,10	2,10
								L	2,35	2,25	2,15	2,05	1,90	1,90
								H	1,70	1,80	1,90	2,00	2,15	2,20
Canada	3,70	3,90	3,61	2,51	1,97	1,77	1,66	M	1,65	1,66	1,70	1,75	1,80	1,80
								L	1,60	1,55	1,50	1,45	1,40	1,40
								H	1,88	2,00	2,10	2,20	2,25	2,25
USA	3,45	3,71	3,31	2,55	1,97	1,93	1,82	M	1,83	1,85	1,88	1,90	1,95	1,95
								L	1,77	1,70	1,65	1,60	1,60	1,60
								H	1,95	2,00	2,05	2,10	2,20	2,20
Australia	3,18	3,41	3,28	2,87	2,54	2,09	1,93	M	1,85	1,80	1,82	1,85	1,90	1,90
								L	1,75	1,65	1,60	1,60	1,60	1,60
								H	2,00	2,05	2,10	2,15	2,20	2,20
New Zealand	3,54	3,93	3,79	3,22	2,79	2,20	1,96	M	1,90	1,85	1,87	1,90	1,90	1,90
								L	1,80	1,70	1,65	1,60	1,60	1,60
								H	1,80	1,90	2,00	2,10	2,10	2,10
Japan	2,75	2,08	2,01	2,00	2,07	1,81	1,76	M	1,70	1,80	1,80	1,80	1,80	1,80
								L	1,65	1,60	1,55	1,50	1,50	1,50
								H	1,95	2,00	2,07	2,14	2,20	2,22
More developed total	2,84	2,82	2,69	2,44	2,20	2,08	1,93	M	1,90	1,89	1,90	1,91	1,94	1,94
								L	1,85	1,78	1,73	1,69	1,64	1,65

Source: World Population Prospects: 1988, prepared by Estimates and Projections Section, Population Division, Department of International Economic and Social Affairs, United Nations /under publication/
H = high variant - M = medium variant - L = low variant

2. Total fertility rates, 1980-1987

Country	1980	1981	1982	1983	1984	1985	1986	1987
Eastern Europe								
Bulgaria	2,05	2,01	2,02	2,00	1,99	1,97		
Czechoslovakia	2,16	2,10	2,10	2,08	2,07	2,06		
German Dem.Rep.	1,94	1,86	1,86	1,79	1,74	1,74		
Hungary	1,91	1,88	1,79	1,73	1,73	1,83	1,83	1,81
Poland	2,26	2,22	2,34	2,40	2,37	2,33	2,21	
Romania	2,43	2,37	2,15	2,00	2,19			
Northern Europe								
Denmark	1,55	1,44	1,43	1,38	1,40	1,45	1,48	
Finland	1,63	1,64	1,72	1,74	1,70	1,64	1,65	
Ireland	3,23	3,08	2,96	2,51	2,58	2,49	2,43	
Norway	1,72	1,70	1,71	1,66	1,66	1,68	1,71	
Sweden	1,68	1,63	1,62	1,61	1,66	1,57	1,59	
United Kingdom	1,79	1,81	1,78	1,77	1,77	1,80	1,78	
Southern Europe								
Greece	2,21	2,10	2,03	1,94	1,85	1,68	1,61	
Italy	1,66	1,57	1,57	1,51	1,50	1,41	1,32	1,27
Portugal	2,19	2,14	2,07	1,95	1,87	1,70	1,61	
Spain	2,16	1,99	1,87	1,71	1,65	1,57	1,49	
Yugoslavia	2,13	2,07	2,08	2,12				
Western Europe								
Austria	1,65	1,67	1,66	1,56	1,53	1,48	1,45	1,43
Belgium	1,67	1,67	1,61	1,56	1,52	1,49	1,53	
France	1,95	1,95	1,91	1,79	1,81	1,82	1,84	1,82
German Fed.Rep.	1,45	1,44	1,41	1,33	1,29	1,28	1,35	1,37
Luxemburg	1,49	1,53	1,49	1,45	1,43	1,39	1,44	
Netherlands	1,60	1,56	1,50	1,47	1,49	1,51	1,55	
Switzerland	1,55	1,54	1,55	1,51	1,52	1,51	1,52	
USSR	2,26	2,25	2,29	2,37	2,41			
USA	1,83	1,81	1,83	1,80	1,81			
Canada	1,70	1,67	1,66	1,64	1,65	1,63		
Australia	1,92	1,99	1,94	1,93				
New Zealand				1,94				
Japan	1,74	1,71	1,74	1,77	1,78	1,73		

Source: UN Demographic Yearbboks INED /Projet International D'Analyse Démographique Conjoncturelle/

3. TOTAL FERTILITY RATE IN EUROPE AND IN MORE DEVELOPED REGIONS

/UN projections - different variants - as assessed in 1982, 1984, 1988/

Region, variant, year of projection	Total fertility rate 1980-1985	1985-1990	1990-1995	1995-2000	2000-2005	2010-2015	2020-2025	In the % of 1982 proj. 2000-2005	2020-2025
EUROPE									
High variant									
1982	2,04	2,05	2,12	2,20	2,24	2,30	2,34	100	100
1984	1,88	2,04	2,12	2,20	2,24	2,30	2,34	100	100
1988	1,81	1,78	1,83	1,91	1,99	2,12	2,18	89	93
Medium variant									
1982	1,90	1,86	1,85	1,87	1,89	1,98	2,08	100	100
1984	1,88	1,83	1,84	1,85	1,87	1,94	2,05	99	99
1988	1,81	1,74	1,72	1,75	1,78	1,84	1,86	94	89
Low variant									
1982	1,81	1,68	1,65	1,65	1,68	1,75	1,83	100	100
1984	1,87	1,68	1,64	1,64	1,66	1,71	1,81	99	99
1988	1,81	1,68	1,63	1,58	1,56	1,54	1,54	93	85
MORE DEVELOPED REGIONS									
High variant									
1982	2,09	2,14	2,20	2,26	2,28	2,32	2,34	100	100
1984	2,00	2,11	2,17	2,22	2,27	2,30	2,30	100	98
1988	1,93	1,95	2,00	2,07	2,14	2,20	2,22	94	95
Medium variant									
1982	1,98	1,97	2,00	2,03	2,04	2,08	2,13	100	100
1984	1,97	1,97	2,00	2,04	2,04	2,07	2,12	100	100
1988	1,93	1,90	1,89	1,90	1,91	1,93	1,94	94	91
Low variant									
1982	1,89	1,81	1,79	1,79	1,81	1,85	1,92	100	100
1984	1,94	1,85	1,82	1,82	1,83	1,86	1,92	101	100
1988	1,93	1,85	1,78	1,73	1,69	1,64	1,65	93	86

4. TOTAL FERTILITY RATE IN MORE DEVELOPED REGIONS

/UN projections - medium variants - as assessed in 1982,1984,1988/

Region, year of projection	Total fertility rate /medium variant/ 1980-1985	1985-1990	1990-1995	1995-2000	2000-2005	2010-2015	2020-2025	In the % of 1982.proj. 2000-2005	2020-2025
Eastern Europe									
1982	2,17	2,15	2,09	2,07	2,06	2,09	2,14	100	100
1984	2,18	2,14	2,10	2,09	2,07	2,07	2,12	100	99
1988	2,13	2,02	1,94	1,91	1,91	1,93	1,94	93	91
Northern Europe									
1982	1,78	1,75	1,75	1,76	1,81	1,92	2,03	100	100
1984	1,86	1,75	1,75	1,78	1,81	1,92	2,03	100	100
1988	1,79	1,78	1,78	1,80	1,82	1,87	1,88	101	93
Southern Europe									
1982	2,12	2,04	1,99	1,97	1,99	2,02	2,04	100	100
1984	1,93	1,84	1,93	1,93	1,93	1,97	2,03	97	100
1988	1,81	1,67	1,68	1,68	1,73	1,82	1,84	87	90
Western Europe									
1982	1,58	1,57	1,64	1,65	1,71	1,87	2,05	100	100
1984	1,63	1,58	1,60	1,66	1,68	1,83	2,00	98	98
1988	1,58	1,58	1,60	1,65	1,71	1,78	1,79	100	89
Europe total									
1982	1,90	1,86	1,85	1,87	1,89	1,98	2,08	100	100
1984	1,88	1,83	1,84	1,85	1,87	1,94	2,05	99	99
1988	1,81	1,74	1,72	1,75	1,70	1,84	1,86	94	87
USSR									
1982	2,36	2,36	2,34	2,34	2,29	2,25	2,25	100	100
1984	2,35	2,37	2,33	2,29	2,29	2,27	2,25	100	100
1988	2,35	2,38	2,30	2,25	2,20	2,10	2,10	96	93
Northern America									
1982	1,85	1,90	2,01	2,07	2,08	2,09	2,10	100	100
1984	1,83	1,89	2,01	2,07	2,08	2,09	2,10	100	100
1988	1,80	1,81	1,83	1,86	1,88	1,94	1,94	90	92
Australia + New Zealand									
1982	1,97	1,92	1,94	2,00	2,06	2,14	2,16	100	100
1984	1,95	1,90	1,89	1,89	1,89	1,89	1,89	92	88
1988	1,94	1,88	1,81	1,83	1,88	1,90	1,90	91	88
Japan									
1982	1,71	1,71	1,77	1,83	1,86	2,01	2,07	100	100
1984	1,79	1,83	1,87	1,92	1,98	2,07	2,09	106	101
1988	1,76	1,70	1,80	1,80	1,80	1,80	1,80	97	87
Mo' developed total									
J82	1,98	1,97	2,00	2,06	2,04	2,08	2,13	100	100
1984	1,97	1,97	2,00	2,02	2,04	2,07	2,12	100	100
1988	1,93	1,90	1,89	1,90	1,91	1,93	1,94	94	91

5. TOTAL FERTILITY RATE IN DIFFERENT PROJECTIONS

Country		1985-1987	2000-05 High	Medium	Low	Declining	WB	2020-25 High	Medium	Low	Declining
Austria	Nat	1,4	1,9	1,6	1,3	1,3		1,9	1,6	1,3	1,3
	UN	1,5	1,8	1,6	1,4		1,7	2,1	1,7	1,4	
Australia	Nat	1,9	2,1	2,0	1,9	1,5		2,1	2,0	1,9	1,4
	UN	1,9	2,1	1,9	1,6		2,1	2,2	1,9	1,6	
Belgium	Nat	1,5		2,0		1,4			2,1		1,3
	UN	1,6	2,1	1,8	1,5		1,7	2,1	1,8	1,5	
Canada	Nat	1,6		1,7		1,4			1,7		1,3
	UN	1,7	2,0	1,8	1,5		1,8	2,2	1,8	1,4	
Czechoslovakia	Nat	2,1	2,1	2,0	1,9	1,9			1,8		1,6
	UN	2,0	2,2	1,9	1,7		2,0	2,2	1,9	1,6	
Denmark	Nat	1,5		1,7		1,4			1,7		1,3
	UN	1,5	1,8	1,6	1,4		1,6	2,1	1,7	1,4	
Finnland	Nat	1,7		1,7		1,4			1,7		1,3
	UN	1,7	2,0	1,7	1,5		1,8	2,1	1,8	1,5	
France	Nat	1,8	2,4	2,1	1,5	1,4		2,4	2,1	1,5	1,4
	UN	1,9	2,1	1,9	1,7		2,1	2,2	1,9	1,5	
German Fed.Rep.	Nat	1,4		1,4		1,3			1,4		1,3
	UN	1,4	1,8	1,6	1,4		1,5	2,1	1,7	1,4	
Greece	Nat	1,6		1,6		1,4			1,6		1,3
	UN	1,7	1,8	1,7	1,6		1,9	2,2	1,9	1,6	
Hungary	Nat	1,8	2,0	1,9	1,8	1,7		2,1	2,0	1,8	1,4
	UN	1,8	2,1	1,8	1,5		1,8	2,1	1,8	1,5	
Ireland	Nat	2,4		2,1		2,1			1,8		1,8
	UN	2,5	2,4	2,1	1,9		2,0	2,3	2,1	1,8	
Italy	Nat	1,3		1,3		1,3			1,3		1,2
	UN	1,5	1,8	1,6	1,4		1,7	2,1	1,7	1,4	
Netherlands	Nat	1,6	1,8	1,6	1,5	1,3		1,9	1,7	1,5	1,2
	UN	1,5	1,8	1,6	1,4		1,7	2,1	1,7	1,4	
Norway	Nat	1,7		1,7		1,4			1,7		1,3
	UN	1,7	2,1	1,8	1,5		1,8	2,1	1,8	1,5	
Poland	Nat	2,2	2,3	2,2	2,0	2,0		2,3	2,2	1,9	1,8
	UN	2,2	2,3	2,1	1,8		2,1	2,3	2,1	1,8	
Portugal	Nat	1,6		1,6		1,4			1,6		1,3
	UN	1,8	2,0	1,8	1,6		1,9	2,2	1,9	1,6	
Spain	Nat	1,5		1,7		1,3			1,7		1,2
	UN	1,7	2,0	1,8	1,6		2,1	2,2	1,9	1,6	
Sweden	Nat	1,6	1,9	1,8	1,7	1,3		1,9	1,8	1,7	1,2
	UN	1,7	2,0	1,7	1,5		1,8	2,1	1,8	1,5	
Switzerland	Nat	1,5		1,5		1,4			1,7		1,3
	UN	1,6	1,8	1,6	1,4		1,7	2,1	1,7	1,4	
UK	Nat	1,8	2,2	2,0	1,7	1,6		2,2	2,0	1,8	1,4
	UN	1,8	2,1	1,9	1,6		1,8	2,2	1,9	1,5	
USA	Nat	1,8		2,0		1,5			2,0		1,4
	UN	1,8	2,2	1,9	1,6		1,9	2,3	2,0	1,6	

Nat = National projections published in 1986 or 1987 or 988 - UN = United Nations projection assessed in 1988 - WP = World Development Report 1987

6. TOTAL FERTILITY RATE IN MORE DEVELOPED COUNTRIES /medium variants of different projections/

Country	1985-87 UN	Nat.	WB	Dec	2000-05 UN	Nat.	WB	Dec	2020-25 UN	Nat.	Dec.
Eastern Europe											
Bulgaria	1,9	2,0	2,0	2,2	1,9	.	2,0	2,0	1,9	.	1,7
Czechoslovakia	2,0	2,1	2,1	2,1	1,9	2,0	2,0	1,9	1,9	1,8	1,6
GDR	1,7	2,1	1,8	1,8	1,8	.	1,9	1,7	1,8	.	1,4
Hungary	1,8	1,8	1,7	1,8	1,8	1,9	1,8	1,7	1,8	2,0	1,4
Poland	2,2	2,2	2,3	2,3	2,1	2,2	2,1	2,0	2,1	2,2	1,8
Romania	2,2	2,2	2,1	2,3	1,9	.	2,0	2,0	1,9	.	1,8
Total	2,0	2,1	2,1	2,3	1,9	2,1	2,0	1,8	1,9	2,1	1,6
Northern Europe											
Denmark	1,5	1,5	1,4	1,4	1,6	1,7	1,6	1,4	1,7	1,7	1,3
Finland	1,7	1,7	1,7	1,7	1,7	1,7	1,8	1,4	1,8	1,7	1,3
Ireland	2,5	2,4	2,6	2,5	2,1	2,1	2,0	2,1	2,1	1,8	1,8
Norway	1,7	1,7	1,7	1,7	1,8	1,7	1,8	1,4	1,8	1,7	1,3
Sweden	1,7	1,6	1,7	1,7	1,7	1,8	1,8	1,3	1,8	1,8	1,2
UK	1,8	1,8	1,8	1,9	1,9	2,0	1,8	1,6	1,9	2,0	1,4
Total	1,8	1,8	1,8	1,9	1,8	1,9	1,7	1,6	1,9	1,9	1,4
Southern Europe											
Albania	3,6	3,2	3,4	3,0	2,4	.	2,4	2,4	2,2	.	2,2
Greece	1,7	1,6	2,0	1,6	1,7	1,6	1,9	1,4	1,9	1,6	1,3
Italy	1,5	1,3	1,5	1,4	1,6	1,3	1,7	1,3	1,7	1,3	1,2
Portugal	1,8	1,6	2,0	1,7	1,8	1,6	1,9	1,4	1,9	1,6	1,3
Spain	1,7	1,5	2,0	1,6	1,8	1,7	2,1	1,3	1,9	1,7	1,2
Yugoslavia	2,0	2,1	2,1	2,1	1,8	.	2,1	1,8	1,9	.	1,5
Total	1,7	1,6	1,9	1,9	1,7	1,5	1,9	1,7	1,8	1,6	1,5
Western Europe											
Austria	1,5	1,4	2,1	1,5	1,6	1,6	1,7	1,3	1,7	1,6	1,3
Belgium	1,6	1,5	1,6	1,6	1,8	2,0	1,7	1,4	1,8	2,1	1,3
France	1,9	1,8	2,0	1,9	1,9	2,1	2,1	1,4	1,9	2,1	1,4
German Fed.Rep.	1,4	1,4	1,3	1,4	1,6	1,4	1,5	1,3	1,7	1,4	1,3
Netherlands	1,5	1,6	1,5	1,6	1,6	1,6	1,7	1,3	1,7	1,7	1,2
Switzerland	1,6	1,5	1,5	1,5	1,6	1,5	1,7	1,4	1,7	1,7	1,3
Total	1,6	1,6	1,9	1,8	1,6	1,7	1,8	1,4	1,7	1,7	1,3
Europe total	1,7	1,7	1,9	1,9	1,8	1,8	1,9	1,6	1,9	1,8	1,5
SSR	2,4	2,4	2,3	2,3	2,2	.			2,1	.	
Canada	1,7	1,6	1,7	1,7	1,8	1,7	1,8	1,4	1,8	1,7	1,3
USA	1,8	1,8	1,8	1,8	1,9	2,0	1,9	1,5	2,0	2,0	1,4
Australia	1,9	1,9	2,0	2,0	1,9	2,0	2,1	1,5	1,9	2,0	1,4
New Zealand	1,9	1,9	2,1	2,0	1,9	.	1,9	1,5	1,9	.	1,4
Japan	1,7	1,7	1,8	1,8	1,8	.	1,9	1,5	1,8	.	1,4
More developed total	1,9	1,8	2,0	2,0	1,9	1,9	2,0	1,7	1,9	1,9	1,6

Nar = National projections published in 1986 or 1987 or 988 - UN = United Nations projection assessed in 1988 - WP = World Development Report 1987

7. INDICES OF TOTAL FERTILITY RATES

Country	1985-87 / 1960-65	2000-05 in the percentage of 1985-87 UN	2000-05 in the percentage of 1985-87 Nat.	2020-25 / 2000-05 UN	2020-25 / 2000-05 Nat.
		medium projections			
Eastern Europe					
Bulgaria	90	97	.	103	.
Czechoslovakia	86	95	95	100	92
GDR	71	103	.	103	.
Hungary	99	103	104	100	104
Poland	83	93	97	100	100
Romania	109	86	.	88	.
Total	87	95	.	101	.
Northern Europe					
Denmark	57	110	115	106	100
Finland	64	105	100	104	100
Ireland	61	84	86	98	83
Norway	59	104	97	103	100
Sweden	68	105	114	104	100
UK	63	103	112	103	100
Total	64	102	.	103	.
Southern Europe					
Albania	52	80	.	92	.
Greece	73	103	100	109	100
Italy	50	110	104	106	100
Portugal	52	103	100	106	100
Spain	52	103	116	109	100
Yugoslavia	72	93	.	104	.
Total	61	104	.	106	.
Western Europe					
Austria	51	107	109	106	100
Belgium	58	113	121	103	108
France	64	101	115	102	100
German Fed.Rep.	55	116	102	106	100
Luxemburg	61	110	127	106	104
Netherlands	50	107	106	110	100
Switzerland	61	103	100	106	113
Total	59	108	.	105	.
Europe total	66	102	.	105	.
USSR	95	92	.	95	.
USA	55	104	110	100	100
Canada	45	106	102	103	100
Australia	58	100	107	103	100
New Zealand	50	100	.	100	.
Japan	83	104	.	100	.
More developed regions total	70	100	.	101	.

8. Group of countries in the change of /calendar/ total fertility rates

	Indices between the periods of 1985-87: 1960-64	2020-25: 1985-87	2020-25: 1960-64
1. Sharp decrease before 1985-87; high increase predicted until 2020-25:			
1. Italy	50	110	54
2. Netherlands	50	110	54
3. Austria	51	119	61
4. Spain	52	128	66
5. Portugalia	52	119	61
6. GFR	55	124	69
7. Denmark	57	115	66
8. Belgium	58	118	68
9. Luxemburg	61	118	71
10. Switzerland	61	112	68
11. Sweden	68	113	77
12. Greece	73	118	86
2. Sharp or moderate decrease before 1985-87; stagnation or low increase			
1. Canada	45	108	50
2. New-Zealand	50	97	50
3. USA	55	107	59
4. Australia	58	98	58
5. Norway	59	105	62
6. UK	63	107	67
7. France	64	104	67
8. Finland	64	109	70
9. GDR	71	103	73
3. Stagnation /or low decreases/ during the period before and after 1985-87			
1. Romania	109	87	95
2. Hungary	99	99	99
3. USSR	95	89	83
4. Bulgaria	90	96	87
5. Japan	88	102	90
6. Czechoslovakia	86	92	79
7. Poland	83	83	77
4. 4. Sharp decrease during the period before and after 1985-87			
1. Albania	52	65	38
2. Ireland	61	84	52
3. Yugoslavia	72	90	70

9. TOTAL FERTILITY RATE IN MORE DEVELOPED COUNTRIES IN DESCENDING ORDER, 1960-2025

TFR	1960-64	1970-74	1985-87	2000-05	2020-25
5,7	1. Albania				
4,6		1. Albania			
3,9		2. Ireland			
3,6	2. Canada		1. Albania		
3,5	3. Ireland				
3,3	4. USA				
3,1	5. Australia				
	6. New Zealand				
	7. Netherlands				
	8. Portugal				
-,9	9. Norway				
	10. France				
	11. UK				
2,8		3. Portugal			
2,7	12. Austria				
	13. Yugoslavia				
	14. Poland				
2,6	15. Denmark	4. Romania			
	16. Finland	5. Australia			
	17. Belgium				
	18. Italy				
2,5	19. USSR				
	20. Spain	6. Spain			
	21. Switzerland				
	22. GFR				
	23. GDR				
2,4	24. Czechoslovakia	7. USSR	2. USSR	1. Albania	
	25. Luxemburg		3. Ireland		
2,3	26. Sweden	8. Yugoslavia			
		9. Italy			
		10. Poland			
		11. Norway			
2,2	27. Greece	12. France	4. Romania	2. USSR	1. Albania
		13. New Zealand	5. Poland		
		14. Greece			
		15. Bulgaria			
2,1	28. Bulgaria	16. Hungary	6. Yugoslavia		2. USSR
		17. Czechoslovakia	7. Czechoslovakia	3. Ireland	3. Ireland
	29. Japan	18. Japan		4. Poland	4. Poland
		19. UK			
2,0	30. Romania	20. USA	8. Bulgaria		5. USA
		21. Austria			
		22. Netherlands			
		23. Canada			
		24. Luxemburg			
		25. Belgium			
		26. Denmark			
1,9		27. Sweden	9. Australia	5. Australia	6. Australia
			10. New Zealand	6. New Zealand	7. New Zealand
			11. USA	7. USA	8. Greece
				8. Czechoslovakia	9. Czechoslovakia
				9. France	10. France
				10. Bulgaria	11. Bulgaria
				11. UK	12. UK
				12. Romania	13. Romania
					14. Portugal
					15. Spain
					16. Yugoslavia
1,8	31. Hungary		12. Hungary	13. Hungary	17. Hungary
		28. Switzerland	13. Japan	14. Japan	18. Japan
			14. France	15. GDR	19. GDR
			15. UK	16. Norway	20. Norway
				17. Belgium	21. Belgium
				18. Canada	22. Canada
				19. Yugoslavia	23. Finland
				20. Portugal	24. Sweden
				21. Greece	
				22. Spain	
1,7		29. GDR	16. GDR	23. Sweden	25. Denmark
			17. Finland	24. Finland	26. Italy
			18. Norway		27. Austria
			19. Canada		28. GFR
					29. Luxemburg
					30. Netherland
					31. Switzerland
1,6		30. GFR		25. GFR	
		31. Finland	20. Sweden	26. Denmark	
			21. Netherlands	27. Netherlands	
			22. Greece	28. Italy	
			23. Portugal	29. Austria	
				30. Luxemburg	
				31. Switzerland	
1,5			24. Switzerland		
			25. Belgium		
			26. Spain		
			27. Denmark		
1,4			28. Luxemburg		
			29. Austria		
			30. GFR		
1,3			31. Italy		

10. COMPLETED COHORT FERTILITY IN SOME EUROPEAN COUNTRIES

Country	1900	1910	1920	1930	1940	1950	1955	1960	1930 birth 1900	1955 cohort 1930	1955 in % of 1900
	Mothers birth cohort / Children born per women										
Austria	.	.	.	2,32	2,14	1,87	1,75	.	.	75	.
Belgium	2,10	2,05	2,13	2,27	2,12	1,79	1,69	.	108	74	80
Bulgaria	.	.	.	2,07	2,06	2,09	2,02	.	.	98	.
Czechoslovakia	3,02	3,04	2,85	2,36	2,22	2,16	2,12	2,09	78	90	70
Denmark	2,20	2,24	2,36	2,39	2,21	1,89	1,76	1,68	109	74	80
Finland	3,16	3,18	2,98	2,45	2,05	1,78	1,69	1,65	78	69	53
France	2,12	2,27	2,51	2,64	2,41	2,09	2,05	2,01	125	78	97
German Dem.Rep.	2,41	2,40	2,34	2,19	1,98	1,79	1,83	1,85	91	84	76
German Fed.Rep.	2,12	2,06	2,05	2,14	1,97	1,68	1,54	.	101	72	73
Greece	.	3,50	2,60	2,21	2,07	1,99	1,93	.	.	87	.
Hungary	2,66	2,36	2,22	2,03	1,88	1,92	1,88	1,88	76	93	71
Ireland	3,26	3,31	3,47	3,51	3,25	3,04	2,65	2,30	108	75	81
Italy	3,14	2,74	2,36	2,30	2,15	1,88	1,70	.	73	74	54
Netherlands	2,86	2,84	2,91	2,69	2,21	1,89	1,83	1,76	94	68	64
Norway	2,07	2,04	2,22	2,49	2,45	2,07	1,94	.	120	78	94
Poland	.	.	.	2,81	2,39	2,25	2,25	.	.	80	.
Portugal	3,52	3,23	3,00	2,87	2,53	2,00	1,94	.	82	68	55
Romania	.	.	.	2,29	2,44	2,43	2,32	.	.	101	.
Spain	3,28	2,89	2,56	2,59	2,59	2,25	1,98	.	79	76	60
Sweden	1,88	1,88	2,04	2,11	2,05	1,96	1,90	.	112	90	101
Switzerland	1,99	2,03	2,21	2,18	2,09	1,77	1,65	.	110	76	83
UK: England and W.	1,96	1,82	2,03	2,35	2,36	2,04	1,95	1,93	120	83	99
Yugoslavia	.	.	.	2,63	2,35	2,15	2,08	.	.	79	.

Source: UN Demographic Yearbooks INED /Projet International D'Analyse Démographique Conjoncturelle/

11. Group of countries in the change of cohort fertility

1. Increase between 1900 and 1930 birth cohort, decrease between 1930 and 1955

	1900-1930 increase	1930-1955 decrease	total change
1. France	125	78	97
2. Norway	120	78	94
3. England	120	83	99
4. Sweden	112	90	101
5. Switzerland	110	76	83
6. Denmark	109	74	80
7. Belgium	108	74	80
8. Ireland	108	75	81
probably:			
9. Austria	.	75	
2. Stable between 1900 and 1930 birth cohort, decrease after:			
1. GFR	101	72	73
2. GDR	91	84	76
3. Netherlands	94	68	64
3. Continous decrease:			
1. Finland	78	69	53
2. Italy	73	74	54
3. Portugal	82	68	55
4. Spain	79	76	60
5. Greece	63	87	55
probably:			
6. Yugoslavia	.	79	.
7. Poland	.	80	
4. Decreases between 1900 and 1930, stabilization after:			
1. Czechoslovakia	78	90	70
2. Hungary	76	93	71
probably:			
3. Bulgaria	.	98	.
4. Romania	.	101	.

12. Ultimate expected number of children /based on family planning surveys/

Country	Year of survey	Percentage distribution of married women by ultimate expected number of children: 0	1	2	3	4	5+	Average ultimate expected number of children	Average number of live birth /standardized/
Belgium	1966	4	20	33	21	13	8	2,50	2,10
	1975	4	19	43	21	9	4	2,25	1,79
Czecho-slovakia	1970	1	9	58	23	5	4	2,37	1,96
	1977	1	8	55	27	6	3	2,40	1,96
Denmark	1970	3	8	43	31	11	4	2,55	2,04
	1975	3	9	50	26	8	3	2,36	2,00
Finland	1971	3	10	47	23	10	5	2,55	2,04
	1977	3	10	45	28	10	4	2,46	1,86
France	1971	3	14	40	25	11	7	2,55	2,12
	1977	3	13	41	28	8	7	2,54	2,01
Hungary	1966	2	20	53	16	5	3	2,14	1,68
	1977	2	15	64	15	3	1	2,08	1,64
Netherlands	1975	.	.	.	.	.	.	.	1,51
Poland	1972	1	9	43	27	11	8	2,71	2,21
	1977	1	10	50	26	8	5	2,50	2,07
UK	1967	8	19	41	18	8	5	2,21	1,81
	1976	4	12	50	21	9	4	2,31	1,83
USA	1970	4	7	35	26	16	13	2,95	2,32
	1976	4	10	43	25	10	8	2,60	2,08
Yugo-slavia	1970	.							2,13
	1976	.							2,17

Fertility Behaviour in the Context of Development United Nations, New York, 1987, 362-363 p.

13. TOTAL FERTILITY RATE BY LIVE-BIRTH ORDER

Country, year	TFR	From this by live-birth order				Distribution of live-birth (%)				Distribution of final fertility (%)				
		1	2	3	4+	1	2	3	4+	0	1	2	3	4+
Bulgaria														
1955	2261	840	405	307	409	37	32	14	18	16	14	40	14	17
1960	2104	854	765	228	257	41	36	11	12	15	9	54	12	11
1970	2178	966	810	256	146	44	37	12	7	3	16	55	19	7
1980	2055	992	772	186	105	48	38	9	5	1	22	59	13	6
1985	1976	917	775	183	101	46	39	9	5	8	14	59	13	5
Czechoslovakia														
1960	2268	841	726	344	357	37	32	15	16	16	12	38	19	15
1970	2072	900	705	258	209	43	34	13	10	10	20	45	16	10
1980	2153	906	809	299	139	42	38	14	6	9	10	51	22	8
1984	2071	927	750	270	124	45	36	13	6	7	18	48	19	8
Denmark														
1950	2471	761	747	451	512	31	30	18	21	25		30	21	24
1960	2437	741	760	480	456	30	31	20	19	24		28	24	24
1970	1967	786	700	311	170	40	36	16	8	21	9	39	20	11
1980	1542	711	571	194	66	46	37	13	4	29	14	38	15	5
1985	1439	670	528	184	57	47	37	13	4	33	14	40	14	4
Finland														
1950	3087	905	802	555	825	29	26	18	27	10	10	25	23	32
1960	2649	879	700	430	640	33	26	16	24	12	18	27	18	25
1970	1827	856	538	234	199	47	29	13	11	14	32	30	13	10
1980	1633	771	572	196	94	47	35	12	6	23	20	38	14	5
1985	1640	659	586	268	127	40	36	16	8	34	7	32	19	8
German DR.														
1955	2209	807	686	364	352	37	31	17	16	19	12	32	19	17
1960	2209	803	632	367	407	36	29	17	18	20	17	27	18	19
1970	2170	971	661	300	238	45	31	14	11	3	31	36	17	13
1980	1945	101	708	157	63	52	36	8	4	29		55	11	5
1985	1757	840	647	194	76	48	37	11	4	16	19	45	15	5
Greece														
1956	2290	855	642	334	455	37	28	15	20	14	22	31	15	18
1960	2115	859	668	300	288	41	32	14	14	14	19	37	17	13
1971	2322	970	897	303	152	42	39	13	7	3	7	59	22	9
1980	2225	987	836	288	115	44	38	13	5	1	15	55	21	8
1984	1825	711	698	224	92	44	38	12	5	19	11	47	17	6
Hungary														
1955	2676	929	800	417	530	35	30	16	20	7	13	38	20	22
1960	1885	780	575	252	278	41	31	13	15	22	21	32	14	11
1970	1963	936	677	181	169	48	35	9	9	6	26	50	11	7
1980	1925	908	724	190	103	47	38	10	5	9	13	53	14	5
1985	1832	857	676	198	101	44	38	12	5	14	18	48	14	6
Ireland														
1961	3764	777	689	618	1189	21	18	16	45	22	9	7	13	49
1970	3858	950	799	652	1457	25	21	17	38	5	15	15	17	48
1980	3228	854	754	630	990	27	23	20	31	15	10	12	21	42
1983	2705	720	667	522	796	27	25	19	29	28	5	15	16	36
Italy														
1981	1540	713	546	195	86	46	36	13	6	29	17	35	15	5
Netherlands														
1950	3065	776	741	531	1017	25	24	17	33	26		21	19	35
1960	3073	915	838	520	800	30	27	17	26	9	8	32	22	30
1970	2583	915	868	437	363	35	34	17	14	9	5	43	25	18
1980	1600	678	592	224	106	42	37	14	7	32	9	37	16	6
1985	1511	656	537	212	106	43	36	14	7	34	12	22	15	6
Poland														
1955	3524	977	922	711	914	28	26	20	26	8		21	29	43
1960	2865	892	800	512	661	31	28	18	23	11	9	29	22	30
1970	2232	849	654	337	392	38	29	15	18	15	20	32	16	18
1980	2275	907	774	332	262	40	34	15	12	9	13	44	20	14
1985	2342	907	801	368	266	39	34	16	11	9	11	43	21	16
Portugal														
1951	2814	710	546	428	1130	25	19	15	40	29	16	12	10	33
1960	3092	950	632	427	1083	31	20	14	35	5	32	21	13	30
1970	2881	970	697	376	838	34	24	13	29	3	27	32	13	24
1980	2067	898	654	234	281	43	32	11	14	10	24	42	13	11
1985	1701	764	542	202	193	45	32	12	11	24	22	34	12	9
Romania														
1962	1874	740	548	243	218	40	29	13	18	26	19	31	12	13
1970	2888	.	.	.	.	.	.	.	.	.	.	.	.	.
1980	2452	965	740	343	404	39	30	14	16	4	23	40	14	21
1984	2193	858	697	310	338	39	32	14	15	14	16	39	14	17
Sweden														
1980	1680	715	626	248	89	43	37	15	5	29	9	38	18	6
1985	1735	710	618	294	113	41	36	17	7	29	9	32	21	8
Yugoslavia														
1950	3710	960	888	580	890	26	24	16	35	5	7	31	19	39
1961	2636	832	683	378	743	32	26	14	28	17	15	32	13	24
1970	2290	870	684	284	452	38	30	12	20	13	19	40	13	16
1982	2071	883	728	232	239	42	35	11	12	12	16	50	14	10
Canada														
1950	3337	867	857	580	1033	26	26	17	31	14		28	23	35
1960	3734	888	882	698	1266	24	24	19	34	12		18	24	46
1970	2258	821	623	366	448	36	28	16	20	18	20	26	18	19
1980	1710	748	593	251	118	44	35	15	7	25	16	34	18	7
1985	1627	711	576	237	103	44	35	15	6	29	14	34	17	7
USA														
1950	2823	826	862	509	626	29	31	18	22	14		35	25	26
1960	3404	772	857	703	1072	23	25	21	32	14		15	25	45
1972	2021	750	581	313	377	37	29	16	19	25	17	27	15	17
1980	1839	768	584	284	203	42	32	15	11	23	18	30	17	11
1984	1803	756	590	277	180	42	33	15	10	24	17	31	17	10
Japan														
1950	3604	842	956	610	1196	23	27	17	33	4		35	19	42
1960	1994	858	649	284	203	43	33	14	10	14	21	37	18	11
1970	2068	900	823	280	65	44	40	14	3	10	8	54	23	5
1980	1746	770	694	233	49	44	40	13	3	23	8	46	20	3
1985	1728	745	681	258	44	43	39	15	3	26	6	42	22	4
Australia														
1983	1927	938	567	281	141	49	29	15	7	6	37	29	18	10

Source: UN Demographic Yearbooks

14. COMPLETED FERTILITY MODELLS OF HYPOTETICAL COHORTS

Average number of children	Distribution of women by children /in %/			
	0	1	2	3+
2,00	10	20	50	20
	10	15	50	25
	10	15	50	25
	10	25	40	25
1,90	10	15	60	20
	10	20	50	20
	15	15	55	25
	20	15	40	25
1,80	10	25	50	15
	10	30	40	20
	15	20	45	20
	20	20	35	25
1,70	10	20	60	10
	10	25	55	10
	15	20	50	15
	20	15	45	20
1,60	10	30	50	10
	10	35	40	15
	15	25	45	15
	20	25	35	20
1,50	10	35	50	5
	15	30	45	10
	20	25	45	10
	25	20	40	15
1.40	15	40	40	5
	20	30	45	5
	20	35	35	10
	25	25	40	10
1,30	25	30	40	5
	30	20	45	5
	30	25	35	10
	35	15	40	10
1,20	30	25	40	5
	35	25	30	10
	35	20	40	5
	40	15	35	10

15. Completed cohort fertility by number of children born
(at age 45-49; based on population census data)

Country, birth cohort	Type of data	Average number of children	Percentual distribution of women by number of children born				
			0	1	2	3	4+
1900-04 cohorts							
France	3	2,520	11	28	25	15	21
GFR	3	2,170	21	23	24	14	18
Hungary	3	3,120	15	16	20	15	34
Norway	3	2,281	15	21	27	17	20
Portugal	1	3,164	20	15	16	12	36
Spain	2	3,427	16	10	16	16	42
Switzerland	3	2,300	22	18	23	15	22
Yugoslavia	1	1,160	18	9	11	11	51
USA	2	2,696	15	17	19	15	34
Japan	3	4,764	9	9	8	10	64
1910-14 cohorts							
Albania	1	6,048	.	.	.	.	.
Belgium	2	2,080	16	26	23	14	21
Bulgaria	2	2,636	7	17	35	19	22
Czechoslovakia	1	2,326	15	18	30	18	19
France	3	2,390	15	23	24	16	22
GDR	3	2,020	27	23	25	13	12
GFR	2	1,935	18	26	28	15	13
Hungary	3	2,642	14	20	25	16	25
Ireland	3	3,912	13	.	.	.	.
Norway	3	2,314	14	.	.	.	.
Netherlands	3	3,206	14	.	.	.	.
Poland	2	3,128	9	14	21	20	37
Portugal	2	3,537	12	.	.	.	.
Spain	2	3,062	13	13	21	18	35
Switzerland	3	2,370	20	.	.	.	.
Yugoslavia	1	3,521	14	12	18	13	41
USA	2	2,402	18	19	25	16	22
Japan	3	3,916	8	10	11	15	56
1920-24 cohorts							
Belgium	2	2,187	13	26	24	15	22
Bulgaria	2	2,348	4	19	46	16	15
Czechoslovakia	3	2,353	10	17	35	20	18
GDR	3	1,861	19	26	29	14	12
GFR	2	1,931	16	27	29	15	13
Hungary	3	2,324	10	22	32	18	18
Ireland	3	4,285	.	.	.	.	.
Poland	2	3,125	6	12	24	23	35
Portugal	1	2,913	17	19	20	13	31
Romania	1	2,465	15	21	25	15	24
Spain	2	2,920	10	13	26	20	31
Yugoslavia	1	3,521	14	15	25	17	29
USA	3	2,854	11	14	27	20	28
Japan	3	2,760	8	11	24	28	29

1930-34 cohorts							
Belgium	2	2,440	10	23	28	18	22
Bulgaria	2	2,073	3	24	55	10	8
Czechoslovakia	3	2,245	7	17	42	21	13
GDR	1	2,251	11	23	30	18	18
GFR	2	2,350	10	24	33	18	15
Hungary	3	2,024	7	27	42	15	9
Poland	2	2,930	2	14	35	23	26
Portugal	1	2,712	14	21	26	14	25
Romania	1	2,297	13	23	29	16	19
Spain	2	3,100	7	13	33	23	24
Yugoslavia	1	2,457	12	19	34	15	20
USA	1	3,106	11	9	21	22	37
1940-44 cohorts (estimated from fertility of 35-39 years)							
Bulgaria	2	2,070	3	22	57	11	7
Czechoslovakia	3	2,130	5	17	50	20	8
GDR	1	1,925	8	29	40	15	8
Hungary	3	1,900	10	26	46	12	6
Portugal	1	2,510	12	20	36	16	16
Romania	1	2,450	10	21	33	17	20
Yugoslavia	1	2,430	11	18	44	14	17
USA	1	2,570	13	13	31	23	20

Source: UN Demographic Yearbooks, 1954-4986

Type of data:
1 : All women
2 : Ever-married women (married, widowed, divorced)
3 : Married women

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THE RETURN TO REPLACEMENT FERTILITY: A MAGNETIC FORCE?

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August 15, 1988

When the theory of the demographic transition was first advanced in the 1930s, the final stage envisioned was one in which population had stabilized following the achievement of a very civilized balance of low mortality and low fertility. Sustained periods of below-replacement fertility, leading ultimately to declines in population growth, were not conceived as the next stage. There seemed to be a metaphysical assumption that some homeostatic device would operate to maintain the nice balance; somehow it was unthinkable that women would not bear two children on the average.

A half century later, the latest UN fertility projections for Europe, following the medium trajectory, seem to make the same mystical assumptions (Figure 1). Their projected total fertility rates plateau at 1.8 and then, at the turn of the century, reassuredly begin to rise again to a level of 2.0 by the end of the first quarter of the 21st century. This is the UN's medium variant, which they state "represents the most plausible course of population trends in the future" (UN, World Population Prospects, New York, 1986, p. 1). The projections for Eastern Europe are even more revealing of this evident divine intervention: the decline in fertility is arrested at 2.1 in 1985-90 and remains unchanged thereafter. In Western Europe, a TFR of 1.8 is the lowest level portrayed, with the reversal in the curve heading back toward replacement beginning in 2010-15. Even West Germany, currently with the lowest TFR (1.4), begins to reverse its decline in the next five years and climbs back to near-replacement by 2020-25. The only countries failing to reach replacement by that time are Denmark, Finland, and Sweden, but the projected reversal in direction is clear there as well.

The United States is yet another example of what might be described as the UN's institutional optimism. In the U.S. the TFR, which has languished unchanged at 1.8 for more than a decade, becomes revitalized in the next year or two, and then marches back to replacement in the next ten years and remains at the magnetic pole of 2.1 thereafter.

Indeed, it seems like a compass-like magnetic force that pulls these countries out of their flirtations with population decline and restores demographic equilibrium. (It is noteworthy that none of these projections in the medium series goes above a TFR of 2.1.)

Quite aside from considerations of what motivates the UN's choice of this projection, the projected return to replacement provokes the question of the plausibility of such an assumption. Period measures can be notoriously unreliable guides that should warn us that the recent precipitous declines in annual fertility rates may be deceptive. The fundamental questions relate to the social trends that have been unfolding over a century or longer and their course in the future.

Social Trends and Causes

It would be comforting to look at the future of reproduction with a clear understanding of exactly what caused the past decline of fertility. But the easy generalizations that seemed to serve so well have been made suspect by the findings of the European Fertility Study, which indicated that the declines in fertility in the 19th and 20th centuries followed somewhat different paths in different places. There are no easy generalizations that can be supported unequivocally by empirical evidence. Nevertheless, several social trends have occurred over the past century or so that are difficult to dismiss as irrelevant to the broad sweep of historical decline in levels of reproduction, despite the numerous particular exceptions and our inability to demonstrate their scientific validity.

The decline of fertility in the West has been unfolding for a century or longer; it is not a phenomenon of the mid- or late-twentieth century. This means that its roots are not to be sought in the development of modern contraceptive technology or in the legalization of abortion, however much they may have facilitated the process in recent decades.

Despite our inability to quantify the connections, the following, now familiar, historical social changes labelled "modernization" seem to have played an important role in the third stage of the demographic transition:

- the weakening of the family by the erosion of basic social functions it once performed -- most importantly, the economic and educational functions that were once the internal province of the family;

- the related transformation of a subsistence agrarian economy to an industrial and service economy, featuring a shift from a rural to an urban society, all of which contributed to a reduction in the economic value of children;

- the spread of mass education and the reduction of illiteracy, exposing increasing proportions of people to modern ideas;

- the decline of traditional religious authority and the increasing secularization of values;

- an ethos of rationality and individualism and a decline of fatalism;

- the changing status of women as indexed by increasing employment outside the home and by their growing economic independence;

- the growth of materialism and its modern form, consumerism;

- the weakening of marriage, as indexed by the increase in divorce, cohabitation outside of marriage, and recent evidence of declining proportions ever marrying. This process -- a result of the social changes just enumerated -- has no doubt been accelerated by the increasing economic independence of women, which has loosened one of the primary rationales for marriage (viewing marriage as an exchange of male economic support for women's childbearing, childraising, and domestic services).

The net result of these social changes has been the rationalization of reproduction, a process greatly facilitated by modern contraceptive technology and the availability of legal abortion. The small family norm that emerged diffused with varying time lags out from cities and across social classes, gathering a momentum of its own. Both structural and cultural forces have combined to transform the reproductive institution.

The Future of Reproduction

If one accepts these social changes as fundamental for the decline of fertility, it is instructive to raise the question of whether any of these trends shows signs of reversing direction, or whether there may be other social changes that would suggest a rise in fertility. Of course, many of these changes relate to the 19th century and earlier and have run their course, but some are more recent in origin and are still in process.

There is certainly no expansion of the functions of the family, there is no return to a rural society, mass education is not declining, and religion in the West is not becoming more important. We may or may not have seen the end of rising divorce rates or of the postponement of marriage. Although informal cohabitation can be regarded as a functional substitute for some aspects of marriage, these certainly do not include fertility.

Perhaps the most important social change that has not yet run its course and which seems incompatible with increases in childbearing is the growing economic independence of women. Although the rate of increase of female labor force participation is undoubtedly declining, the equalization of income of men and women still has some distance to go. As men and women become more equal economically, one important rationale for marriage will be further weakened.

In addition, there will undoubtedly be further technological advances in contraception, the most recent of which is the French product RU-486. An analysis of the demographic effects of improvements in contraceptive practice on the fertility rates of several European countries suggests that fertility could fall by as much as an additional ten percent by the prevention of unwanted births alone.

What social changes are occurring or are likely to occur that might reverse the downward slide of fertility? After all, we are not expecting any return to pre-transition levels; most concerned parties would be gratified by some assurance of replacement fertility.

One response has been an accelerating program of government family allowances, many of which aim at reducing the costs of reproduction. These involve a variety of financial incentives for childbearing, housing and credit programs, child care arrangements, maternity leaves, and so on. Although there have been increases in period fertility, especially in some Eastern European countries, that might reasonably be attributed to such government benefits, the conventional wisdom seems to be that the effects are on the timing and not on the ultimate number of births, and that the public soon takes such measures for granted. One can imagine a society in which public revenues are increasingly directed toward facilitating marriage and childbearing, but the best guess is that massive infusions of revenue will be required, with the demographic outcome still uncertain.

Despite the various assaults on the institution of the family, it continues to survive. Divorced persons continue to remarry, and people still usually expect to marry and have children. Behavior does not always correspond with social norms, however; the proportions ever marrying are declining in some countries, and the proportions remaining childless or having only one child are increasing. The behavioral model that seems to be emerging is for young people to delay marriage until their late twenties, for the wife to work, and for childbearing to be postponed with effective contraception and perhaps abortion until the mid-thirties. At that age, the various costs of children have increased, and many will stop at one or back into childlessness. It is not that women expect to remain childless, but rather that as fertility is postponed to later ages, the costs of childbearing increase; later does mean fewer.

Abortion has played an important demographic role in several countries such as Japan and Rumania in earlier decades. It currently plays an important role in the U.S., especially among young women with high rates of unintended pregnancy. The subject of abortion remains as controversial as ever, even though the rhetoric has now become quite predictable on both sides. There is no guarantee that liberal abortion policies will not be reversed in some countries and that some significant number of pregnancies might continue that would otherwise have been interrupted. But unless this happens in a country with little available contraception, the fertility impact is not likely to be great.

Perhaps at the heart of the issue in the middle classes is whether modern couples will grow tired of consumerism and material advancement and invest in children. The answer does not seem positive, but modern society is highly vulnerable to changes in fashion, and having children could "catch on" again.

Conclusion

The bulk of the evidence points to the conclusion that fertility will remain low; indeed, it may even decline further. We began with the question of whether there is some built-in mechanism that magnetically will return below-replacement fertility to the replacement level; the negative answer seems self-evident. How low it will go is a question about which we can only speculate. West Germany has demonstrated that very low levels of period fertility can be realized. Negative rates of natural increase are indeed a reality. The theory of the demographic transition has to be extended to include a fourth stage in which zero growth yields to population decline. Whether this is the final stage is the unanswerable question, since we are now moving into uncharted territory.

Table 1. UN Projections of Total Fertility Rates for Developed Countries.*

	1950 -55	1960 -65	1970 -75	1980 -85	1985 -90	1990 -95	1995 -2000	2000 -05	2010 -15	2020 -25
Developed Countries	2.8	2.7	2.2	2.0	2.0	2.0	2.0	2.0	2.1	2 1
Europe	2.6	2.6	2.2	1.9	1.8	1.8	1.9	1.9	1.9	2.0
Eastern Europe	2.9	2.3	2.2	2.2	2.1	2.1	2.1	2.1	2.1	2.1
Northern Europe	2.3	2.8	2.0	1.9	1.8	1.8	1.8	1.8	1.9	2.0
Southern Europe	2.6	2.7	2.5	1.9	1.9	1.9	1.9	1.9	2.0	2.0
Western Europe	2.4	2.7	1.9	1.6	1.6	1.6	1.6	1.7	1.8	2.0
Australia	3.2	3.3	2.5	2.0	1.9	1.9	1.9	1.9	1.9	1.9
United States	3.5	3.3	2.0	1.8	1.9	2.0	2.1	2.1	2.1	2.1
Canada	3.7	3.6	2.0	1.7	1.8	1.8	1.8	1.9	2.0	2.1

* Source: United Nations, World Demographic Estimates and Projections. 1950-2025. New York, 1988.

Name: Paula Rantakallio, Antero Myhrman and Irma Moilanen
Department of Public Health Science, University of Oulu, Oulu, Finland

Title of Paper:

Liberal abortion law and the wantedness of pregnancies

Summary:

The wantedness of pregnancies has been studied in two birth cohorts in Northern Finland, before and after the introduction of the liberal abortion law of 1971 in order to determine the effect of the law on the number of wanted and unwanted deliveries. The two birth cohorts concerned represent 96% of all births in the region in 1966 (12 068 mothers) and 99% (9 362 mothers) in 1985-86.

The pregnancy was wanted in 62.9% of cases in 1966 and 91.8% in 1985-86. Wantedness was connected with age, in that the age groups in which childbearing was most frequent had the highest incidence of desired pregnancies. These age groups were 20 - 25 years in 1966 and 26 - 30 years in 1985-86. Each age group except that of mothers under 20 years had a higher percentage of wanted births in 1985-86 than in 1966. The percentage of wanted births was also higher in 1985-86 than in 1966 in each parity group. In spite of the fact that there were 1.44 times as many births per women aged 15-49 years in the former cohort, more wanted children were born to the age group 25 - 34 years in the latter cohort.

This increase in wanted births is a sign of a successful family planning programme. Simultaneously with the change in the abortion law, more care was also taken through the maternal care system to prevent unwanted conceptions. About one sixth of all pregnancies were terminated by legal abortion during that period.

Table. Induced abortions per women aged 15 - 49 years in Northern Finland in 1966 and 1984

Year	Number of abortions	Number of women	per 10.000
1966	323	148248	22
1984	1693	158334	107

Name: Zdeněk P a v l í k

Title of Paper: General and specific features of the reproduction after demographic revolution

Summary:

The differences and specificities of the process of demographic revolution in individual countries and regions, in to-day developed and developing countries, have served often for denying the regularity and universality of this process. Such specificities are not surprising if the different conditions, i.e. traditions, level of economic and social development, cultural background, religions, social homogeneity or heterogeneity ..., are taken into consideration. The social factors (conditions) have increased their weight considerably during the demographic revolution.

The most important general feature has been the revolutionary change in the approach to the number of children. If only a few individuals before the demographic revolution willingly controlled the number of their children, the huge majority of population do so deliberately after this process.

The demographic revolution is a relatively independent process and at the same time a part of many revolutionary changes in all social (incl. economic) spheres which can be named as a global revolution of modern era. With the CDR arround 10 per thous. in the world's average in 1988, expectation of life at birth arround 60 years, the CBR 28 per thous. and the world natural increase arround 17-18 per thous., the demographic revolution is in its second phase taking the world as a whole.

The end of the demographic revolution in demographically developed countries has created a completely new situation, never known before. A few authors contended already in 1960's that the countries after demographic revolution would face the depopulation but the probability of the rather stable replacement levelhas been accepted by the majority of them. Such an opinion has been sustained by the post-war baby boom in many countries. However, the constant decrease in the fertility levels in the GFR, Austria, Netherlands and recently in Italy led several authors to seek the deeper conditions for it than it was previously admitted. This new demographic situation was even labelled as the second demographic transition. In spite of the considerable changes in the value system, to equal these changes with the first demographic transition or the demographic revolution (I am accepting them as synonyma) is the evident exageration which would never happen if the first demographic transition has been called more properly as a revolution taking into consideration revolutionary both quantitative and qualitatives changes in the human reproductive behaviour.

Name: PETER ZVIDRIŅŠ

Title of Paper: PATTERNS OF POPULATION REPRODUCTION IN THE COUNTRIES OF THE BALTIC REGION

Summary: This research aims to specify the differentiation and tendences of population reproduction in three Soviet Baltic republics (Lithuania, Latvia and Estonia) and the countries of the Baltic region (the GDR, Poland, West Germany, Sweden, Finland, Denmark) in the postwar period, as well as to draw prognozes in this field. For purposes of comparison data about Norway are also used.

In the postwar period both the general and the specific fertility rates were the highest in Poland, Finland, Lithuania and Norway. Intensity of population reproduction and natural increase were also the highest in these countries. Since the beginning of the 50ies, Latvia gives low fertility rate which is below the replacement level. Only a little higher it was in Estonia. Yet, as a result of a more active demographic policy it has noticeably increased (esp. in Latvia) and lately net reproduction coefficient fluctuates around one (in view of real generations a little below). Irrespective of a lower mortality rate in the capitalist countries of the region, reduced population reproduction takes place during the last two decades. In West Germany and Denmark the net reproduction coefficient has fallen to 0.6-0.7, which has resulted into a negative balance of natural population movement. Only slightly higher it is in the other capitalist countries of the region and the GDR. This indicator was above 1.0 in the postwar period only in Poland and Lithuania, and even in Lithuania during last years extended population reproduction is not ensured.

The existing very low fertility rate with a high level of population ageing will inevitably lead to a negative balance of natural population movement in all the capitalist countries of the region in the future. Therefore, it is not only in West Germany and Denmark, but also in all Nordic countries that the most reliable prognosis is a decrease of absolute number of population: in Sweden and Finland in the end of this century, in Norway - at the very beginning of the next century.

Population growth and fertility level are recognized(1987) as too low in the GDR and West Germany (in Sweden - only the fertility level), but the government of the GDR alone intends to stimulate the fertility and population increase actively. Also in the Baltic Soviet republics a complex of measures has been worked out to stimulate the natural population growth. The first complex demographic purpose-program in the USSR has been accepted by the government of Latvia. Therefore it reasonable to prognose that in nearest futere essential differences in the levels of population reproduction intensity will remain: in all the socialist countries up to the end of the 20th century it will be close to simple replacement level (net reproduction coefficient from 0.9 to 1.1), while in the capitalist countries there will be a reduced reproduction level (0.7 - 0.9).

Name: Joop de Beer, Netherlands Central Bureau of Statistics

Title of Paper: TIME-SERIES METHODS FOR PROJECTING AGE-SPECIFIC FERTILITY

Summary:

Statistical time-series models can be used for projecting the annual total number of births from its own past. As this approach ignores changes in size and distribution of the population affecting total numbers of births, time-series models may be applied to total fertility rates instead. In that case, however, no attention is paid to the difference between changes in fertility caused by a changing average family size and those caused by a changing age pattern of fertility. Hence it is useful to look at separate age-specific rates.

Recently several models have been suggested for projecting a complete set of age-specific rates simultaneously. Thompson et al. (1987) suggested to describe the age pattern of fertility in successive calendar years by Gamma functions. The parameters of these functions can be projected by using statistical time-series models, such as ARIMA-models. De Beer (1985) developed the CARIMA-model which is capable of describing both changes in fertility rates between cohorts and between ages. Willekens and Baydar (1984) decompose the observations into age-, period- and cohort effects. ARIMA-models can be used to project the separate effects. One advantage of the APC-model is that the estimated parameters seem better suited for demographic interpretation. However, due to incomplete fertility of recent cohorts the interpretation is not without problems. The forecasting performance of the CARIMA-model and the APC-model is examined for Dutch age-specific fertility rates in the period 1971-1984. In projecting total fertility rates up to five years ahead the average errors of the two models do not differ very much. Both models perform slightly better than ARIMA-models directly applied to series of total fertility rates. If parity-specific rates are used, the projections of the CARIMA-model are more accurate than those of the APC-model.

Statistical time-series models such as the ARIMA model describe local trends. The forecasts of these models are mainly determined by changes in the observations at the end of the observation period. Therefore these models are especially useful for short-run forecasting.
Alternatively, the forecasts of deterministic models describing global trends, emphasize the importance of developments in the medium or long run. A problem in using such models is the selection of the correct model. The forecasts depend heavily on the choice of the model. For forecasts in the medium term this problem may be solved by using linear spline functions which are appropriate for describing strongly different developments.
Linear spline functions can be used for projecting separate age-specific fertility rates. However, if fertility rates for different ages are projected independently, the forecasts may not be consistent. For that reason a new model is introduced in which the age pattern of the coefficients representing the changes in the fertility rates between successive calendar years or cohorts is described by a cubic spline function. This model is capable of describing widely varying patterns. By way of an illustration the model is applied to age-specific fertility rates for a number of countries.

Name: Hans van de Giessen, Netherlands Central Bureau of Statistics

Title of Paper: BIRTH EXPECTATIONS AS A GUIDE FOR FERTILITY HYPOTHESES IN POPULATION PROJECTIONS

Summary:

The use of birth expectations for fertility hypotheses in population projections is not a new idea. Since the fifties demographers (especially in the United States) have been asking women in surveys their intentions with respect to having children and have been trying to use their answers as a guide to forecast fertility.
The degree of success of these attempts depends strongly on the reliability of such expectations. Past experience has taught us that on average women overestimate their future number of children. In the sixties and seventies in particular forecasters all but lost their confidence in the predictive power of birth expectations. Obviously, at the time women included in the surveys who had to state their expectations did not anticipate the dramatic fertility decline that was to occur in almost all Western countries in that period.
Nevertheless some demographers continued to believe in the potential predictive power of birth expectations. Among them were the researchers of the Department for Population Statistics of the Netherlands Central Bureau of Statistics. This department prepares the national population forecasts for the Netherlands and organized fertility surveys including questions about birth expectations in 1975, 1977, 1982 (with a follow up in 1985), and 1988. A research project studying the reliability of birth expectations and the use of birth expectations for population projections started in 1979. Some results so far are presented in this paper.

From the study of the reliability and stability of birth expectations it turns out that nowadays Dutch women, as a group, provide fairly accurate forecasts. This conclusion, that has to be monitored each time new survey data come available, does not mean that there will be no overestimation at all any more. In order to make the expectations suitable for forecasting purposes, some adjustments have to be made. Three adjustment methods that have been developed at the Department are discussed. Applied to the 1982 and 1985 surveys an average expected number of life-time births to women born in the early 1960's of around 1.6 results. If already available the adjusted results from the most recent survey (1988) will be presented too.
The overall conclusion of the paper will be that, provided the questioning in the survey is right, provided the interviewers know their job, and provided nonresponse will not influence the results too much, birth expectations from surveys can be, with some adjustments, a useful source of information for forecasting fertility, perhaps the only one we really have. In addition, however, forecasters should always be attentive to possible societal changes affecting reproductive behaviour that will not be foreseen by respondents in surveys.

Name: Ing. Jaroslav Kraus

Title of Paper: The Future of Reproduction - Results of Czechoslovak Projection

Summary:

In the first half of 1987 the statistical bodies elaborated the projection of the Czechoslovak population, an important basis for preparation of socio-economic prognosis. The projection was computed by sex, age units and in one years´ steps to 2010 but the computation was prolonged up to 2030. Population projection was calculated - contrary to previous projections - in the three variants: hight, medium and low. The results of the three variants are commented together with input parametres and problems of methodology. The projection was compiled in territorial classification for Czechoslovakia, the Czech and the Slovak republics and for regions and districs of Czechoslovakia. The input parametres takes into account the further, however, very slight decline of realized fertility and a certain improvement of mortality conditions. In the migrations balance between the Czech and the Slovak Socialist Republics there is apparent a further equalizing of the national economics. By the results of the low projection variant the number of the Czechoslovakia population will reach the peak after 2000 and then it will start to decrease slighly. From the result of high variant of the projection there is on the contrary issues a significant - and continuous growth of the number of the population in Czechoslovakia. The population development after 2010 is characterized by considerable diversity: by the results of a low variant of the projection the number of Czechoslovak population will decline under 15 millions in 2030 and by results of a high variant of the projection it will grow above 17.5 millions of inhabitans, 16.5 millions being however the most probable results in 2030 /medium variant/.

Name: Fernando Rajulton and T.R. Balakrishnan

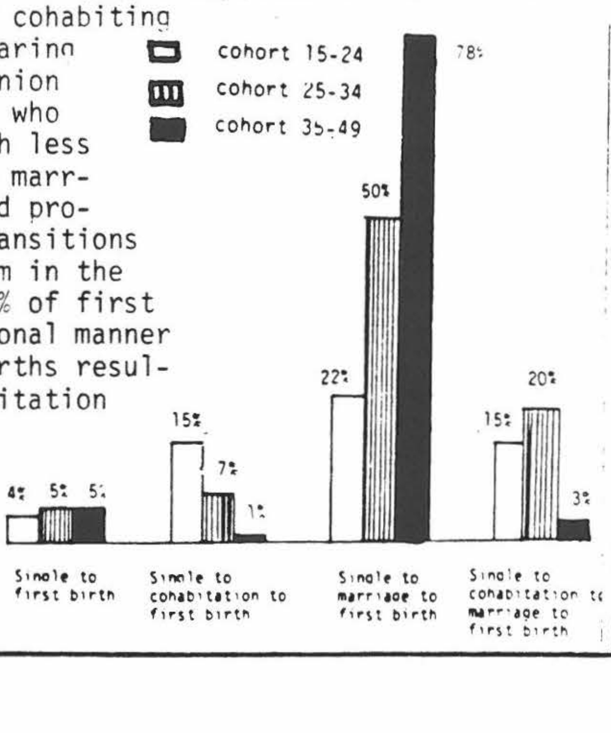
Title of Paper: Developments in Nuptiality and Fertility in Canada

Summary:

With total fertility rates in many developed countries stabilized around the replacement level for more than a decade, research interests naturally shift from investigation of summary measures such as mean number of births to a more relevant investigation of changes in timing of fertility and their dependence on changes in marital patterns. This paper exemplifies one such investigation, making use of the marital and fertility histories obtained through the Canadian Fertility Survey 1984, and examines the trends over cohorts in timing and type of transitions among marital and parity states.

The analysis is carried out first through a semi-Markovian framework built on sample paths of women. An examination of age-and-duration-specific transition probabilities in a system of marital and parity states for three age-cohorts of women in the sample reveals that the most conspicuous change over cohorts lies in the very first transition made in marital/reproductive life after age 15 - either to first marriage or to first cohabitation. This leads to investigating further how the first transition affects subsequent transitions. Towards this end, the semi-Markov model is refined to consider changes in a system of coupled and dynamically interdependent states. In fact, this attempt leads to the specification of a non-Markovian model, as past transitions have to be necessarily included in the calculation of transition probabilities.

The first transition after age 15 does indeed affect the timing and intensity of births, and throws light on the changes in fertility behaviour running parallel to changes in marital behaviour. To spell out a few salient features of this analysis : (i) Though cohabitation still largely serves as a prestage to marriage, younger women are showing a deviating trend in the sense that first births, if not subsequent births also, are more likely to occur in cohabitation. (ii) Acceptance of new marital patterns is revealed by the fact that cohabiting women are at ease to continue childbearing in cohabitation as those in marital union do. However, the proportion of women who have their second/third births is much less among cohabiting women than among the married. (iii) An examination of combined probabilities of typical sequences of transitions (presented in the accompanying diagram in the case of first births) reveals that 40% of first births will take place in the traditional manner in marriage but will be flanked by births resulting from the new life style of cohabitation as an authentic state in itself or as a prestage to marriage. (iv) Higher order births will be the privilege of women who follow the traditional norm of fertility in marriage.



Name: Charles A. Calhoun

Title of Paper: Do Excess And Deficit Fertility Really Offset One Another? Some Econometric Evidence From The United States

Summary:

Studies of the validity of survey data on expected or desired fertility have generally concluded that positive and negative errors made by individuals when predicting their own fertility are offsetting, so that aggregate measures of average desired family size or expected completed fertility are still useful for population forecasting. This paper considers the question of offsetting errors in the context of a multivariate model of desired family size and children ever born for a sample of white married women from the Panel Study of Income Dynamics in the United States. The model corrects for the censoring of desired family size by attained family size to produce the underlying distribution of cumulative and desired fertility in the sample. This distribution is used to calculate the percent and average number of excess and deficit births for women classified by age, education, marital duration, residence, income, employment status, work experience and religion. Particular attention is given to the distributions of excess and deficit fertility for women near the end of childbearing.

NOTES

SESSION 3

Future Structures of Families and Households

Organizer: Louis Roussel

Projections des ménages et des familles : un état de la question

Louis Roussel

Les effets de la démographie se sont longtemps consacrés en priorité à l'analyse des phénomènes qui réglaient l'évolution globale de la population, fécondité et mortalité, nuptialité aussi dans la mesure où celle-ci était liée à la fécondité, migrations, enfin interdépendance de ces facteurs. L'étude de la répartition de cette population en unités primaires de résidence n'était pas totalement négligée, mais elle apparaissait comme une annexe sans grande importance de la démographie véritable. On s'y bornait généralement à des constats. Seules, semblait-il, des raisons administratives justifiaient après chaque recensement une série de tableaux regroupés en deux parties, l'une sur les familles, l'autre sur les ménages.

On y trouvait généralement peu d'informations sur la structure interne de ces unités. Pour l'essentiel, les données étaient analysées suivant les caractéristiques démo-économiques des "chefs de ménages". Une distribution des ménages suivant leur taille, par groupe d'âge du "marqueur", constituait la donnée la plus utile sans doute pour l'utilisateur administratif.

Quant à l'idée de calculer des projections de ménages ou de familles, elle semblait à beaucoup un exercice méthodologiquement difficile et pratiquement gratuit. Au dernier colloque des démographes français (Grenoble, 1987), qui portait pourtant sur "Les perspectives" une communication seulement traita des ménages [1].

La situation pourtant avait commencé à changer depuis 1975. A partir de cette date, mais surtout après 1980, la fréquence des recherches et des publications sur l'évolution de la structure des ménages et des familles augmenta considérablement. Il n'est pas question d'en faire ici une liste même approximative. Le nombre des communications présentées à cette séance témoigne que cet intérêt est loin d'avoir cédé. Indiquons en passant quelques-unes des organisations qui s'efforcèrent de coordonner la recherche dans ce domaine : le CICRED au début de la présente décennie (réunions à Paris de 1982 et 1984) ; l'IUSSP avec la création de deux comités succcessifs sur l'évolution récente et future de la famille ; et mainte-

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1 Claudie Louvot, Projection du nombre des ménages jusqu'en l'an 2010. VIIIème Colloque National de Démographie, Les projections démographiques, Actes du colloque, tome I, Paris, PUF, 1987, 135-150.

nant l'IIASA. Simultanément, mais de manière dispersée, des efforts étaient faits un peu partout par les démographes pour renouveler les méthodes de projection. Le mémorandum préparé en 1987 par Heeren et Keilman fournit sur ce point une excellente documentation dont il est inutile de reprendre ici le contenu [1]. Plus récemment encore le livre édité par Keilman, Kuijsten et Vossen apporte une sorte de synthèse des progrès méthodologiques réalisés au cours des récentes années [2]. Pour qui s'intéresse à la question, il est difficile de ne pas consulter ces deux documents. De même, lira-t-on avec profit le rapport du comité organisé par l'IUSSP sur la démographie formelle de la famille [3]. Notre intention n'est pas de reprendre ce qui a déjà été excellement dit, mais de tenter de comprendre, très partiellement, les ressorts de cette évolution : "Pourquoi ce sursaut récent ? Pourquoi aussi la longue stagnation antérieure ?".

I - Un territoire enclavé et délaissé

Plusieurs raisons rendent compte de l'hésitation des démographes à traiter des données collectives et a fortiori à tenter, dans ce domaine, des projections. La première est sans doute que la formulation des concepts et la construction des typologies étaient, d'un pays à l'autre, très différentes. Comment, sans comparaisons possibles, dépasser la description d'une situation particulière, celle d'un pays ? Le livre de Le Bras sur ce sujet témoignait bien de la surprise et du désarroi du démographe lorsqu'il tentait simplement d'établir une certaine comparabilité entre des données radicalement hétérogènes [4]. Récemment encore, Wall faisait, lui aussi, l'expérience de ces difficultés [5].

Par ailleurs on voyait mal comment articuler ménages et familles : il y avait des ménages à plusieurs familles, d'autres sans famille ; on rencontrait des ménages formés de la seule famille ; d'autres qui accueillaient un ou plusieurs hôtes permanents. Ne s'engageait-on pas ici sur un terrain mouvant, où il était difficile de trouver en itinéraire sur ?

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1 H. Heeren et N. Keilman, Proposal for an international comparative study among IIASA member countries, The Hague, Octobre 1987.

2 N. Keilman, A. Kuijsten, A. Vossen, Modeling household formation and dissolution, Oxford, Clarendon Press, 1988.

3 J. Bongaarts, Family demography : methods and their application, Oxford, Clarendon Press, 1987.

4 Hervé Le Bras, L'enfant et la famille, Paris, OCDE, 1979.

5 R. Wall, Behond the nuclear family, in Demography of the family, Paris, CICRED, 1984.

Une autre difficulté, et elle subsiste toujours, venait du fait que certains mécanismes qui règlent la formation et la transformation des ménages relèvent non des facteurs démographiques mais de contraintes économiques ou de mouvements culturels. On voit bien que l'étroitesse du parc de logements influence la structure des ménages, mais il est difficile de préciser l'incidence exacte de ce facteur. Plus délicat encore pour un démographe, d'intégrer dans ses projections l'évolution à terme de ce parc. De même les normes de décohabitation ou de re-cohabitation entre parents et enfants sont-elles influencées à la fois par des contraintes économiques comme le chômage et par des tendances à caractères culturels, comme le désir d'acquérir le plus vite possible et de garder le plus longtemps possible son autonomie résidentielle. Ces "externalités" étaient pour les démographes des causes d'incertitudes et, sans doute, des motifs suffisants pour se méfier de ce champ de recherche.

A notre avis pourtant, la raison essentielle de leur réticence était le sentiment que ce territoire n'appartenait pas à la véritable démographie. Plus précisément peut-être étaient-ils convaincus que les progrès qui pourraient être faits dans le domaine des données collectives ne retentiraient pas sur l'analyse des comportements individuels. Quels rapports existaient entre ces distributions de la population en unités élémentaires et les problèmes centraux de la fécondité et de la mortalité ? Qui aurait songé à une enquête mondiale sur les ménages ?

D'où vint le renouveau d'intérêt pour ce thème ? Incontestablement, les demandes de la puissance publique furent ici décisives. Celle-ci avait désormais besoin d'informations sur les données collectives, ou plutôt elle voyait soudain combien ces données lui étaient indispensables. Plusieurs raisons lui donnèrent conscience de cette nécessité. La première tient désormais au besoin de planification du budget social. Deux sous-populations semblaient se développer d'une manière rapide : celles des personnes âgées bénéficiaires de pensions, mais aussi de services médicaux dont le coût augmentait avec l'âge ; celle enseuite des familles atypiques, économiquement fragiles, et en particulier, les ménages monoparentaux.

Dans le second cas, le poids relatif de ces ménages était longemps demeuré à peu près constant. Les perturbations démographiques observées depuis 1965 avaient rompu cette stabilité. D'autre part, au moment où les besoins devenaient plus importants, les ressources de l'Etat étaient affectées par une crise économique qui ne fut pas tenue longtemps pour conjoncturelle. Les administrations ressentaient donc l'urgente nécessité de projections sur la répartition des ménages et des familles.

Autre facteur favorable, et celui-là décisif : au moment où la demande se faisait pressante, l'ordinateur paraissait apporter le moyen d'y répondre et, de fait, les progrès réalisés depuis dix ans n'auraient pu, sans cet instrument, eussent été impossibles.

Enfin, le problème de l'articulation entre ménages et familles s'orientait vers une solution. Dans la théorie, Ryder montrait comment se complexifiait progressivement l'unité élémentaire, de l'individu au couple, du couple à la famille et de la famille au ménage [1]. En même temps, dans la réalité, on assistait à une progressive simplification de la structure des unités élémentaires dans les pays industriels. Les ménages à deux familles devenaient marginaux ; ceux où était accueilli un hôte permanent, rares. Il semblait donc possible de s'entendre sur une typologie sommaire mais qui pouvait servir de base à d'utiles comparaisons.

Figure 1 : Une typologie des ménages (Overton et Ermisch)

	Ménages simples	Ménages complexes
Ménages sans famille	1 personne	Plusieurs personnes
Ménages avec famille		
Couples avec enfant(s)	sans aucun hôte permanent	avec hôte(s) permanent(s)
Couples sans enfant	sans aucun hôte permanent	avec hôte(s) permanent(s)
Un parent + enfant(s)	sans aucun hôte permanent	avec hôte(s) permanent(s)
dont mères	sans aucun hôte permanent	avec hôte(s) permanent(s)
dont pères	sans aucun hôte permanent	avec hôte(s) permanent(s)

Source : E. Overton et J. Ermisch, Minimal households units, Population Trends, Printemps 1984.

Le terme "simple" signifie que le ménage est composé uniquement par les membres de la famille ; "complexe", symétriquement, indique qu'un hôte, apparenté ou non, en fait partie.

A partir de cette typologie, des comparaisons élémentaires sont possibles.

1 N. Ryder, Recents developpements in the formal demography of the family, International Population Conference, Florence, 1985. Vol. 3, IUSSP, 1985, pp.207-220.

Figure 2 : Evolution de la distribution des ménages (1960-1982)

	1^re date					2^e date					3^e date					Dates successives
	Sans famille		Avec famille			Sans famille		Avec famille			Sans famille		Avec famille			
Types de ménage *	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Allemagne (RFA)	21	2	55	20	2	26	2	47	23	2	31	2	42	22	3	1961, 1970, 1981
France	20	6	45	25	4	22	5	41	27	5	24	5	39	27	5	1962, 1975, 1982
Angleterre et Pays-de-Galles	12	4	49	28	7	18	4	44	27	7	22	4 *	39	27	8	1961, 1971, 1981
Pays-Bas	12	3	56	23	6	17	3	53	22	7	22	6	43	23	6	1960, 1971, 1981
Suède	20	10	37	30	3	25	9	30	33	3	33	5	25	33	4	1960, 1970, 1980
Suisse	15	7	48	25	5	20	6	45	24	5	27	5	41	23	4	1961, 1971, 1980
Canada	9					13	5	50	30	2	20	5	37	35	3	1960, 1970, 1982
Etats-Unis	13	7	44	32	4	17	7	40	31	5	23	8	29	32	8	1960, 1970, 1982

* Légendes : 1. Ménages d'une personne
2. Ménages sans famille de plusieurs personnes
3. Ménages avec couple et enfants
4. Ménages avec couple sans enfant
5. Ménages monoparentaux.

Note : Distinction n'est faite ni entre ménages simples et ménages complexes, ni entre couples légitimes ou non.

Source : L. Roussel, Evolution récente de la structure des ménages dans quelques pays industriels, Population, 6, 1986.

Que pouvait-on attendre de tels tableaux ? Peu d'informations en réalité, et davantage de questions que de réponses. On y lira certaines grandes tendances, comme la diminution des ménages composés d'un couple avec enfants, et encore la progression rapide des ménages d'une personne. De simples constats, donc, et sommaires puisque la composition des ménages d'une personne, d'un Etat à un autre, varie considérablement suivant la répartition en sexe, âge et statut matrimonial. A plus forte raison, ne pouvait-on attendre de ces observations des projections sérieuses pour l'avenir. Il est bien difficile en effet de "projeter" ce dont on ignore les mécanismes de formation et de dissolution. Comment décider dans ces conditions si une tendance observée depuis 1965 allait ou non se prolonger ?

Des perspectives furent pourtant tentées suivant la méthode dite des "taux de chefs de ménage". Là, on comparait groupe d'âge par groupe d'âge, et d'un recensement à l'autre, les pourcentages de chefs de ménage (ou de personnes de référence) dans l'ensemble de la population. On obtenait, en prolongeant les tendances, des proportions de chefs de ménages, donc des ménages, à échéance par exemple de cinq ans. Des projections suivant le statut matrimonial et la présence d'enfants permettaient d'obtenir ensuite une projection des ménages suivant leur composition. Tel est par exemple, le type de travail réalisé par Louvot et cité plus haut.

Enfin, l'idée de cycle de vie familiale parut alors utilisable pour mieux comprendre, et éventuellement calculer plus précisément, les projections. A un instant donné, les ménages se répartissaient, en somme, en fonction de la phase atteinte dans le cycle : ici couple encore sans enfant ; à l'autre extrémité "nid vide". Ne pouvait-on pas faire "vieillir" de cinq ou dix ans ces ménages et voir quelle serait leur distribution après ce délai ? Telle était du moins l'idée générale. On quittait ainsi le simple constat de tendance ; on entrait dans la cohérence d'une histoire, d'un cycle réglé à la fois par la biologie et les institutions. Ne s'approchait-on pas ainsi d'une intelligibilité des changements ?

Le malheur fut que l'idée de cycle familial devint obsolète avant d'avoir vraiment été appliquée. Plus précisément, son application n'apparut pertinente que pour comprendre une situation dépassée, celle où un modèle unique réglait l'évolution des ménages. On comprend aisément que, dans une telle situation, la diversité des ménages tenait avant tout au fait qu'à un même moment, ceux-ci étaient à des phases différentes. Si l'on prend un modèle réglé par un certain calendrier de mariage, par l'indissolubilité des unions, par une fécondité non contrôlée, par le remariage rapide des hommes jeunes en cas de veuvage, par la cohabitation de l'aîné marié avec ses parents, par le départ du cadet marié, on obtient une image approximative de la distribution des ménages et, en particulier, on peut expliquer par là, au moins en partie, la juxtaposition de ménages à deux familles et de ménages constitués par une famille nucléaire.

Impossible pourtant d'appliquer ce modèle dès lors que les séparations ne sont plus réglées seulement par le calendrier relativement stable de la mortalité, mais par des décisions volontaires dont la fréquence est difficilement prévisible. L'unité élémentaire permanente cesse alors d'être le ménage, mais se réduit à l'individu. Celui-ci, seul, devient un support durable de probabilités. Le recul de la mortalité avant 60 ans et le caractère exceptionnel du divorce avaient, un temps, conféré au cycle familial une consistance suffisante pour que le concept puisse servir de cadre à des projections. Mais cette conception théorique avait à peine été élaborée qu'elle cessait de correspondre à la réalité. C'est ce que soulignait avec humour Le Bras dans un article intitulé : "Le cycle de la vie familiale : une nouveauté déjà périmée ?" [1].

1 H. Le Bras, Le cycle de la vie familiale : une nouveauté déjà périmée, Dialogue n°72, 1981.

A ce propos aussi, Heeren cite une phrase de Birg, elle aussi un peu provocante : "The family cycle is in fact less cyclic than before" [1]. En même temps, il devenait évident que les biographies individuelles se diversifiaient de plus en plus. Dans la génération 1930 en France, 85% environ des individus avaient suivi l'itinéraire classique : mariage, enfants, "nid vide",veuvage. Cette homogénéité avait cessé et cela non seulement en raison d'une distinction entre ceux qui divorçaient et ceux qui ne le faisaient pas. En effet, les événements non légaux multipliaient soudain les cas de figure : une vie commune pouvait commencer par une simple cohabitation ; un enfant pouvait naître dans cette situation ; les conjoints pouvaient, après ou sans mariage, se séparer sans divorce. Une seconde union devenait moins probable, du moins sous la forme d'un mariage. Enfin la cohabitation effective n'était plus la seule forme de couple : parmi les jeunes, non mariés et non cohabitants, un tiers, en France, auraient une relation stable sans co-résidence .

Mais aussi, et ce n'était pas là un handicap léger, il était devenu évident que depuis 1965, on avait quitté une zone d'eaux calmes et que les turbulences rendaient plus difficile encore une prévision des évolutions prochaines. Allait-on vers un apaisement de ces mouvements ou vers une poursuite ? Et sur quels critères fonder son choix ? Pouvait-on oublier les renversements de situation de 1945 à 1965 ? La mode des "communautés" s'était dissipée, mais par contre la fréquence des cohabitations paraissait correspondre à un changement durable. L'évidence de ces difficultés devait pourtant céder devant la nécessité, en dépit de ces incertitudes, de fournir des projections.

II - Les routes ouvertes

Les tentatives de projections réalisées depuis trois ans sont très nombreuses. Certaines adoptent encore la méthode des "taux des personnes de références". Ces anciens chefs de ménages. Elles ne sont pas sans présenter une certaine utilité. Les plus récentes, celles de Louvot [2], Kono [3] et Linke [4], sont, dans leur genre, très au point.

1 H. Birg, A biographic theory of aging and fertility, Sopron 1986. Cité par Heeren, op.cit. p.8.

2 C. Louvot, Projection du nombre des ménages à l'horizon 2010 collection de l'INSEE, Série D, 129, Février 1988.

3 S. Kono, The headshit rate method for projecting households, in J. Bongaarts and alii, op. cit. p.287-308, 1987.

4 W. Linke, The headship rate approch in modeling housecholds : the case of the Federal Republic of Germany, in : N. Keilman et alii, op. cit p.108-112.

Elles semblent pourtant les expressions ultimes d'une conception aujourd'hui dépassée. Elles sont considérées en effet comme "statiques" parce qu'elles se bornent à observer des changements de stock à stock. On observe des distributions successives des ménages, mais les flux ne sont pas analysés. Dans ces conditions, on constate, on ne comprend pas. Les méthodes aujourd'hui préconisées et de plus en plus souvent pratiquées doivent être "dynamiques" c'est-à-dire montrer les mécanismes qui expliquent le passage d'une observation transversale à to à une autre à to+x.

C'était déjà là, l'ambition des recherches de Festy [1] et de Rallu [2]. Il ne s'agissait de rien de moins que de faire le point d'une situation à une autre à partir des événements enregistrés dans l'intervalle. On se proposait donc de marier l'état civil et les recensements, les séquences d'événements individuels et la structure des données collectives. On s'efforçait en somme de "désenclaver" l'analyse des ménages, de réintroduire leur étude dans une démographie unifiée. Les types de ménages étaient finalement considérés comme des sous-populations auxquelles on appliquait des "tables d'événements multiples". Bien entendu, il fallait ici aussi choisir des paramètres, qui permettaient de projeter les tendances observées. Mais à partir d'informations classiques, on proposait des modèles cohérents où était pris en compte l'ensemble des données disponibles.

Aussi bien, la remarque de Festy paraît-elle justifiée : "Ces projections, écrit-il, n'apparaissent donc pas comme un sous-produit de la démographie, mais comme un lieu privilégié où se renouvelle sans cesse le stock des méthodes et où celles-ci démontrent leur fécondité" [3].

La faiblesse de cette méthode tient à son propos même. Il s'agissait de faire le pont entre deux types de données régulièrement enregistrées. Mais qu'advient-il quand se développe le monde flou et difficilement mesurable des comportements "hors-la-loi" ? Tant que les ménages induits demeurent marginaux, d'une proportion inférieure à 10% par exemple, on peut bien procéder à des ajustements approximatifs. Mais peut-on considérer qu'il en est encore ainsi ? Il n'est pas rare dans la tranche d'âge 20-24 ans que les couples non mariés représentent le tiers

1 Patrick Festy et Jean-Louis Rallu, Construction et reconstitution des familles françaises. Etat-civil et recensements de 1968 et 1975 Population 1, 1981, p.63-92.

2 Jean-Louis Rallu, Projection des familles aux 1-1-1990 et 1-1-1995, Population, 3/1986, p.511-532.

3 P. Festy, La projection des sous-populations : principes et illustrations, Actes du Colloque de Grenoble, op. cit., p.202.

des unions. Récemment, une enquête de l'INED montrait à la fois la difficulté d'évaluer les situations atypiques et l'importance de certaines sous-populations généralement négligées : ainsi les enfants de parents séparés sans avoir été mariés représentaient 40% de l'effectif des enfants de parents mariés et divorcés [1].

Le modèle construit par Bongaarts et son équipe diffère assez peu de celui de Festy et Rallu. On en trouvera un exposé dans le rapport que Bongaarts a établi avec Burch et Watcher sur les travaux du premier comité sur la famille de l'IUSSP et qui à été cité plus haut.

Dès lors, les modèles se multiplient. Il serait fastidieux de présenter ici, même les principaux [2]. On trouvera, répétons le, d'excellents résumés dans le livre tout récent de Keilman, Kuijsten et Vossen. Disons que tous ces essais se proposent d'être "dynamiques', c'est-à-dire qu'ils ne travaillent pas seulement sur les stocks, mais sur les flux ; qu'ils ne se contentent pas de projeter des situations, mais qu'ils entendent bien comprendre les mécanismes d'évolutions.

Cela ne signifie pas que tous ces modèles soient identiques ou mêmes proches. Les uns retiennent le ménage comme unité élémentaire, les autres l'individu [3]. Les uns utilisent une stimulation stochastique, les autres veulent suivre des méthodes plus déterministes. Il est difficile, pour l'instant, de débattre objectivement de leurs mérites respectifs. D'abord parce qu'il est encore difficile de comparer leur perspicacité ; mais aussi parce que le choix des chercheurs est souvent déterminé par les données disponibles. Du point de vue de la banque des données, il y a aussi des pays riches et des pays pauvres.

Tous ces travaux augurent bien du développement de cette branche, désormais intégrée, de la démographie. On voudrait pourtant dans une dernière partie signaler quelques unes des difficultés qui restent à vaincre et quelques uns des écueils qu'il faut continuer à éviter.

III - Les difficultés des parcours

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1 H. Leridon et C. Villeneuve-Gokalp, Les nouveaux couples : nombre, caractéristiques et attitude, Population, 2, 1988, p.331-374.

2 Citons néanmoins ceux qui paraissent les plus élaborés pour l'instant en Europe : le modèle suédois de Harsman, le modèle allemand (ISP) de Möller, enfin celui mis au point par le NIDI au Pays-Bas (LIPRO).

3 Sur les avantages et inconvénient de l'une et l'autre solution, voir le chapitre de N. Keilman et N. Keyfitz, Recurrent issues in household modeling, in Keilman et alii, op. cit.

La première remarque, malgré son apparence, n'est pas moralisante, mais méthodologique. Le démographe, ici plus que dans les autres domaines, risque de céder à une illusion sur la fiabilité des résultats qu'il présente. Il est investi de la confiance de responsables administratifs de haut niveau. Les estimations qu'il calcule leur sont indispensables. Il est la seule compétence et l'ultime recours. On ne lui ménage pas les moyens. Il entre dans les conseils de planification. Les législateurs le consultent. Il ne lui faut pourtant pas perdre son sens critique ; il doit aussi avoir parfois le courage de décevoir les attentes et de rappeler les limites de sa compétence. Est-il besoin de rappeler que nous avons été pris de court par les changements de 1965, que nous n'avons pas prévu la multiplication des cohabitations sans mariages, et que tout récemment encore nous avons été surpris par la soudaine augmentation des naissances hors mariage. Ces nouvelles méthodes de projections, nous savons bien qu'elles ne sont pas encore au point. Bartlema et Vossen ont raison de nous le rappeler. Ils présentent pour le mettre en évidence les écarts, sur cinq ans, entre les données prévues et celles qui ont été observées aux Pays-Bas [1].

Les différences sont négligeables en ce qui concerne la mortalité ; elles dépassent 15% pour les mariages et les divorces, autrement dit pour des comportements qui sont décisifs en matière de projections de ménages. La distorsion atteint d'ailleurs 40%, dans la période quinquennale précédente pour la nuptialité. Ce qui suggère que nous devrions ici ne présenter qu'avec de fortes réserves les projections qui dépassent l'horizon de cinq ans. Pour comprendre ces insuffisances et mieux mesurer ce qu'elles ont d'incompressible, examinons rapidement les obstacles qui, aux différentes phases des calculs prospectifs, entravent encore la recherche dans ce secteur.

Le premier, on l'a déjà signalé, est que le démographe ne dispose pas toujours de données de base qui soient à la fois fiables, récentes et précises. L'enquête de l'INED sur les situations familiales a permis de mesurer une sous-estimation des ménages de cohabitants non mariés faite à partir de l'enquête Emploi : elle l'a estimée à 30%. Il faudrait pouvoir disposer de bonnes informations à la fois sur les situations de départ et sur les "probabilités de transition". Cela signifie en réalité que les sources traditionnelles des données sont désormais insuffisantes et que les enquêtes lourdes sont devenues, non plus un complément intéressant, mais des instruments indispensables pour une connaissance objective de la situation et des

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1 J. Bartlema et A. Vossen, op. cit. p.245.

mouvements qui la transforment. Cette difficulté, à notre avis, est provisoire : déjà, aux Etats-Unis et en Europe, de telles enquêtes existent, se multiplient, et s'améliorent sans cesse.

Faut-il attribuer les insuffisances des démarches actuelles à la médiocrité des modèles de simulation ? Que font ceux-ci, sinon mettre en oeuvre une sorte de logique interne des phénomènes démographiques, qui mesure l'incidence des comportements individuels sur la distribution domestique de la population ? Il s'agit là de montages sophistiqués qui peuvent sans doute être encore améliorés. On a rapporté plus haut les hésitations actuelles des chercheurs entre l'approche stochastique et les méthodes déterministes. Sans doute s'oriente-t-on, ici aussi, comme le prévoient Keilman et Kofitz vers une convergence des deux conceptions.

Pour revenir à la situation actuelle, les risques d'erreurs tiennent-ils vraiment à cette démographie formelle, c'est-à-dire au modèle mathématique retenu ? L'opinion de Bartlema et Vossen semble convaincante : il n'est pas certain que l'on puisse attendre de grands progrès d'une sophistication formelle plus poussée [1].

Probablement, les écarts entre le calculé et l'observé s'expliquent-ils plutôt par les paramètres dont il faut bien nourrir le modèle formel. Comment décider de ces "probabilités de transition", et finalement de l'évolution à moyen terme des mouvements qui retentissent sur la distribution des ménages ? Il n'est guère possible d'éviter que les projections sur les ménages soient le carrefour des hypothèses et des incertitudes. Il est vrai que les choix du démographe ne sont pas arbitraires : il s'agit simplement de décider de combien varieront dans l'avenir les indices observés au cours des récentes années. Les écarts d'une année sur l'autre sont donc relativement modestes. Il n'en reste pas moins qu'il est nécessaire de choisir cette ampleur et d'abord la probabilité d'une éventuelle inversion de la tendance. Sur quelle base prendre de telles décisions ?

Le système des paramètres retenus est en réalité décidé en fonction d'un scénario général, plus ou moins explicite, par exemple la stabilité générale des tendances, avec léger ralentissement de la divortialité et accroissement sensible des naissances dans les unions hors mariage. C'est à partir d'un scénario central de ce type que les paramètres sont, d'année en année, ou pour une période de cinq ans, fixés.

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1 J. Bartlema et A. Vassen, op. cit., p.246.

La distribution doit donc être clairement faite entre la modélisation qui établit les répercussions d'un événement individuel possible sur la structure domestique de la population et les hypothèses relatives à la fréquence des événements probables, hypothèses qui ne font qu'expliciter et préciser le scénario adopté. Il faut en conclure qu'il n'y a pas de modèle économique, mais seulement des modèles démographiques où les variables économiques sont introduites dans le scénario et considérées comme déterminantes. Il y a bien ici deux tâches distinctes, l'une et l'autre indispensables pour les projections de ménages comme pour toutes les autres projections : l'une où le démographe est seul maître du jeu, une autre où la décision finale lui revient mais dont l'élaboration exige des compétences qu'il n'a pas toujours.

En matière de familles et de ménages, on voit qu'interviennent des données externes à la démographie formelle, et très complexes : le parc des logements, le niveau des revenus, mais aussi les attitudes à l'égard de la famille, la transformation des relations entre hommes et femmes dans la société. C'est tout cela, cet écheveau de motivations qui décidera des comportements démographiques à venir. Est-il besoin, de plus, de rappeler que nous sommes dans une société culturellement et économiquement hétérogène et que le scénario doit être en réalité lui aussi pluraliste ?

Sur le principe et la nécessité d'un scénario, sur son importance dans le choix des paramètres, tout le monde, en principe, serait d'accord. Mais certains démographes, en pratique, estiment qu'ils sont compétents pour choisir le scénario le plus probable, comme d'ailleurs certains économistes s'estiment statistiquement assez armés pour construire le modèle démographique auquel ils appliqueront leur scénario.

Une distinction plus nettement affirmée entre ces deux moments des projections, une attention égale dans l'un et dans l'autre moments, une collaboration plus systématique entre les spécialistes, telle est semble-t-il la condition principale pour que des progrès soient enregistrés, qui soient à la mesure des investissements, des besoins et des espoirs. Il ne s'agit pas d'autre chose que de faire plus délibérément et plus systématiquement ce qui, dès maintenant, s'articule spontanément, mais dans une certaine confusion [1].

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1 Que l'on ne dise pas que les simulations stochastiques permettraient de faire l'économie du scénario : elles supposent elles aussi un schéma général de l'avenir, en fonction duquel sont choisies les probabilités qui affectent chaque individu.

Une autre question se pose dont la solution pourrait bien être bénéfique. La probabilité d'un événement dépend d'un certain nombre de variables généralement évaluées à partir de la situation de l'individu à un moment donné. Mais ne serait-il pas intéressant de moduler les probabilités en fonction de toute l'histoire domestique antérieure. On pourrait, par exemple, calculer des probabilités différentielles de divorce ou de fécondité suivant qu'une personne a contracté d'abord un mariage ou d'abord une simple cohabitation, suivant qu'elle a eu ou non un enfant hors mariage, suivant qu'elle a rompu sa cohabitation avec son premier conjoint ou qu'elle a finalement épousé son partenaire. On pourrait établir ainsi des séries de probabilités différentes suivant les deux ou trois événements du début de la biographie. Le schéma suivant de Höhm et Höhm montre que ces départs sont très diversifiés. Evidemment, cette différenciation exigerait des enquêtes longitudinales sur des échantillons lourds. Mais, de toutes manières, on l'a vu, la démographie sera de plus en plus amenée à recourir à cette source de données.

Figure 3 : Statuses and transitions leading up to first union dissolution for women who have not entered motherhood before first union formation

Legend : Read chart from top down in terms of sequential life transitions (events), and think of chart as continuing beyond its lower row of states.
Abbrevations : CH = child/children ; MAR = married ; DIS = first union dissolved
Source : Britta Hoem et Jan Hoem, Dissolution in Sweden, Stockholm. Research reports in Demography n°45.

Enfin, on peut observer qu'il est parfois utile de calculer non ce qui arrivera dans dix ans mais ce qui arriverait à cette échéance sous certaines conditions raisonnables comme la poursuite des tendances actuelles. Schwarz, par exemple, présente un modèle très simple pour estimer le pourcentage d'enfants de divorcés vers lequel tend une population à partir de la fréquence des divorces, du nombre moyen d'enfants au moment du divorce, et de la descendance finale.

Dans une cohorte de mariage, où 40% des unions finiraient par un divorce, où les ménages auraient en moyenne un enfant au moment du divorce et où la descendance finale serait de deux enfants, il est manifeste que le pourcentage serait de 20%. Une telle procédure permet de mettre en évidence la situation vers laquelle on tend et la précision de ces perspectives est peut-être suffisante pour décider les responsables politiques à une action corrective ou à l'élaboration d'un programme de mesures sociales adaptées à l'évolution probable.

Conclusion

Les progrès qui ont été faits récemment dans l'analyse de l'évolution des distributions de ménages et dans la projection de ces distributions résultent de la conjonction de deux événements. D'une part, et l'on n'insistera jamais assez sur ce point, la possibilité de faire, grâce à l'ordinateur, des calculs autrement impossibles ; d'autre part, un changement dans la conception même de la place de l'analyse des ménages en démographie. On a abandonné une dichotomie stérilisante pour considérer les ménages comme des haltes, plus ou moins longues, dans la combinaison des biographies personnelles. On a renoncé à l'idée, désormais non pertinente, des ménages ou des familles qui suivraient un cycle unique, réglé à la fois par les institutions et la biologie.

On a admis au contraire que l'individu est le seul support permanent de probabilités et que les rencontres de biographies comme les situations solitaires peuvent se succéder suivant des itinéraires complexes et variés. Le pluralisme des types de ménages tient désormais au pluralisme des biographies. Mettre en évidence une typologie des biographies n'est certes pas une entreprise aisée. Mais peut-être, comme on l'a dit, y parviendrait-on en adoptant comme critère discriminant les différentes manières de former un ménage. Ce serait là une typologie fondée sur des critères internes à la démographie. Quoi qu'il en soit, le modèle général est désormais celui d'un ensemble d'unités qu'un métabolisme, complexe et rapide, réunit puis sépare.

Ces mouvements affectent en particulier les jeunes adultes de 20 à 35 ans. C'est pour les personnes de ce groupe d'âge que les difficultés de projection sont les plus grandes, parce que les passages d'un état à un autre, d'un ménage à un autre y sont les plus fréquents. Ces transitions sont devenues en même temps, plus rapides, plus nombreuses et, pour certaines, moins visibles.

Rien d'étonnant dans ces conditions que les résultats acquis puissent paraître parfois décevants. Nous n'en sommes sur ce terrain, répétons-le, qu'à une phase exploratoire. Cette constatation ne doit pas être interprétée comme un échec, mais plutôt comme une appréciation objective pour le présent et une promesse pour l'avenir.

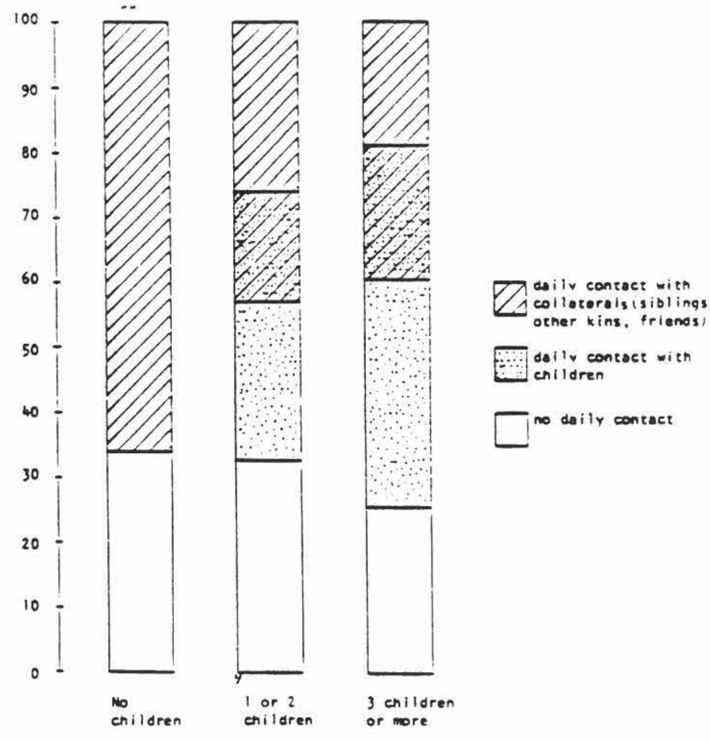
L. ROUSSEL

Name: Jacques Légaré, Nicole Marcil-Gratton

Title of Paper: Human network surrounding future older people: What may we expect from kinship support?

Summary: The acceleration of population aging in developed countries will without any doubt create tremendous pressure, in terms of sheer numbers, on the numerous services that societies must provide for their elderly. The fear does exist that such pressure may extend to the family network, and that thus the future old will not be able to rely on the offspring they chose not to have. Shall we expect that this relative lack of children will lead to a growing proportion of older people living alone and isolated, without the daily support that can be more easily sought from a larger family? Shall we rather witness the transfer of such support from the children to a network of collaterals, may they be siblings, other kins or friends? Part of the answer may be found in examining how present-day elderly with a demographic profile similar to that of a great many future old cope with the prospect of isolation. Using Canadian data collected from a sample of 3150 persons aged 65 and over living in private households, we tested the hypothesis that a transfer does exist from offspring support to collaterals, and that isolation in old-age is not necessarily linked to previous fertile behavior (see graph). Overall, the proportion of elderly Canadians without spouses that have no daily contact with either their offsprings or collaterals does not vary significantly whether they have many, little, or no children at all; greater support is offered by the children when there are many, but in all cases contacts with collaterals do compensate for the lack of intergenerational links. That may reflect a general tendency in our societies to steer away from family life and responsibilities; we may then expect the future old, as the former old did before them, to live through their twilight years as they did in their zenith.

PROPORTIONS OF CANADIANS AGED 65 AND OVER, WITHOUT SPOUSES, WHO HAVE DAILY CONTACT WITH THEIR CHILDREN AND/OR COLLATERALS, ACCORDING TO THE NUMBER OF CHILDREN THEY HAVE



Source: General Social Survey 1985, Statistics Canada.

Andrej Boozin

DEMOGRAPHIC CONSEQUENCES OF CONSANGUINEOUS MARRIAGES IN SMALL POPULATIONS

Some stochastical models of demography of monogamous population with nonoverlapping generations are considered. Random numbers of sibs' and cousins' marriages are investigated. Their distributions are near to Poisson, but the average values are smaller then the classical estimations by O.Frota-Pessoa or A.Jacquard (e.g. the later for the number of cousins' marriages is 4.5; our estimation is 3.5).

The demographic consequences of marriages between near relatives follow from the fact, that the number of offsprings depends on the kinship coefficient of parents. This effect being irregular and insignifficant for a distinct generation becomes apparent on evolutionary time intervals.

Suppoused that the number of consanguineous marriages may by substituted with stationary stochastical processes with Poisson distributions, the demography of population is described as some marcovian process. Further simplification takes into account the deviation of population rate caused by the random sex disproportion (this deviation is of order $1/\sqrt{N}$, where N is the number of marriages in previous generation).

The simplified model is marcovian process, which transition probabilities may be easy calculated. In particular, while consanguineous marriages are prohibited (incest-taboo) we have Galton-Watson branching process. Some estimation of "characteristic selection time" of population with incest-taboo are discussed.

Name: **Jan Nelissen / Ad Vossen**

Title of Paper:

Applying a microsimulation model to project the future structure of families and households.

Summary:

One of the most prominent societal features of this century is the longlasting and continuous tendency of individualization. This has, among others, been reflected in the way people live together and form and dissolve household units. In this respect modern societies can be characterized as highly pluriform. As a consequence, this pluriformation has made it far more difficult to make accurate forecasts of the future household composition. In more traditional models, household composition is determined by means of headshiprates. Consistency with the assumed trends in fertility and family formation is in this case, however, hard to guarantee. Microsimulation approach has solved this kind of consistency problems.

In our paper we present household forecasts for The Netherlands (2010) produced by a microsimulation model (TYLDYMAS).

After introducing the paper in short, the main principles of the microsimulation model are explained for those who are less familiar with the subject. Thereafter - in a rather simplified way - two context scenarios are constructed, functioning as alternative societal 'environments' of the household system in the year 2010. Next - as a substitute of real household theory - some hypotheses are formulated, relating the main elements of the context scenarios with processes of household formation and dissolution. After some general considerations, the conceptualization of the household system requires our attention, followed by the formulation of the assumptions regarding the future state of the key parameters of the household model, as 'logically' to be deducted from the combination of the context scenarios and household 'theory'. Finally the simulation results are presented and commented on.

Name: Viviana Egidi and Alvaro Tomassetti

Title of Paper: A method for projecting families. Some consequences of actual demographic behaviour on family dynamics in Italy.

Summary: This paper provides some of the preliminary findings of an ongoing research project on Italian family features and trends and the repercussions on the social security system of demographic behaviour affecting the formation and break-up of the family. The definition of the family used for the research comprises married couples with children (nuclear families) or without children (conjugal units), one-parent families with children, and one-person families.

The approach adopted considers that changes in family size and structure are strictly related to the life history of the family members and to the history of the relationships between the members. The reconstruction or the simulation of the life histories of individuals related to the same family unit is used to describe the group dynamics and predict possible future developments. Of all the many events that may characterize the life history of each individual, only the those which directly influence the processes of family formation, break-up and structural features. More specifically, only the events relating to the three different careers are considered for each individual: survival career, marital career and fertility career. For the children, in addition to considering the possibility of departure from the original family unit for marriage, the research also considers departure to form a one-person family comprising a single unmarried male or female. The new family units formed by the departure of the children from their parents' family are examined independently.

Each event experienced by any family member affects his life history, modifying his status and the status of the other members of the family, and hence the size and features of the family unit, through the relationships between family members.

A stochastic microdemographic model was elaborated to simulate individual life histories and their relationships in the family groups. The basic unit selected to develop the model is the family unit, whose dynamics are viewed as an outcome of several interrelated stochastic processes, and are monitored year by year through the events experienced by each of its members. Although the model works on a discrete time basis, it does not share the drawbacks of the traditional discrete models, in that this model provides for the occurrence of multiple events to the same individual during an elementary time interval in a hierarchical causal order, which varies from one individual to another, even within the same elementary time interval (one year). The kinship relations in the family unit are expressed in terms of a conventional family head, whose sex, age and marital status are also used to classify the family units.

Name: Magdolna Csernak and Kalman Szabo

Title of Paper: CHANGES OF FAMILY AND HOUSEHOLD COMPOSITION IN HUNGARY

Summary:

Since the end of the Second World War social, political and cultural conditions in Hungary have changed radically. Changes occured in a very short period of time and they affected both functions and demographic features of the families.

One of the most important demographic changes observed in the past few decades was the decrease of average size of families. By 1984 the average size of families fell below three persons. There was a significant decline in the average household size as well.

The main processes contributing to the changes are the following:

1. the decline of fertility and mortality in a long term perspective
2. the nuclear family, reduced to parents and children, becoming dominant
3. the single-parent families spreading
4. the high rate of persons living alone.

Among the social factors in the background the housing conditions have got a great impact on the changing of families and households. Besides both parents and married children tend to live separately and the demand for independent life for others is increasing, too.

Since the seventies the high frequency of divorce and decreasing propensity for remarriage have played an important role in the formation of incomplete families and one-person households. Nowadays after ten years of marriage already 20 p.c. of all marriages are dissoluted and only about every second person marries again.

Since the mid-seventies the rates of first marriages have also been declining. It is possible that men and women do not only postpone their first marriage but an increasing part of them ramains ultimately single.

In spite of these phenomena it is expected that marriage continue to give a framework to family life. It may also be supposed that the structure and other demographic features of families in the future change to a lesser extent than it was experienced in the previous decades.

Name: Dr. Klaus-Peter Möller

Title of Paper: SIMULATION MODEL FOR THE DEVELOPMENT OF FAMILY STRUCTURES

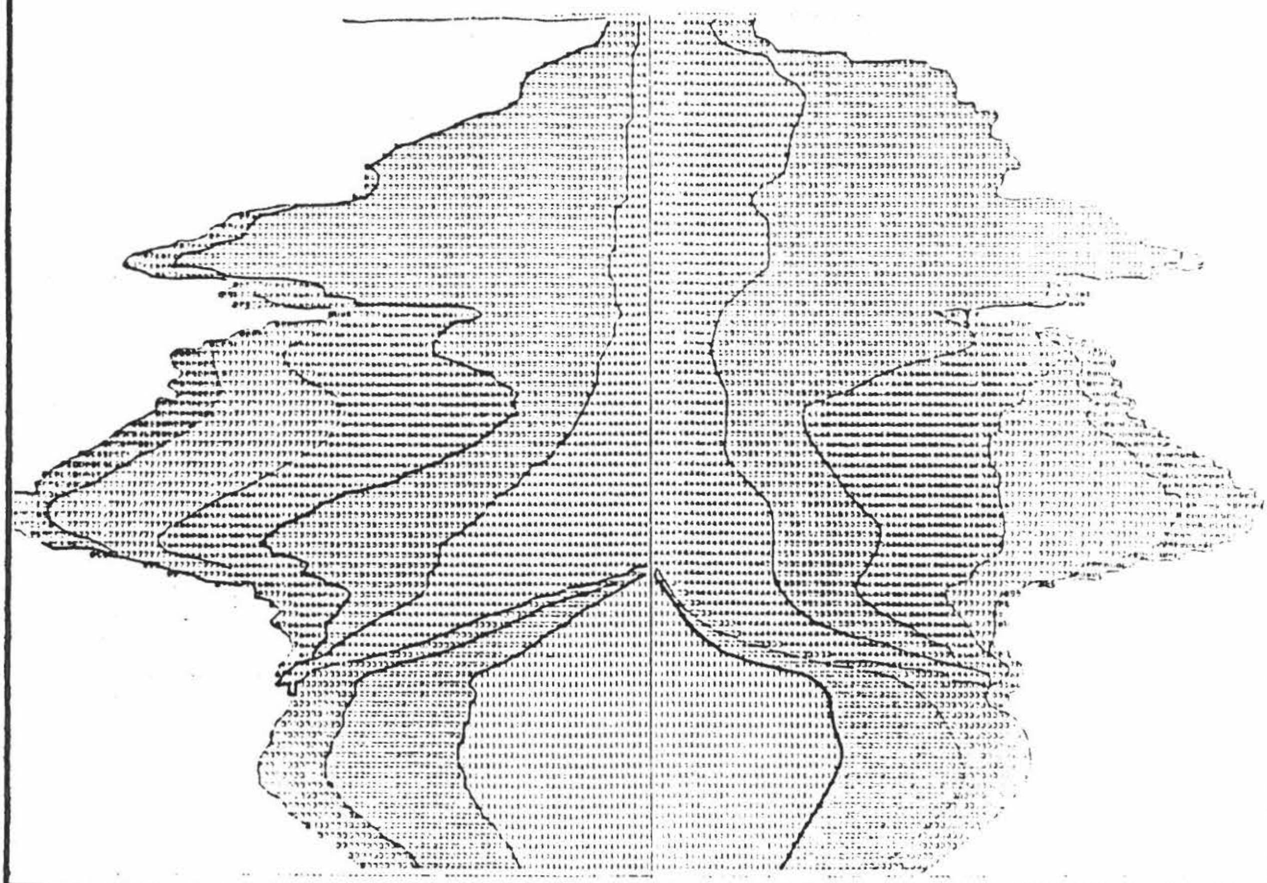
Summary:

A computer model for the simulation of family future structures in a country with uneven age structure (West Germany) is developed at the Institute for Applied Systems Analysis and Prognosis in Hannover.

The presentation gives an overlook on the demographic premisses (fertility, mortality and imigration) for the basic population model, a description of the model structures to simulate family relations between children (by sequence number of birth) and their parents and the results of the simulation for the time up to the year 2000.

Computer outprints and plots of the future family Formation in the different age groups are shown.

AGE STRUCTURE AND FAMILY FORMATION IN WEST GERMANY IN THE YEAR 2000



Name: Robert A. Horváth

Title of paper: Future structures of families and households - the point of view of a population economist

The fact that the theory of population growth is not sufficiently integrated with the theory of econonic growth was last time stressed by SPENGLER and is felt more since population policy became more general adopted either on political or moral grounds.

However, the emphasis was laid more on pure demographic factors, than on economic ones, even if their effects were considered on household formation and economic well-being of families as recently in a paper of KINGSLEY DAVIS. His theory of the replacement of the agrarian "household economy system" by the industrial and urbanized "breadwinner system" as a consequence of the Industrial Revolution is insisting only on demographic factors by the changing feature of the division of labour through the increasing employment of women by altering the family size and its composition. This theory - remarkable from the pure and applied demographic point of view - does not include the contribution of population economics in absence of which no comprehensive synthesis may be possible for the social scientist in the broader sense.

The economic theory of "population optimum" has already demonstrated the rising costs of population growth within the conditions of industrialized and urbanized societies and has also shown that a considerable part of them is due to losses arizing from technological, economic and environnemental changes, analysed the first time thoroughly by KUZNETS, among them also those ensueing from the change in skill, know-how, education and general culture. Even if not well documented yet, many researches are indicating that these costs are increasing in stagnating and even in decreasing developed populations and within them the share of the procreating and raising of children. Parallel to it, there is a considerable shift of these costs to others than the family because of the consequences of the breadwinner system and the ageing of the population,having a redistribution effect on individual incomes and social funds, - a question nearly retaining exclusively the attention of population policy makers.

The present author is insisting on the need of the revision of the theories of welfare economics on the basis of detailed cost calculations of the involved sub-populations in a macro-economic system, i.e. the costs of the replacement of population and within it the share of the female population not only as a part of "human capital", but as the core of family and household as a "birthplace" of children. Only by measuring the impact of these social costs and their alternatives in monetary as well as in material terms compared to GNP and NI the future trend of a satisfactory level of life-cultural, moral and even aesthetic requirements included - may be assessed an planned.

NAME: Michael Bracner and Gigi Santow
TITLE OF PAPER: Changing of family composition from life history data

SUMMARY:

Australia has undergone fundamental demographic change this century entailing fertility decline, increased longevity and, over recent decades, an increased incidence of marital dissolution. This has had an immediate effect on patterns of co-residence, most obviously on household size and more subtly on household composition. Such demographic change is not unique to Australia and our findings are broadly applicable also to other industrialized countries.

In 1986 the Australian Family Project screened a nationally representative probability sample of slightly more than five thousand private dwellings. Face-to-face interviews were conducted with all women aged between 20 and 59 years who were usual residents and agreed to participate. The collection through these interviews of detailed event histories of residence and housing, marital unions, childbearing and co-residence of each child enables us to chart who each respondent was living with, month by month, throughout her life. This in turn allows us to put together a dynamic picture of family composition, from childhood until the time of interview, from the point of view of a referent woman, in contrast with the static picture obtained from cross-sectional or census data. The analysis relies heavily on graphical representations of age-cohort allocation of exposure in different states.

Women now in their fifties, who were born over the decade spanning the Great Depression, were the latest to leave their childhood homes, and women in their early thirties the earliest. Linking the time of leaving home to marriage, and then to childbearing, demonstrates the increasing importance of a number of key states. First, women are now less likely simply to exchange one familial situation for another by moving from home to marry or, more recently, to live with a boyfriend. Nevertheless, the intermediate state has not assumed the significance implied by a comparison of leaving home and first marrying because much of the exposure in the never-married state of the youngest women is now being spent in consensual unions. Secondly, because of profound changes in patterns of childbearing women are now spending more time with a spouse but no children. Another state to gain in importance is that of being with neither spouse nor children; another is that of lone parent.

Given the upper age limit of 60 years the survey provides an incomplete picture of changing co-residence patterns beyond middle age. But at younger ages the picture is detailed and clear. Consensual unions partially compensate for later marriage, and the conjugal state has therefore not become as unpopular as recent marriage statistics would suggest. It is nevertheless true that increasingly fewer women move straight from the parental home to establish their own family unit, and that more live alone or in shared accommodation with friends. When they do move into a marital union it is far more likely to be informal, perhaps leading to marriage but perhaps not, and their middle years are spent with fewer children. Young women are more likely than their mothers to spend time out of union, and to spend time as lone parents.

Name: KING-MEI TSAY

Title of Paper: LIVING ARRANGEMENTS OF AISAN IMMIGRANTS IN THE UNITED STATES

Summary:

The rapid growth of Asian population in the United States during the past two decades has received increased attention. In 1978, Asia overtook North and Central America as the largest source of U.S. immigrants and it has maintained its predominance ever since. Of these Asian immigrants, the six largest subgroups include the Chinese, Filipino, Japanese, Asian Indian, Korean, and Vietnamese. The present paper examines differentials in living arrangements patterns among these Asian ethnics. Specifically, the research aims at investigating the residential choices of living in extended families versus nonfamily households among the unattached individuals. The data were drawn from 1980 Census Public-use Microdata, one-percent sample of foreign born population.

The results of the analysis indicate cultural variations in residential choices among Asian immigrants. The paper additionally demonstrates that the hypothesized factors such as life cycle and gender have significant relationships with household patterns. For all Asian ethnics, the tendency for the unattached individuals to live in nonfamily increases with age and then declines in the older age groups. Moreover, it is found that the extent of nonfamily living varies with gender. In most cases, men are more prone than women to form one-person households or reside with nonrelatives. Holding the effects of age and sex constant, the data reveal that Japanese and Asian Indian immigrants have the highest proportion of untied individuals reporting as living alone or as nonrelative of household head.

The choice of family extension is also prevalent among Asians in the United States. There is convincing evidence that this type of living arrangement appears to be negatively related to duration of residence in American society. The inclusion of other relatives in the household may be a strategy which recent arrivals adopted to make economic adjustment to the new environment. Lastly, the data confirm that variation in cultural preferences regarding family extension clearly exist among these Asian minority groups. Filipino immigrants are most likely to establish extended households as compared with other Asian counterparts.

NOTES

SESSION 4

The Future of Mortality

Organizer: Tapani Valkonen

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THE FUTURE OF MORTALITY IN INDUSTRIALIZED COUNTRIES

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Prepared for the IIASA conference
on Future Changes in Population
Age Structures, Sopron (Hungary),
October 18-21, 1988

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The future of mortality in industrialized countries

The purpose of this paper is to give a background for the sessions on the future of mortality. The paper is divided into five sections. The first one is a review of the recent trends in mortality in industrialized countries. It is partly based on an earlier review prepared by Bourgeois-Pichat (1984). The second section deals with the assumptions about the trends in mortality made in some recent population projections and discusses the effects of alternative mortality assumptions. Methods for preparing mortality projections are discussed in the third section. The fourth section summarizes the discussions on the effects of eliminating certain causes of death and also considers the related question concerning the assumed biological limit to life. The final part of the paper attempts to identify the main open questions in the future of mortality. I raise four such questions and hope that the papers and discussions in the conference will contribute to answering them.

1. Recent mortality trends and projections

Bourgeois-Pichat has recently (1984) presented an excellent review of mortality trends in industrialized countries. The review covers the period 1960-1981. Below I summarize some of the main findings in the review and complement these with additional data.

Figure 1 shows the development of life expectancy at age one in Japan, the USSR, Eastern Europe and the other

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I am indebted to Pekka Martikainen and Raili Tynkkynen for their assistance in the preparation of this paper and to Seppo Koskinen and Tuija Martelin for their helpful comments.

industrialized countries from 1960 to 1981. The four curves show very disparate trends. All the countries or groups of countries were at similar levels in about 1965 but after that the four curves form a fan which opens wider with time. At the bottom is the USSR, then comes Eastern Europe, where the levels have changed little. In contrast to the USSR and Eastern Europe are the capitalist countries in which health is improving continuously. Japan, however, beats all records for improvement.

Bourgeois-Pichat (1984, 194) shows that the Eastern European countries form a fairly homogenous group, whereas the variation within the industrialized capitalist countries is larger. On the basis of data on life expectancy in 1980, Bourgeois-Pichat distinguishes between a group of "vanguard" and "rearguard" countries. The vanguard countries include Iceland, Norway, Sweden, the Netherlands and Switzerland (life expectancy at age one 75-77 years); the rearguard countries are Malta, Scotland, Northern Ireland, Portugal and Yugoslavia (life expectancy at age one 70-71 years). The remainder may be called average capitalist countries. This classification is used in Tables 1 and 2, which present data on life expectancy at birth according to sex for individual countries for five-years periods between 1960-84 and for the latest single year, the data for which were obtained from the 1987 World Health Statistics Annual. The same data for groups of countries are presented in Figure 2.

The female life expectancies in the vanguard, average, and rearguard capitalist countries followed broadly parallel and rising trends from 1961 to 1984, the intervals between groups remaining about the same. For the males in these countries there was, on the average, only little improvement in the 1960's and the beginning of the 1970's. In fact, male life expectancy declined temporarily in several industrialized countries. During the last 10-15 years male life expectancy has again increased in most of these countries. For the vanguard countries the gains have been smaller than for the others and the gap in male life-expectancy between the vanguard and rearguard countries has diminished from six to four years.

The pace of the increase of life expectancy for both sexes has been spectacular in Japan: the gain from 1960-64 to 1986 was about 10 years for females and 9 years for males. There was no stagnation in the rise of male life expectancy in the 1960's and the latest (1986) figure of 75.5 years is two years higher than the average for the vanguard countries.

At the beginning of the 1960's the average life expectancy of the rearguard countries was below Eastern Europe, but the difference diminished with time, and disappeared by the end of the 1970's for both males and females. The average male life expectancy in Eastern Europe is currently only slightly higher than at the beginning of the 1960's. The female life expectancy in Eastern Europe has risen by about two years. The development has thus been better than among males but not as good as among the females in the industrialized capitalist countries.

The World Health Statistics Annual, which was used as the source for the data on life expectancies, does not include data for the Soviet Union. The source for the figures presented in Tables 1 and 2 and Figure 2 is an article by Blum and Pressat (1984), which is based on Soviet statistics. Since the data do not cover all years estimates for the five-year periods were made by graphic extrapolation.

If the data are correct, male life expectancy at birth declined from 66.3 years in 1964-65 to 62.5 years in 1978-79. During the first half of the 1980's life expectancy was almost unchanged, but the figure for 1986 (65.0) shows a clear improvement.

Female life expectancy remained stable at about 74 years from 1964 to 1972 but thereafter declined to 72.6 years in 1978-79. The recent rise in female life expectancy is smaller than that of male life expectancy. The difference between female and male life expectancy has, therefore, diminished from 10.4 years in 1978-79 to 8.6 years in 1986.

To obtain a more detailed picture of the trends in mortality the average annual changes in mortality for 10-year age-groups from 1970 to 1984 were calculated for selected countries representing the sub-groups used above (Figure 3). The decline of mortality has been rapid in ages 0-14 in all countries with the exception of the Soviet Union. The development of mortality in these age-groups and among young adults is, however, unimportant for the development of life expectancy in countries, where low levels of mortality have already been reached. The differences in the trends of life expectancy are mainly due to the differences in developments for the middle-aged and elderly population.

In Japan, where the rise of life expectancy has been most rapid, the decline has been marked in almost all age-groups. In Norway, death rates have also diminished in all age-groups for both sexes, but much less than in Japan. The unfavourable development in Hungary seems to have stemmed from an increase in mortality among both males and females of working-age. Similar increases are also seen among males in other Eastern European countries. The decline of life expectancy in the Soviet Union is partly due to the exceptional increase of infant mortality.

It is interesting to note that the relative decline in mortality is generally almost as rapid in the old female age-groups as in the younger age-groups. This observation is relevant to the question of the possible biological limit to life expectancy, which will be discussed later in this paper.

An analysis of the trends in mortality by cause of death would also illuminate the differences in the development of life expectancy, but such an analysis is beyond the space limitations of this paper. Some results from the review by Bourgeois-Pichat (1984), may be mentioned, however. He distinguished between only two broad groups of causes of death - cardiovascular diseases and other diseases (Bourgeois-Pichat 1984, 205-216). Bourgeois-Pichat concluded that male mortality from cardiovascular diseases had been rising in many countries, including those in Eastern Europe, until about 1965. In the Eastern European countries male mortality has continued to rise, whereas it has tended to decline in the other European countries. Trends in other diseases than cardiovascular reveal no obvious differences between Eastern Europe and other countries, although the level of mortality is higher in Eastern Europe. Cardiovascular diseases thus play an important role in the deterioration of male health in Eastern Europe.

There was almost no change in female cardiovascular mortality in Eastern Europe from 1969 to 1977. In the rest of Europe and in Japan cardiovascular mortality has declined continuously since the Second World War.

2. Assumptions about the future of mortality and its effect on projected demographic development

In addition to past trends, Tables 1 and 2 and Figure 2 also include the projected life expectancies for the future according to the World Population Prospects as Assessed in 1984 published by the United Nations. The mortality assumptions in the United Nations projection are in the form of life expectancies at birth and age and sex patterns of probabilities of surviving, which correspond to different levels of life expectancies at birth. The assumptions for the more developed countries are presented and expressed very briefly: "For those countries in which life expectancy at birth has reached a high level, the maximum assumed level of life expectancy at birth was assumed to be 75 years for males and 82.5 years for females" (United Nations 1987, 9). This assumption is the same as in the 1982 assessment, but lower life expectancies were used in the 1980 assessment, namely 73.5 years for males and 80 years for females. The change was made "in accordance with current demographic records in several developed countries" (United Nations 1985, 10).

According to the UN projection the maximum female life expectancy (82.5 years) will not be reached in any country by the year 2025. On the basis of Figure 2 it can be estimated that female life expectancy would reach the limit of 82.5 only in the late 2040's. The assumptions about the development of female life expectancy seem rather cautious, at least for the industrialized capitalist countries. Japan has already reached the projected 2020-25 level and Switzerland the projected 2000-05 level. In each of the three sub-groups of the capitalist countries the average latest life expectancy is higher than what would have been expected based on the UN projection. For Eastern Europe and the Soviet Union the UN projection for females is possibly too optimistic, at least in the near future. The gap between Eastern Europe and the rest of the countries appears not to be narrowing in the way anticipated.

The United Nations projections about male life expectancy seem even more questionable than those for females. The assumed maximum life expectancy for males is 75 years. Japan and Iceland have already exceeded this limit. The UN projection assumes that the rise of male life expectancy will end in Japan in the late 1990's, and in the vanguard capitalist countries by 2025. This implies that the life expectancy for females will continue to rise for 25-50 years longer than that for males.

The UN projection assumes that, similarly to female life expectancies, male life expectancies for all countries will converge and the differences between groups of countries diminish. Actual developments in the 1970's and 1980's, however, show a widening of the mortality gap both between Japan and the rest of the capitalist countries and the capitalist countries and the socialist countries.

It is interesting to compare the UN assumptions with those made by national experts on population. Table 3 compares the assumptions about the development of life expectancy in selected national population projections with those of the UN projection. All the countries included in the table are vanguard or average capitalist countries, in which mortality is declining and the assumptions of earlier projections have recently been corrected towards higher life expectancies.

Most of the projections are relatively similar to the UN projections. The Danish projection is, however, more pessimistic than the UN projection; it assumes that the male life expectancy will remain at the 1983-84 level and the maximum female life expectancy will be as low as 79 years. The projections for Norway, Sweden and the Netherlands are based on the explicit assumption that the rise of life expectancy will not continue beyond the year 2000.

The "trend" projection for French females is clearly more optimistic than the UN projection, whereas the projection for males is in line with the UN projection. The "low" mortality alternative for France is based on the assumption that the increase of life expectancy is twofold to that in the trend projection. This assumption leads to clearly higher life expectancies than the maximum life expectancies in the UN projection.

The projection for the United States covers a much longer period than the other projections. It assumes that the decline of mortality will continue until the year 2080. The maximum projected life expectancies are, therefore, higher than those for the other countries. The projected life expectancy in the year 2000 is 72.9 years for males and 80.5 years for females. These life expectancies are almost the same as those projected by the United Nations.

Mortality is usually considered the least problematic component of population projections, since the errors in the projected total populations caused by wrong mortality assumptions are small when compared to the errors caused by wrong fertility or migration assumptions. Mortality is not, however, totally unproblematic, since the sizes of the oldest age-groups depend almost solely on the development of mortality. The population projection publishhed by the Central Statistical Office of Finland in 1969 (Hartman 1969) serves as an example of the significance of mortality assumptions. According to this projection the population aged 75 and over should have been 180 000 in 1985, when actually it was 250 000, an error of 40 per cent. The projection was based on the assumption of constant mortality, and the error was caused by a rapid and unanticipated decline of mortality which followed the unfavourable development in the 1960's. According to the latest projection (1985) the over 75 population will be about 80 per cent larger in the year 2000 than was projected in 1969. Large errors in the projected sizes of the elderly population have a harmful effect particularly on plans and decisions in health and social policy.

A more systematic picture of the demographic influence of varying mortality assumptions can be obtained by comparing results of projections based on different assumptions of the development of mortality. As an example of such a comparison I shall use the rather realistic calculations presented by Benjamin and Overton (1981). More speculative long-term calculations have been presented by Vaupel and Gowan (1986).

Benjamin and Overton constructed three projections of death rates for England and Wales from 1978 to 2018. The first (medium) projection assumes continuation of present trend; the second assumes that there is no improvement in mortality rates of persons over the age of 30; and the third is an optimistic projection which assumes inter alia that most cancers are eliminated and that the deaths from most diseases would occur ten years later than they do now. According to the medium projection the male and female life expectancies at birth are 74.4 years and 80.4 years, according to the pessimistic projection 71.3 and 77.3 and according to the optimistic projection 81.3 and 87.1, respectively.

The population projections, which differed from each other only with respect to the mortality assumptions, resulted in the following populations for selected age-groups for the year 2018:

	Medium	Pessi-mistic	Opti-mistic
Total popul. (million)	53.5	51.9	57.6
Econ. active ages*	32.9	32.5	33.2
Pensioners	10.0	8.7	13.8

(* Men aged 15 to 64 and women aged 15-59.)

The figures show, that mortality assumptions influence only slightly the sizes of the projected working age-population for the year 2018. For the younger age-groups the difference would be even smaller. On the other hand the sizes of the old age-groups will depend heavily on the development of mortality, and this will also have consequences for the size of the total population. The influence of mortality assumptions is, of course, much more marked for the oldest age-groups of pensioners than for all pensioners.

3. Comments on the methods of mortality projection

Methods of mortality projection have been described and discussed earlier by e.g. A.H. Pollard (1949), Pressat (1974) and Preston (1974) and recently by J.H. Pollard (1988). I shall, therefore, only make some general comments about them.

Assumptions about future mortality are for the most part based on the extrapolation of past trends of age-specific death rates. The extrapolation may be graphical, in which case qualitative aspects and expert opinions can be taken into account. Mathematical extrapolation is a common and less subjective method. The improved objectivity of mathematical extrapolation is, however, questionable, because the projected results depend on the length of the period on which the calculation is based and on the formula used.

One way of trying to improve the understanding of the past and the projection of future development is to use cohort analysis (see e.g. Osmond 1985 and Hamajima and Aoki 1984). This is done by using data on age- and period- specific death rates and by applying a statistical model which includes parameters describing the effects of age, cohort and period. As Hobcraft and Gilks (1984) emphasize, there are problems in the identification of such a model, but users of this approach have not always been aware of them.

A basic choice made in the preparation of mortality projections is that between using data on total (all-cause) mortality or using data on mortality by cause of death. In most cases mortality assumptions for national population projections are based on an analysis of the trends in total mortality. There are exceptions, however, for example the population projection for the United States (U.S. Bureau of the Census 1984) and for the elderly in England and Wales (Alderson and Ashwood 1985) being examples. Cause-specific analyses of the changes and future prospects of mortality are more common in studies oriented more towards health policy planning than to population forecasting (e.g., Valkonen 1986, Hamajima and Aoki 1984).

Factors affecting mortality from different causes of death differ and the trends and rates of change may vary. The analysis of cause-specific death rates is a better basis for understanding the past trends and for projecting the future than an analysis of total mortality. More work in the cause-specific analysis of mortality trends is, therefore, needed.

The methods described above are based on the utilization of data on past mortality trends only. In addition, outside information is often used. The most common type of outside information considered is the mortality experience of "more advanced" populations in which the life expectancies have reached high levels. For example, the mortality projections for Finland have been based on the assumption that the Finnish death rates will reach the recorded levels of Swedish death rates after a certain time lag.

Information on "advanced" populations might be used more than what has been the case thus for. An analysis of mortality trends in regions with exceptionally low mortality within countries with the highest life expectancy (e.g. Japan, Norway and Sweden) would be particularly interesting from this point of view. Studies in several countries have shown large differences in mortality between socio-economic groups and educational categories (see e.g. Valkonen 1987). Persons with high socio-economic status and a high level of education may be taken as an "advanced" population and data on their mortality patterns could be utilized in making mortality assumptions for national populations.

Another kind of outside information used in making mortality assumptions concerns the effects of non-demographic factors on mortality, such as advances in medical techniques or changes in the prevalence of risk factors of diseases. A most obvious factor affecting mortality is cigarette smoking, and the effects of possible changes in smoking habits have been estimated in several studies (e.g. Martelin 1985; Benjamin and Overton 1981). Manton (1986) has presented an ambitious model-based method through which the effects of the simultaneous dimishing of the exposure to several risk factors of diseases can be evaluated.

4. Cause-elimination calculations and the problem of the biological limit to life

A well known method for evaluating possibilities for mortality decline is to calculate how much the elimination of a certain cause of death would increase the life expectancy of a population. These kind of calculations have been quite common (see e.g. Pressat 1974, 531; Preston, Keyfitz and Schoen 1972; Keyfitz 1977). They are usually not used directly in making assumptions for population projections, but are rather prepared mainly to aid in setting up health goals, allocating resources and evaluating health programmes.

An example of a study on the effects of a reduction of mortality in leading causes of death is the article by Tsai, Lee and Hardy (1978), which examines the potential gains in expectation of life among the United States population when the three leading causes of death are totally or partially eliminated. The calculations are based on data for 1967-71. The authors conclude that the impressive gains theoretically achieved by a total elimination of certain diseases do not hold up under the more realistic assumption of a partial elimination. The number of years gained by a new-born child, under a condition of a 30 per cent reduction in major cardiovascular diseases would be approximately two years, whereas the total elimination would give 12 years. A 30 per cent reduction in cancer mortality would raise life expectancy at birth by only 0.7 years.

A more optimistic view of the potential gains in life expectancy is presented by Schatzkin (1980), who believes that it is possible to reach nine or perhaps ten decades of vigorous and healthy life by eliminating such social determinants of premature death as smoking, excessive animal fat consumption, hypertension and alcohol consumption. These are common risk factors for the major causes of death. Schatzkin argues that their simultaneous elimination would result in greater gains in life expectancy than the single-cause elimination on which the results presented by Tsai, Lee and Hardy were based. Schatzkin does not, however, present exact calculations to support his arguments.

The studies on the effects of eliminating or diminishing certain causes of death are closely related to the discussion of the hypothesis of a biological limit to life expectancy. According to this hypothesis, the increase of life expectancy for populations cannot continue indefinitely because of the unavoidable restrictions caused by the biology of the human species. Several researchers have made calculations to determine this biologically determined maximimum life expectancy. For example, Bourgeois-Pichat presented estimates about the "temporary" limit on mortality decline already in 1952. This limit was assumed to be determined by the so called "endogenous" deaths. "Exogenous" deaths, which are avoidable, included infective and parasitic diseases, diseases of the respiratory system and accidents, poisonings and violence. Using data from Norway, Bourgeois-Pichat estimated that the biological limit for life expectancy at birth was 78.2 and 76.2 years for females and males, respectively. In 1978 he revised his calculations and gave new estimates: 80.3 years for females and 73.8 for males (Bourgeois-Pichat 1978).

The idea of a biological limit of life expectancy has more recently been presented as the theory of the "rectangularization" or " squaring" of the survival curve (Fries 1980, Fries 1983). According to Fries there is a finite life span, which appears to be approximately 85 years. The life expectancy can rise toward, but cannot exceed the life span. The increase of life expectancy is due to the increasing share of the population who die a "natural death", that is, from general frailty caused by the aging of the organism. As premature deaths due to diseases are eliminated, more and more people achieve the fixed life span and the survival curve becomes "rectangularized".

Myers and Manton (1984) have noted that relatively little empirical work has been undertaken to assess the existence of rectangularization. They examined several aspects of the issue using data from the United States during the twentieth century and specificially during the period 1962-79. They conclude that there is no evidence that rectangularization has had a significant effect on the population and mortality dynamics of the elderly, at least through 1979. According to them there is little direct evidence to suggest that the U.S. population is currently near a biological limit of life span that is constraining increases in life ecpectancy, even at advanced ages.

Fries (1984) disagrees with the conclusions presented by Myers and Manton and argues that their analysis contains several fallacies (flaws). Manton and Soldo (1985, 221-223) have continued the debate by carrying out certain additional calculations suggested by Fries. The results of the calculations suggest that the effects of retangularization have been minimal.

Olshansky and Ault (1986) interprete the implications of the recent decline of mortality in the United States in a way that is closer to the view of Myers and Manton than that of Fries. They use the term "fourth stage of the epidemiologic transition" to summarize their view. According to the older "theory of the epidemiologic transition" presented by Omran (1971) there are three stages in the epidemiologic history of mankind. These stages have been characterized generally by a substitution of degenerative diseases for infectious diseases.

On the basis of their analysis of mortality data Olshansky and Ault conclude (1986) that the United States appears to have recently entered a fourth stage in the epidemiologic transition - a stage characterized by rapid mortality declines in advanced ages caused by a postponement of the age at which degenerative diseases tend to kill. They refer to this redistribution of degenerative diseases as The Age of Delayed Degenerative Diseases - "a stage that will propel life expectancy into and perhaps beyond eight decades".

A combination of several factors is responsible for this new era in the epidemiologic history. These factors include reductions in some major risk factors for degenerative diseases such as declines in smoking, more exercise and improved dietary habits and advances in medical technology and public health measures that favor the old over the young. During the fourth stage of the transition the major degenerative causes of death remain the major killers, but the risk of dying from these diseases is postponed until older ages (Olshansky and Ault 1986).

According to Olshansky (1987, 364) we do not know enough about the precise nature of the new era of delayed mortality to judge how long it will continue. In any case the era will end sooner or later when the inevitable average limit to life is reached. "If the era is long lived, we face unknown constraints imposed by an average biological limit to life that is beyond current estimates of 100 years of life."

The arguments concerning the "rectangularization hypothesis" and on the "fourth stage of the epidemiologic transition" are interesting and highly relevant to the projection of future mortality. It should be noted, however, that the discussion has been based mainly on empirical data from the United States. It would be interesting to discuss these concepts in the light of data from several other countries. Martelin (1988) and Kannisto (1988) have recently presented relevant data on mortality at old age for the Nordic countries. Martelin will summarize the results of these studies in her paper at the Sopron conference.

5. Open questions in the future of mortality

In the previous sections I have discussed several aspects connected with the future of mortality in industrialized countries. I shall not try to summarize these aspects here. Instead, I should like to distinguish the following specific questions to be discussed in the sessions on the basis of the contributed papers:

The future of female mortality. In all industrialized countries females have higher life expectancy than males. Females are thus the vanguard who should be the first to show the limit of the possible decline in mortality. In the light of the material presented above the decline of female mortality is likely to continue even in those countries where female life expectancy already is the highest. A most important question is how far this decline can continue. Is there a fixed or changing limit to longevity? If a limit exists, is it closer to 80, 90 or 100 years and how long does it take to reach it?

The future of excess male mortality. The difference between female and male life expectancy has, in general, increased in industrialized countries. We do not know to what extent excess mortality and the increasing gap between female and male life expectancy is determined by biological factors and to what extent by socio-cultural factors. Is it possible for men to reach the same high life expectancy as women? If not, what is the likely minimum excess mortality of men?

High mortality countries. There is considerable variation in the levels of mortality among the industrialized countries. There seems to be no necessary reason why mortality in Eastern Europe should remain permanently higher than in Western Europe, although the trend has been moving towards a widening gap. A problem for research is to reveal the factors that prevent the currently high mortality countries from reaching lower levels.

Medical breakthroughs, catastrophes and other unanticipated factors. It is possible and even likely that new factors, not taken into account in our current projections, influence the future of mortality. There may be breakthroughs in medicine, which help to prevent or cure cancer, heart diseases or other major causes of death. On the other hand, wars, ecological or economic catastrophes or epidemics may cause an unexpected increase of mortality. It is not possible to estimate the influence of these kinds of factors, and we tend to ignore them in our mortality projections. There is, however, one relevant factor which we already know, namely the epidemic of AIDS. I have therefore invited Dr Heilig to prepare a paper on the influence of AIDS on the future mortality in industrialized countries for the mortality session at the Sopron conference.

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Table 1. Actual male expectation of life at birth in industrialized countries from 1960 to 1985 or to the latest year available and projected expectation of life from 1985 to 2025 (projected by UN)

COUNTRY	WHO Actual 1960-64	1965-69	1970-74	1975-79	1980-84	1985	Projected by UN 1980-85	2000-05	2020-25
JAPAN	66.6	68.8	70.6	72.8	74.3	75.5[7]	74.3	75.0	75.0
VANGUARD CAPITALIST COUNTRIES									
ICELAND	71.3	71.1	71.2	73.7	74.0	75.1	73.6	74.8	75.0
NETHERLANDS	71.3	71.1	71.1	71.9	72.8	73.1	72.7	73.9	75.0
NORWAY	71.1	71.2	71.3	72.1	72.7	72.6	72.6	73.8	75.0
SWEDEN	71.5	71.8	72.2	72.4	73.4	73.8	73.4	74.6	75.0
SWITZERLAND	68.7	69.7	70.7	71.9	72.8	73.8[7]	72.8	74.0	75.0
MEAN	70.8	71.0	71.3	72.4	73.1	73.7	73.0	74.2	75.0
AVERAGE CAPITALIST COUNTRIES									
CANADA	68.4	68.9	69.4	70.5	72.2	73.0	72.3	73.7	74.9
UNITED STATES	66.8	66.8	67.6	69.5	70.6[9]	71.3[6]	70.6	72.9	74.1
AUSTRIA	66.2	66.6	66.9	68.3	69.4	71.0[7]	69.5	72.5	73.7
BELGIUM	67.3	67.6	68.2	69.3	70.3	70.8[6]	70.2	72.8	74.0
DENMARK	70.4	70.5	70.9	71.5	71.5	71.7	71.5	73.0	74.2
FINLAND	65.5	65.7	66.5	68.1	69.9	70.6[7]	69.8	72.6	73.8
FRANCE	67.7	68.1	69.2	70.1	71.2	71.8	70.6	72.9	74.1
FRG	67.1	67.5	67.7	68.9	70.5	71.9[7]	70.4	72.8	74.0
GREECE	70.1	70.6	72.0	72.6	73.4	73.5	72.1	73.5	74.7
IRELAND	68.2	68.5	68.7	69.3	70.3	70.8[6]	70.4	72.8	74.1
ISRAEL	n.a.	n.a.	n.a.	71.3	72.8	73.6	72.8	74.0	75.0
ITALY	67.0	67.8	69.0	70.4	71.4[9]	71.3[5]	71.2	73.2	74.3
LUXEMBOURG	n.a.	66.7	66.9	68.2	69.4	70.6[7]	67.9	71.4	73.3
SPAIN	68.0	69.1	70.2	71.1	72.6[4]	n.a.	71.3	73.2	74.4
ENGLAND & WALES	68.1	68.6	69.1	70.0	71.3	71.9	70.7[1]	72.9[1]	74.1[1]
AUSTRALIA	67.8	67.7	68.0	69.9	71.7	72.2	71.6	73.4	74.7
NEW ZEALAND	68.5	68.2	68.6	69.3	70.6	71.0	70.7	73.0	74.2
MEAN	67.8	68.1	68.7	69.9	71.1	67.5	70.8	73.0	74.2
REARGUARD CAPITALIST COUNTRIES									
MALTA	67.1	68.1	68.5	68.2	69.4	72.3[7]	69.4	72.4	73.7
PORTUGAL	61.6	63.0	64.6	66.1	68.7	70.2[7]	68.4	71.7	73.4
NORTHERN IRELAND	67.7	68.1	67.2	67.8	69.5	70.3	n.a.	(72.5)[2]	(73.8)[2]
SCOTLAND	66.3	67.0	67.3	68.0	69.3	70.1[7]	n.a.	(72.3)[2]	(73.6)[2]
YUGOSLAVIA	63.0	65.1	66.0	67.5	67.8[8]	67.1[5]	68.0	71.4	73.2
MEAN	65.1	66.3	66.7	67.5	68.9	70.0	68.6	72.1	73.5
EASTERN EUROPEAN COUNTRIES									
BULGARIA	68.4	68.9	68.8	68.6	68.5	68.3	69.0	72.1	73.5
CZECHOSLOVAKIA	67.6	67.0	66.6	67.0	67.0	67.3	67.5	71.1	73.1
GRD	67.3	68.1	68.6	68.8	69.1	69.5	69.3	72.4	73.8
HUNGARY	66.4	66.9	66.5	66.3	65.3	65.3[7]	66.9	70.5	72.8
POLAND	65.1	66.7	67.1	66.9	66.9	66.7[7]	67.3	71.1	73.0
ROMANIA	n.a.	n.a.	66.6	67.3	66.9	67.1[6]	67.9	71.0	73.2
MEAN	67.0	67.5	67.4	67.5	67.3	67.4	68.0	71.4	73.2
USSR[3]	65.6	65.6	64.3	63.0	62.5	65.0	66.5	70.7	73.0

SOURCES: Actual life expectancy: World Health Statistics Annual 1986 and 1987 (WHO)
Projections: World Population Prospects, Estimates and Projections as Assessed in 1984 (UN)

1. United Kingdom
2. Estimated on the basis of the projection for Malta
3. Source: The life expectancies for the 5-year periods for the Soviet Union are estimates based on interpolation from the data presented by Blum and Pressat (1987, Table 1). The life expectancy for 1986 is from the same source
4. 1981
5. 1983
6. 1984
7. 1986
8. 1980-82
9. 1980-83

n.a.=not available

Table 2. Actual female expectation of life at birth in industrialized countries from 1960 to 1985 or to the latest available year and projected expectation of life from 1985 to 2025 (projected by UN)

COUNTRY	WHO Actual 1960-64	1965-69	1970-74	1975-79	1980-84	1985	Projected by UN 1980-85	2000-05	2020-25
JAPAN	71.7	74.1	75.9	78.1	80.0	81.6[7]	79.7	80.7	81.5
VANGUARD CAPITALIST COUNTRIES									
ICELAND	76.4	76.5	77.3	79.6	80.3	79.4	80.3	81.0	81.8
NETHERLANDS	75.9	76.4	77.1	78.5	79.7	79.9	79.5	80.7	81.5
NORWAY	75.9	76.8	77.7	78.6	79.6	79.6	79.5	80.7	81.5
SWEDEN	75.5	76.5	77.7	78.5	79.6	79.9	79.4	80.7	81.5
SWITZERLAND	74.5	75.5	76.9	78.6	79.6	80.6[7]	79.7	80.7	81.5
MEAN	75.6	76.3	77.3	78.8	79.8	79.9	79.7	80.8	81.6
AVERAGE CAPITALIST COUNTRIES									
CANADA	74.4	75.5	76.7	78.1	79.4	80.0	79.3	80.6	81.4
UNITED STATES	73.5	74.1	75.3	77.4	78.1[9]	78.5[6]	78.1	80.3	81.1
AUSTRIA	72.7	73.3	74.1	75.4	76.6	77.8[7]	76.7	79.7	80.7
BELGIUM	73.3	73.9	74.7	75.9	77.1	77.8[6]	77.0	80.0	80.8
DENMARK	74.5	75.3	76.4	77.4	77.7	77.7	77.6	80.2	81.0
FINLAND	72.5	73.3	75.0	77.0	78.5	78.9[7]	78.0	80.3	81.1
FRANCE	74.6	75.6	77.0	78.3	79.4	80.1	78.7	80.5	81.3
FRG	72.7	73.5	74.1	75.6	77.3	78.5[7]	77.2	80.0	80.8
GREECE	73.6	74.5	76.3	77.2	78.0	78.5	76.0	79.3	80.7
IRELAND	72.0	72.9	73.6	74.6	75.8	76.3[6]	75.7	79.0	80.6
ISRAEL	n.a.	n.a.	n.a.	74.9	76.2	77.0	76.2	79.4	80.6
ITALY	72.4	73.6	75.1	76.9	78.0[9]	77.9[5]	78.0	80.2	81.0
LUXEMBOURG	n.a.	73.2	74.1	75.5	76.2	78.2[7]	74.0	77.9	80.2
SPAIN	72.7	74.3	75.7	77.0	78.8[4]	n.a.	77.5	80.1	80.9
ENGLAND & WALES	74.1	74.9	75.4	76.1	77.3	77.6	76.9[1]	79.9[1]	80.8[1]
AUSTRALIA	74.2	74.3	74.8	77.0	78.7	78.7	78.6	80.4	81.2
NEW ZEALAND	74.0	74.4	74.8	75.8	76.9	76.9	77.0	80.0	80.9
MEAN	73.4	74.2	75.2	76.5	77.6	73.6	77.2	79.9	80.9
REARGUARD CAPITALIST COUNTRIES									
MALTA	70.8	71.8	72.7	72.7	73.9	75.8[7]	74.2	78.2	80.4
PORTUGAL	67.2	69.3	71.0	73.3	75.7	77.1[7]	75.2	79.2	80.6
NORTHERN IRELAND	72.6	73.4	73.6	74.2	75.8	76.5	n.a.	(79.3)[2]	(80.7)[2]
SCOTLAND	72.2	73.1	73.7	74.4	75.5	76.3[7]	n.a.	(79.1)[2]	(80.5)[2]
YUGOSLAVIA	66.4	69.1	70.9	72.7	73.4[8]	73.0[5]	73.5	77.8	80.2
MEAN	69.8	71.3	72.4	73.5	74.9	75.7	74.3	78.7	80.5
EASTERN EUROPEAN COUNTRIES									
BULGARIA	72.1	73.0	73.4	73.7	74.2	74.2	74.4	78.2	80.3
CZECHOSLOVAKIA	73.3	73.5	73.6	74.2	74.4	74.8	74.7	78.3	80.4
GDR	72.2	73.2	73.9	74.6	75.1	75.4	75.1	78.6	80.5
HUNGARY	70.9	72.0	72.4	72.8	73.1	73.3[7]	73.8	77.8	80.2
POLAND	71.2	73.1	74.1	74.9	75.1	75.1[7]	75.3	78.9	80.4
ROMANIA	n.a.	n.a.	71.1	72.0	72.4	72.7[6]	72.7	77.3	80.2
MEAN	71.9	73.0	73.1	73.7	74.1	74.3	74.3	78.2	80.3
USSR[3]	73.1	74.2	73.4	72.8	72.7	73.6	75.4	78.9	80.5

SOURCES: Actual life expectancy: World Health Statistics Annual 1986 and 1987 (WHO)
Projections: World Population Prospects, Estimates and Projections as Assessed in 1984 (UN)

1. United Kingdom
2. Estimated on the basis of the projection for Malta
3. Source: The life expectancies for the 5-year periods for the Soviet Union are estimates based on interpolation from the data presented by Blum and Pressat (1987, Table 1). The life expectancy for 1986 is from the same source
4. 1981
5. 1983
6. 1984
7. 1986
8. 1980-82
9. 1980-83

n.a.=not available

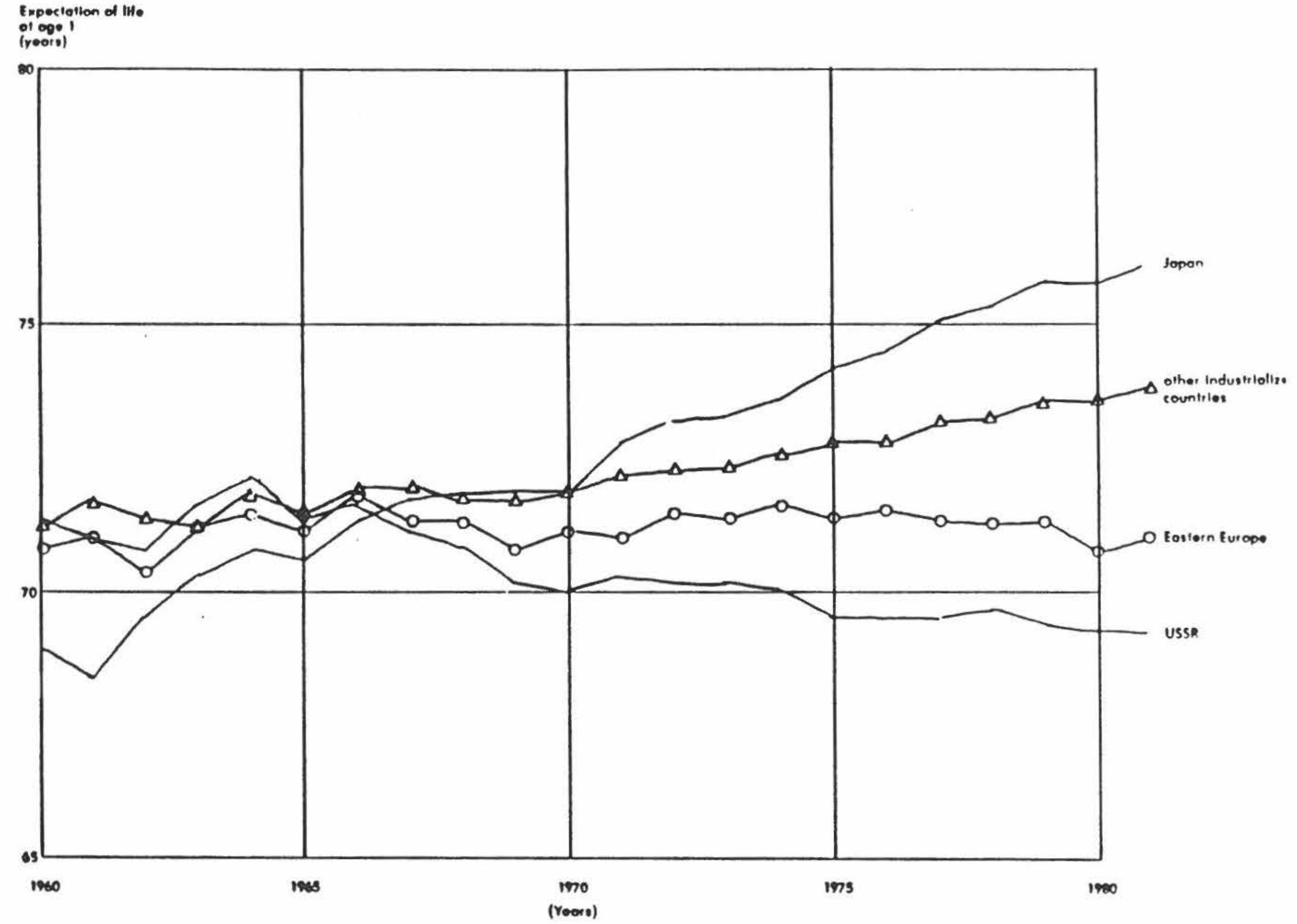
Table 3. Life expectancy at birth (e_0) by sex in 1985 and the highest projected life expectancy according to selected national population projections compared to the UN projections

	Country and period of projection								
	Finland 1984–2010	Norway 1985–2050	Sweden 1986–2025	Denmark 1986–2015	Austria 1985–2015	U.K. 1983–2023	France 1985–2040	Netherlands 1986–2035	USA 1983–2000 (middle)
MALES									
Life expectancy in 1985	70.1	72.6	73.8	71.7	70.4	71.9[1]	71.8	73.1	70.6[5]
Time t when the highest e_0 is projected to be	2010	2000	2000	1983–84	2015	2023	2020	2000	2080
Projected highest e_0	73.5	74.7[6]	74.9	71.5	74.1	73.8	74.0[2] 76.6[3]	74.5[4]	76.7
UN projection e_0 for time t	73.1	73.7	74.5	71.5	73.3	74.1	74.0	73.8	n.a
UN projection e_0 for 2020-25	73.8	75.0	75.0	74.2	73.7	74.1	74.1	75.0	74.1
FEMALES									
Life expectancy in 1985	78.5	79.6	79.9	77.7	77.4	77.6[1]	80.1	79.9	78.5[5]
Time t when the highest e_0 is projected to be reached	2010	2000	2000	1996	2015	2023	2020	2000	2080
Projected highest e_0	79.5	81.1[6]	81.3	79.0	80.5	79.8	82.4[2] 85.1[3]	80.5[4]	85.2
UN projection e_0 for time t	80.6	80.6	80.6	79.7	80.4	80.8	81.2	80.6	n.a
UN projection e_0 for 2025	81.1	81.5	81.5	81.0	80.7	80.8	81.3	81.5	81.1

1) England and Wales
2) On the basis of the trends of death rates
3) On the basis of rapid decline of mortality
4) According to the "low" alternative 0.5 years less and according to the "high" alternative 0.5 years more
5) 1984
6) Calculated on the basis of the Norwegian life table

For sources see the end of the list of references

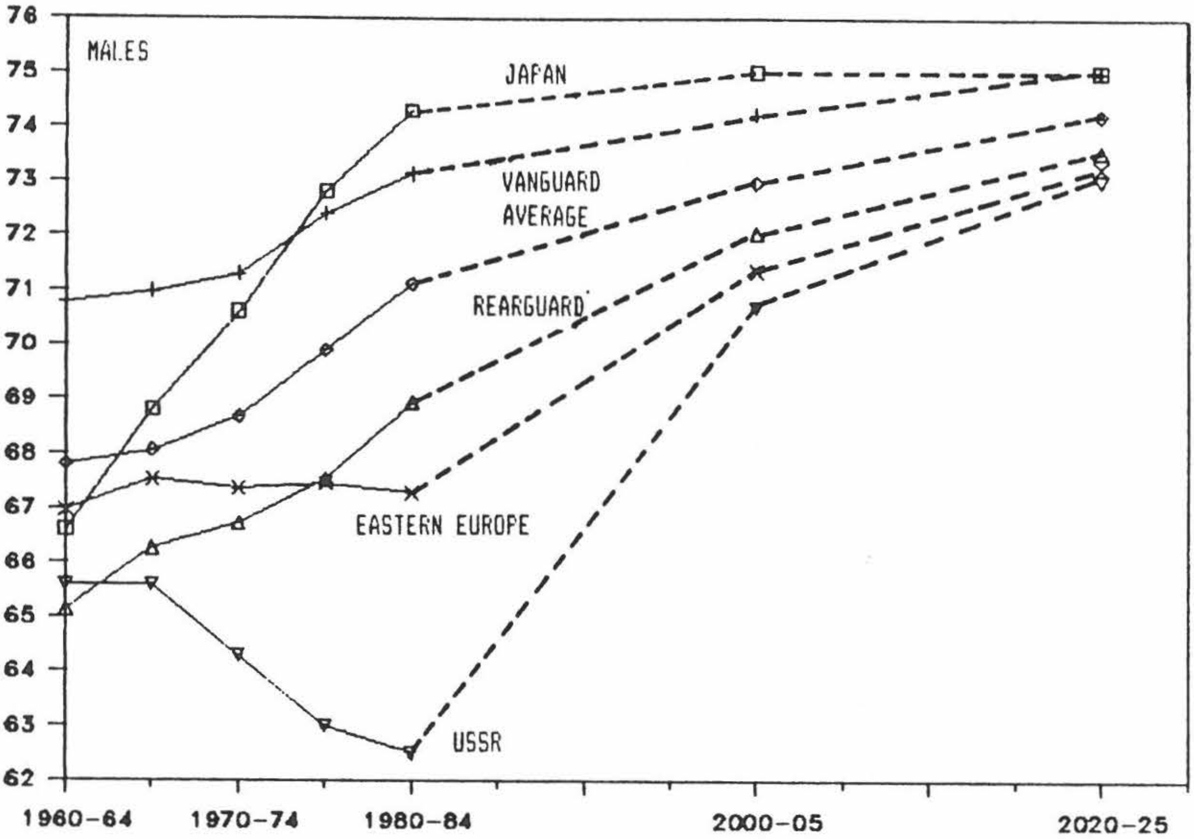
Figure 1. **Expectation of life at age 1 in industrialized countries, 1960-1981**

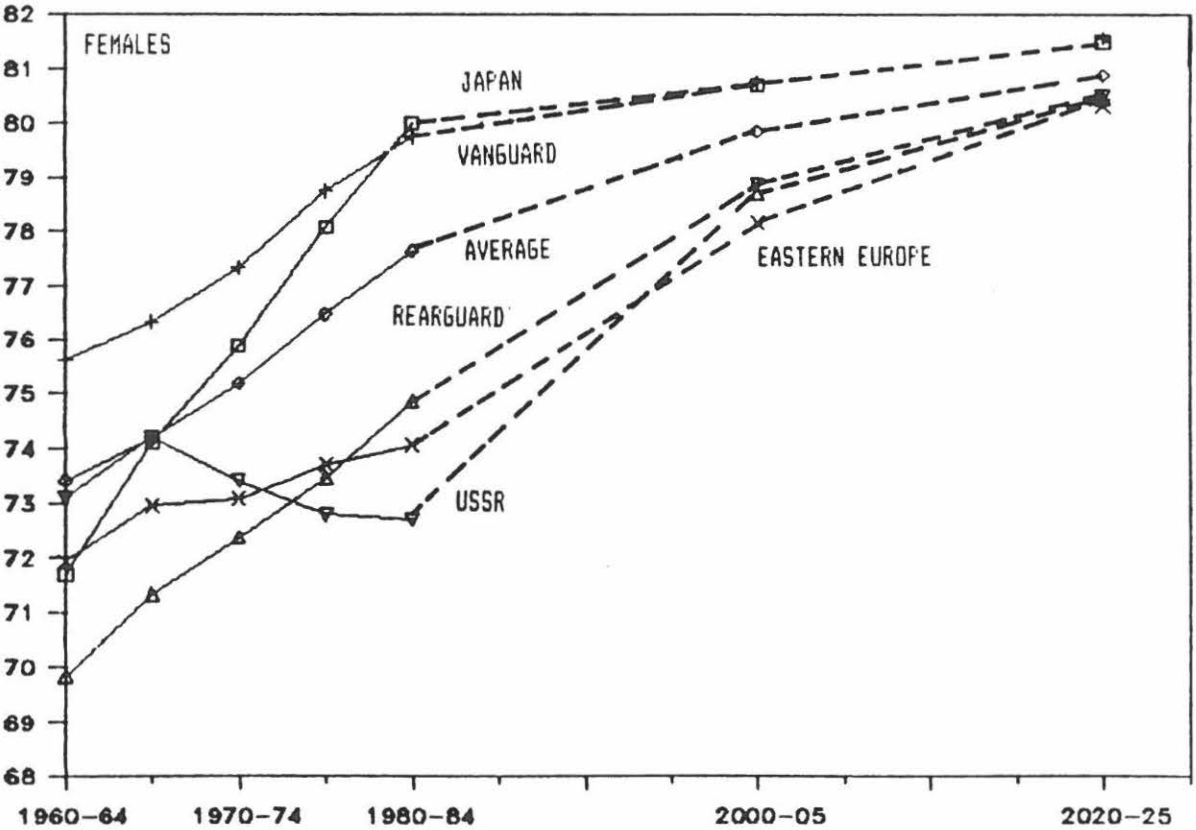


a/ Northern Europe, Overseas Europe, Western Europe, Southern Europe.

Source: Bourgeois-Pichat 1984, Figure IV.

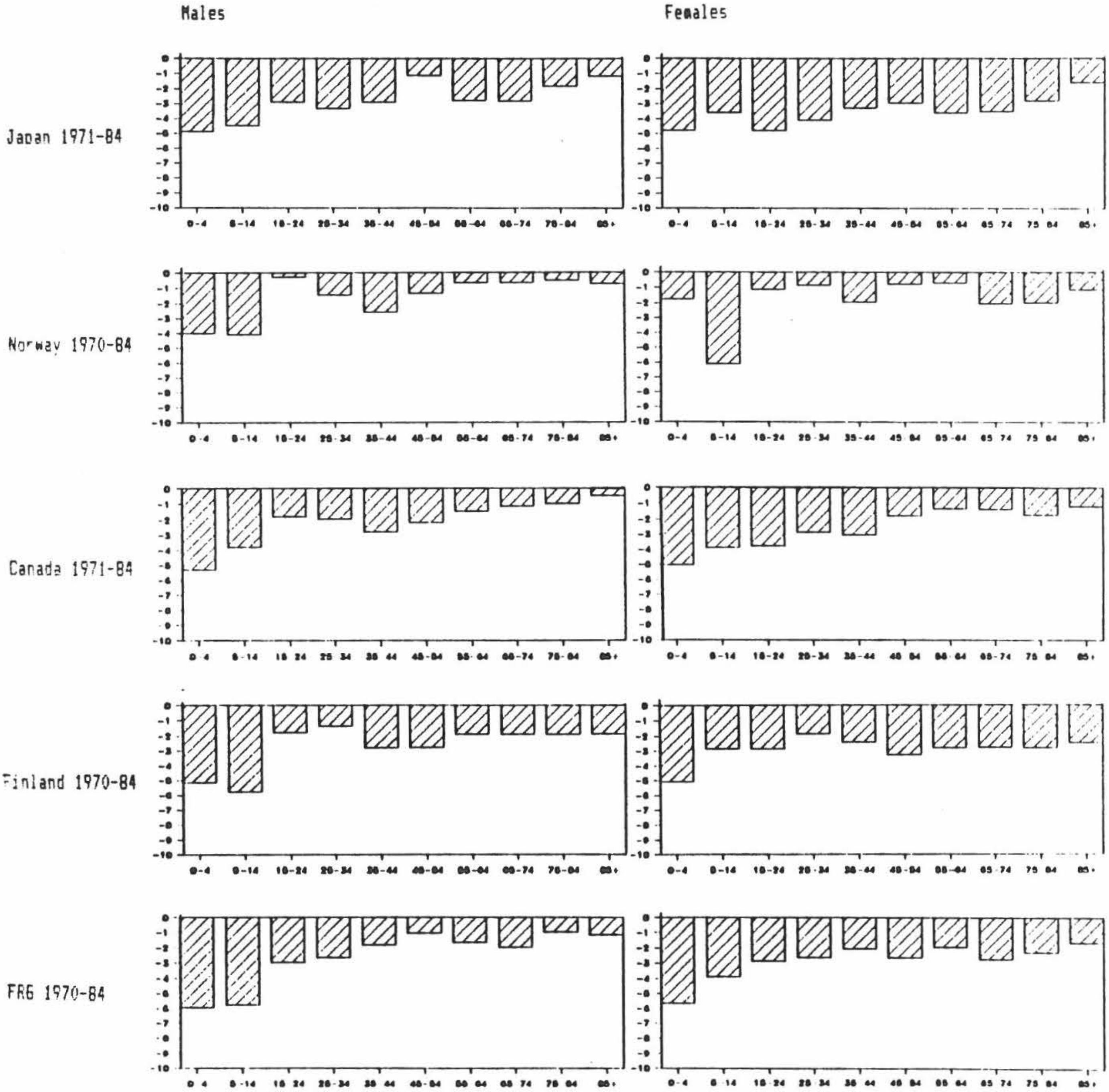
Figure 2. Expectation of life at birth by sex in industrialized countries 1960-84 (actual) and and 1985-2025 (projected by UN)





Source: See Table 1

Figure 3: The average relative annual change of mortality (in per cent) by age and sex in selected countries from about 1970 to about 1984



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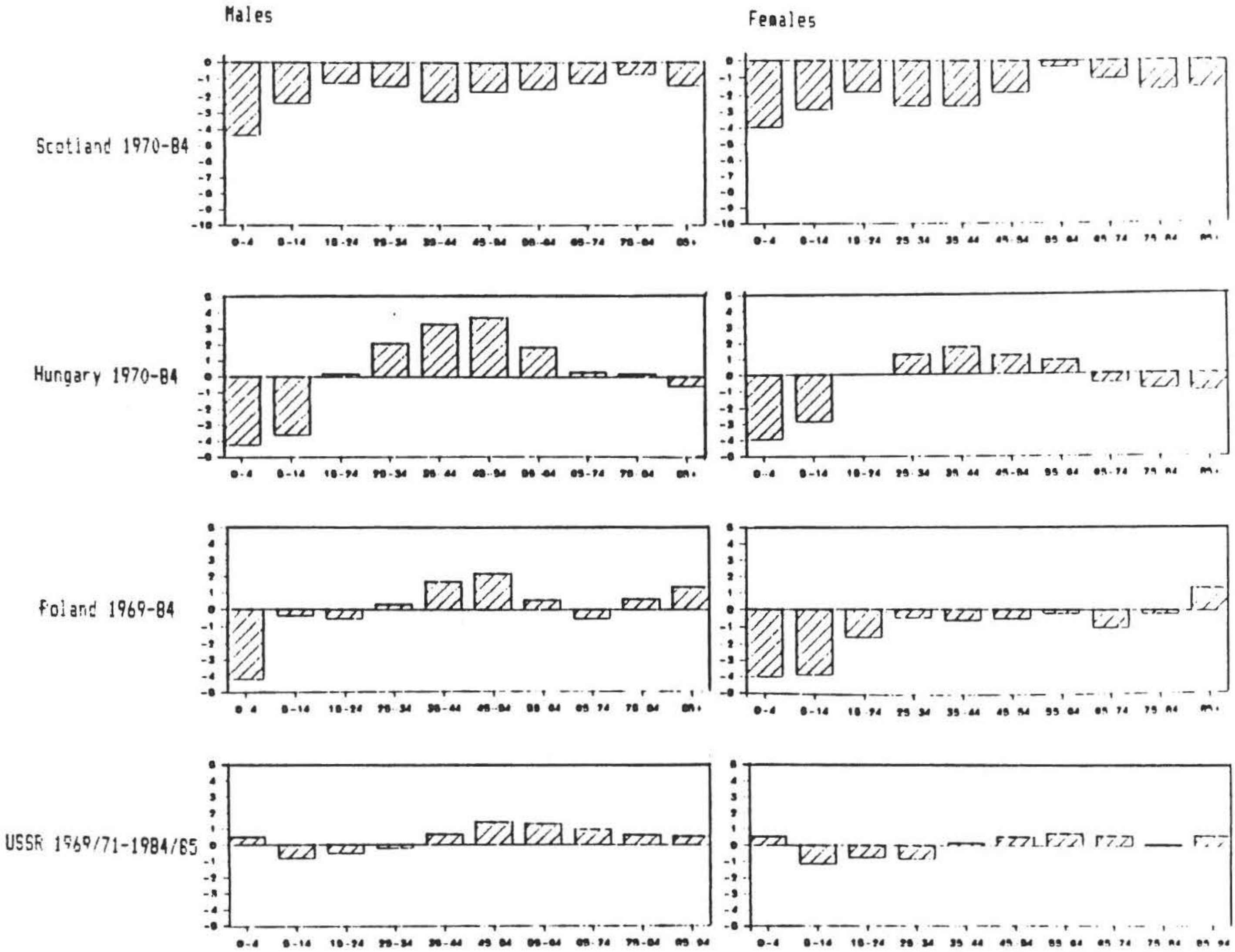

Sorces: United Nations Demographic Yearbooks 1974 and 1985. The data are not accurate, since the United Nations Demographic Yearbook gives the deaths rates as deaths per 1000 with one decimal only. Rounding errors may be considerable particulary in age-groups 1-29.

The data for the USSR were calculated from the Soviet life tables published in Blum and Pressat (1987)

THE IMPACT OF AIDS ON FUTURE MORTALITY

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CONTENTS

Abstract

This paper summarizes available information concerning the impact of AIDS-related deaths on future mortality. To understand the potential demographic impact of the Acquired Immunodeficiency Syndrome (AIDS), four characteristics of this disease need to be taken into account.

o First, it must be realized that AIDS is just the *terminal stage* of an infectious disease, which is caused by the Human Immunodeficiency Virus (HIV).[1] It is therefore the *spread of this virus*, and not the still relatively low number of AIDS cases and deaths, which *is the crucial factor*. It is the incredible speed with which the HIV epidemic has brought the virus to 150 countries in only a few years that will substantially affect future trends of mortality.

o Second, the natural course of an HIV infection is characterized by a *very long asymptomatic incubation period*, during which the seemingly "healthy" carrier can transmit the virus both sexually and through blood contact. Since the average incubation period is estimated at some 8 to 10 years, the *present number of AIDS cases and deaths is just the tip of the iceberg*: it represents the epidemiological situation at the end of the 1970s and during the first few years of the 1980s. For every AIDS case diagnosed today, there might be another 10 to 50 cases of HIV infection.

o Third, if no cure is found in the near future, it must be reckoned that some 50 % of all those presently infected with HIV will develop AIDS and die during the next 10 to 12 years. Indeed, the possibility cannot be dismissed that all HIV carriers might progress to AIDS. Since the average period of survival following the development of AIDS has been found to be only one to two years, *a rapid increase in deaths throug AIDS must be expected during the 1990s.*

o Fourth, compared to the victims of other causes of death, *AIDS patients die young*. In the United Kingdom, the present average age at death from AIDS is 37 years. The premature deaths of AIDS patients will soon add up to a massive loss of years of potential life. In the United States of America, *AIDS is already the 5th leading cause of death*, if measured in terms of years of potential life lost before age 65.

After discussing these basic characteristics of the HIV infection, the paper reviews studies analyzing the impact of AIDS on mortality. It documents the increases in premature mortality attributable to this disease in high prevalence areas, such as New York, San Francisco or East Africa. Finally, the paper argues that the further spread of HIV infection in Africa south of the Sahara and the Caribbean will result in a substantial decrease in overall life expectancy within these regions.

1 Infection with another retro-virus, called HIV-2, has recently appeared in West Africa, and seems to be spreading among the same risk groups as HIV. Genetically, HIV-2 has a higher similarity to an animal retrovirus (the Simian T-Cell Leukemia Virus Typ III (STLV-III)), than to the Human Immunodeficiency Virus (HIV). Apparently HIV-2 also causes (a less serious form of ?) AIDS.

1. Introduction: The natural history of HIV infection and AIDS

To appreciate the possible impact of AIDS on future trends of mortality, it is necessary to understand some medical aspects of HIV infection. The natural course of this disease consists of several distinctive stages:

(0) **Infection**: The disease starts when Human Immunodeficiency Viruses (abbreviated HIV) invade certain human cells (T-Helper-Cells and Macrophages) and write their genetic information into the genome of these "host cells". As far as we know today, the inevitable consequence of this is a life-long infection with this retrovirus. There is probably no way of eliminating the viral information from inside the cells, because the virus has written its genetic code at some unknown location into the DNA sequence of the human "host cell".

(1) **Initial lymphatic reaction:** A short time after infection, some patients (10-15%) suffer from a temporary glandular fever-like illness, comparable to influenza. Very often, however, these symptoms are passing by unrecognized. As a result of infection, the human immune defence system is stimulated to produce antibodies which should destroy the invading virus. This antibody reaction of the human immune defence is the basis of contemporary HIV tests (ELISA, Western Blot), which measure the existence of HIV-specific antibodies in the blood serum of the patient. If these antibodies are found, the test is said to be "sero-positive". The time span between initial infection and seroconversion is unknown. Until recently it was thought that some 4 to 6 weeks should be accepted as a "diagnostic window", during which a HIV infection could not be detected by an antibody test. More recent studies, however, have demonstrated that some patients were actually infected several *month before* an HIV-antibody test detected the virus.[2]

(2) **Asymptomatic latency period**: Most important for any understanding of this disease is the latency period between initial infection and the development of AIDS, which can be *of considerable duration*.[3] During this period many HIV-infected persons feel more or less healthy. Nevertheless, these asymptomatic HIV carriers can transmit the virus sexually or via blood contact und thus add to the further spread of the epidemic. A substantial proportion of HIV infected persons remain in this symptomless stage for a very long time or develop only a mild form of persistent generalized lymphadenopathy (swelling of lymph nodes).

(3) **AIDS-related complex (ARC):** This stage of the disease is usually reached after several years of asymptomatic HIV infection. Some patients, however, quickly progress to this stage after infection. It is characterized by symptoms such as fever,

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2 Ranki, A. / Krohn, M. / Allain, J.P. / Franchini, G. / Valle, S.L. / Antonen, J. / Leutherer, M. / Krohn, K.J.E. (1987): Long latency precedes overt seroconversion in sexually transmitted Human Immunodeficiency Virus infection. In: The Lancet, Vol. II/1987, September 12, 45-48, 589-593

3 Alvaro Munos et al. have reported results of a follow up study of 227 HIV infected homosexual men, participating in the Multicenter AIDS Cohort Study in the United States of America. According to their data, AIDS is very unlikely to develop before 12 month after infection. Approximately 80% of HIV infected are AIDS-free after 60 months. Between 30 and 60 months, however, a significant increase in incidence rates of AIDS was observed. See: Munos, A. / Wang, M.C. / Good, S. / Detels, R. / Ginzburg, H. / Kingsley, L. / Phair, J. / Polk, B.F. (1988): Estimation of the AIDS-free times after HIV-1 seroconversion. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 292.

weight loss or diarrhoea, severe opportunistic infections and pathological laboratory parameters of the immune system. ARC patients have a high probability of progressing to AIDS.

(4) **Full blown AIDS**: Strictly speeking, this is only a *terminal stage* of this infectious disease - and not, as many people tend to believe, the disease itself.[4] The definition of AIDS is based upon certain clinical manifestations that are indicative of the acquired immunodeficiency. AIDS is the most severe consequence of HIV infection, but there are other equally fatal manifestations. Clinical research has demonstrated that the virus not only affects the human immune system, but is also responsible for a diversity of neurological syndroms including progressive dementia. These fatal symptoms appear to be due to the direct effects of the virus itself. In most cases, the neurological symptoms can be found in patients with AIDS; some other patients, however, develop these neurological manifestations in the apparent absence of an immune deficiency.[5] Since the latency for *neurological symptoms* of the HIV infection may be longer on average than for the development of an *immunodeficiency*, the long term morbidity of HIV infection caused by neurological diseases may be substantial.

Fig. 1: The natural history of HIV infection

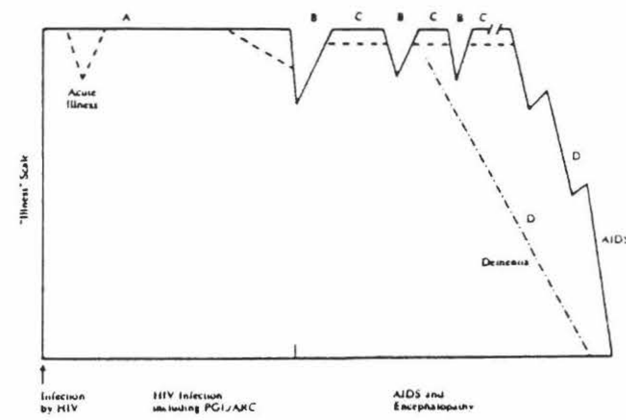

Fig. 1 The shape of HIV disease: A. Early phase of HIV infection including: acute HIV infection, asymptomatic carrier state, persistent generalised lymphadenopathy (PGL) and AIDS-related complex (ARC). B. Acute treatable opportunist infections/tumours in AIDS. C. AIDS patients between opportunist infections or with Kaposi's sarcoma. D. AIDS patients beyond active diagnosis and treatment including patients with severe dementia/physical dependency.

Source: Pinching, A.J. / Weiss, R.A. / Miller, D. (1988): AIDS and HIV infection: New perspectives. In: British Medical Bulletin, Vol. 44, No. 1, 1-19 (13)

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4 The clinical definition of AIDS was given by the Centers of Disease Control. See: Centers for Disease Control. (1987): Revision of the CDC case definition for Acquired Immunodeficiency Syndrome. In: Morbidity and Mortality Weekly Report, Vol. 36 (suppl), 1S.; Kirn, D. / Feigal, D.W. / Edison, R. / Lemp, G. / Abrams, D.I. (1988): Revised center for disease control AIDS case definition: Impact on case reporting. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 210.; Editorial (AIDS-Forschung) (1986): WHO-Definition für AIDS. In: AIDS-Forschung, Jg. 1, Heft 12, 642-644.

5 DesJarlais, D.C. / Sotheran, J. / Stoneburner, R. / Friedman, S. / Marmor, M. / Maslansky, R. / et al. (1988): HIV-1 is associated with fatal infectious diseases other than AIDS among intravenous drug users. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 314.

2. Data

The most obvious way to study the demographic impact of AIDS would be to analyze mortality rates by cause of death. As was argued above, however, this would only lead to an underestimation of the real problem. It is not the 110,000 cases of AIDS presently reported to the World Health Organization, that will substantially affect mortality, but the estimated 10 to 20 million HIV-infected persons worldwide. AIDS-related mortality has to be analyzed in conjunction with all stages of this fatal disease, including the asymptomatic HIV infection.

2.1 HIV Infection

Since the causative agent of AIDS is the Human Immunodeficiency Virus, it is essential that we study its spread to estimate the future trends of AIDS-related mortality. Unfortunately the prevalence of HIV infection among the general population can only be estimated indirectly from limited surveys, the majority of which have been conducted among **high-risk groups**, such as homosexual men, i.v. drug abusers, haemophiliacs or prostitutes.[6] The prevalence rates found in these surveys vary substantially from country to country and region to region. The highest rates of HIV infection are among prostitutes in the urban areas of East and Central Africa and the Caribbean. Several studies (in Nairobi, Mombassa, Kinshasa, Kampala) have documented infection rates of some 50 to 90%. Very high prevalence rates of HIV infection are also found among homosexual men and i.v. drug addicts in the urban areas of developed countries, especially in the United States of America. Studies in San Francisco, New York[7], Paris, Zürich, Berlin or Frankfurt have demonstrated HIV prevalence rates among these high-risk groups of up to 70%[8] (see Fig. 1).

While there is certainly a worldwide spread of HIV among social groups with high-risk behavior, the prevalence rate of the **general population** is still under debate. Some quantitative information on this subject can be found in surveys among certain "low risk" populations, such as pregnant women,[9] military personnel and applicants, or representative samples of the sexually active population.

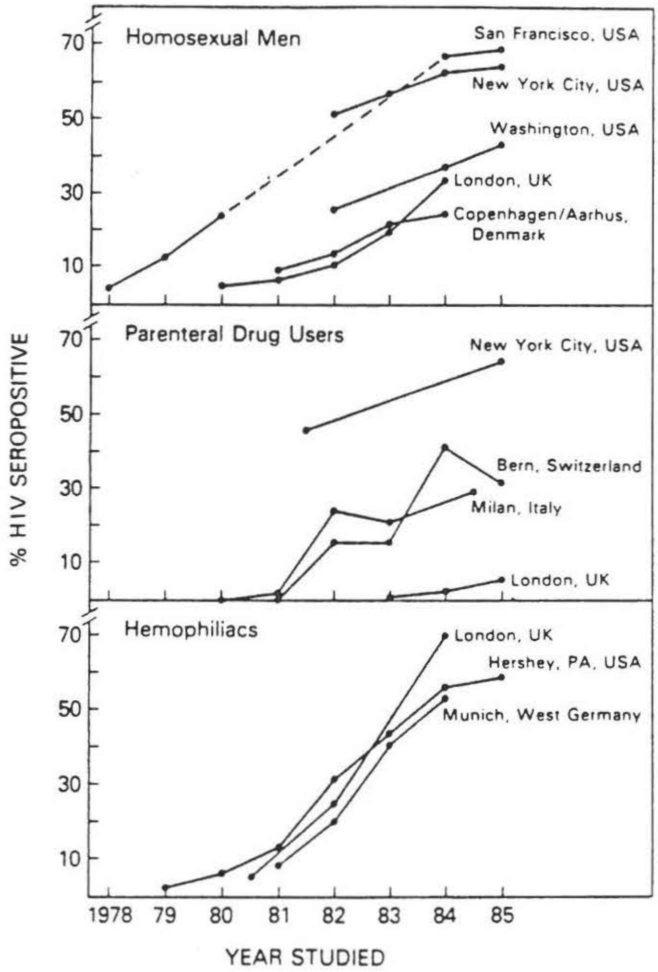
6 Battjes, R.J. / Pickens, R. (1988): HIV infection among intravenous drug abusers (IVDAs) in five U.S. cities. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 292.

7 Chiasson, M.A. / Lifson, A.R. / Stoneburner, R.L. / Ewing, W. / Hildebrandt, D. / Jaffe, H.W. (1988): HIV-1 seroprevalence in male and female prostitutes in New York City. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 288.

8 Brown, L.S. / Lee, H. / Cerney, M. / Allain, J.P. / Chu, A. / Foster, K. (1988): HTLV-1 and HIV-1 infection in intravenous drug abusers (ivdas). In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 190.

9 Hoff, R. / Berardi, V.P. / Weiblen, B.J. / Mahoney-Trout, B.S. / Mitchell, M.L. / Grady, G.F. (1988): Seroprevalence of Human Immunodeficiency Virus among childbearing women. In: The New England Journal Medcine, Vol. 318, No. 9, March 3, 526-530.

Fig. 2: Proportion of HIV infected persons by selected high-risk groups and geographical location according to various surveys.



Source: Melbye, M. / Goedert, J.J. / Blattner, W.A. (1987): The natural history of Human Immunodeficiency Virus Infection. In: Gottlieb, M.S. et al. (eds.): Current Topics in AIDS. Vol. 1, 57-93, (64)

(a) Child-bearing women:

The New York State Department of Health in Albany, New York, for instance, conducted a study, to determine the prevalence of HIV infection in pregnant women and their children.[10] Blood specimens were taken from 25,804 newborn infants in the State of New York. 215 (0.83%) tested positive in both standard HIV ELISA and Western Blot. Seropositivity varied substantially between the regions of New York

10 Novick, L.F. / Berns, D. / Stricof, R. / Stevens, R. (1988): HIV seroprevalence in newborn infants in New York State. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 433. See also: Araneta, M.R. / Thomas, P.A. / Cedeno, S. / Ramirez, L.L. / Ruiz, A. / Schultz, S. (1988): Seroprevalence of HIV-1 among pregnant women at time of birth and abortion in N.Y.C.-1987. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 269.; Archibald, D.W. / Witt, D.J. / Craven, D.J. / Vogt, M.W. / Hirsch, M.S. / Essex, M. (1987): Antibodies to Human Immunodeficiency Virus in cervical secretion from women at risk for AIDS. In: Journal of Infectious Diseases, Vol. 156, No. 1, 240-241.; Armson, B.A. / Mennuti, M.T. / Talbot, G.H. (1988) Seroprevalence of Human Immunodeficiency Virus (HIV) in an obstetric population. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 218.

State: the lowest prevalence rate was found in upstate New York (0.19 %), the highest rate among neonates in the Bronx (2.29%) and in Brooklyn (1.56%). From this data can be concluded that substantial rates of HIV infection among women of childbearing age can be found in certain areas of New York City. The number of HIV positive newborn infants in 1988 will be approximately 2,241. Since at least some 40% of these children will be HIV infected, some 900 HIV infected infants will be born in the state of New York. According to the authors of this study, *"this figure far exceeds the number of previously reported or projected cases for 1988"*.

However, this very high prevalence of HIV infection among females of childbearing age in New York, does not seem to be typical for other urban areas in the developed world. A similar study was conducted in Paris, where 15,465 pregnant women were screened between February 1987 and October 1987.[11] Only 99 women were found to be HIV-positive (0,64 %); 54 of the HIV infected pregnant women were i.v. drug abusers or transfusion patients; 32 had partners with well defined risk factors. Only 3 women might have been infected through random partners. This indicates that heterosexual transmission through random partners appeares (still) to be a rare event in 1987 in Paris.

(b) Military Personnel:

Civillian applicants to the US army and regular-duty soldiers certainly represent a much better cross-section of the population in the USA than the high-risk groups of homosexuals, drug addicts or prostitutes. Since October 1985, the U.S. Department of Defense has routinely tested both new applicants and active-duty soldiers for HIV. The findings are of great significance in estimating the extent of potential AIDS morbidity and mortality.

According to a report of the *Centers for Disease Control*, 789,578 civillian applicants for military service were HIV tested between October 1985 and December 1986. Of these, 1,186 (0.15%) were confirmed as carriers of the AIDS virus.[12] There was a great variation of prevalence rates according to age, sex, race and geographical region (see Tab. 1).

11 Brossard, Y. / Goudeau, A. / LarJ. / Schwartz, D. (1988): A sero-epidemiological study of HIV in 15 465 pregnant women screened in Paris area between Feb. 1987 and Oct. 1987. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 219.

12 Centers for Disease Control (1987): Trends in Human Immunodeficiency Virus Infection Among Civilian Applicants for Military Service - United States, October 1985 - December 1986. In: Morbidity and Mortality Weekly Report, Vol. 36, No. 18, 273-276

Tab. 1: Prevalence of HIV antibody among civilian applicants for military service, by age group and region of residence. No. of Tests: 789,578.

	HIV sero-positive per 1000
Total (1,186)	1.5
Age 17-20	0.6
Age 21-25	2.5
Age >= 26	4.1
Males	1.6
Females	0.6
Whites	0.8
Blacks	4.1
Hispanics	2.3

Region	Age Groups 17-20	21-25	>= 26	All Ages
New England	0.4	1.0	3.8	0.9
Middle Atlantic	0.7	4.6	10.0	2.9
EN Central	0.4	1.8	1.9	0.9
WN Central	0.2	1.0	1.8	0.6
South Atlantic	0.9	3.4	5.4	2.1
ES Central	0.4	1.9	1.3	0.9
WS Central	0.6	2.7	3.0	1.6
Mountain	0.3	1.5	1.9	0.9
Pacific	0.8	1.5	4.0	1.5
US Territories	1.6	6.3	12.3	5.8
All Regions	0.6	2.5	4.1	1.5

Source: Centers for Disease Control (1987): Trends in Human Immunodeficiency Virus Infection Among Civilian Applicants for Military Service - United States, October 1985 - December 1986. In: Morbidity and Mortality Weekly Report, Vol. 36, No. 18, 273-276

At the 4th World AIDS congress in Stockholm this year, several papers gave updates of the results of this military screening program.[13] *Michael Stek* and his co-authors presented data from the U.S. Navy and Marine Corps, according to which the testing of 760.000 soldiers yielded an overall prevalence rate of 0.25% HIV for the Navy and 0.1% for the Marine Corps. *Patrick Kelley et al.* reported on the HIV infection rates of all active duty U.S. Army soldiers screened between 1985 and 1987. Their report covered 555,900 soldiers, of whom 1,154 (0.21%) were diagnosed as carriers of the AIDS virus.

The most recent information available are results from the U.S. Department of Defense screening program of **all active-duty military personnel.** A total of 1,752,191 persons who remained on active duty as of April 24, 1988, were tested. HIV infection was confirmed in 2,232 (1,3 per 1000) of these persons.[14] While the *overall* prevalence rate of HIV infection among active-duty soldiers seem to be relatively low, quite hight rates were found in certain social and ethnic groups and geographical regions (see Tab. 2).

13 Bunin, J.R. / McNeil, J. / Renzullo, P. / Brundage, J. (1988): The epidemiology of HIV infection in active duty army women. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 275.; Burke, D.S. / Brundage, J.F. / Herbold, J.R. / Bernier, W. / Gardner, L.I. / Gunzenhauser, J.D. / Voskovitch, J. / Redfield, R.R. (1987): HIV infections among civilian applicants for US military service, October 1985 to March 1986. In: The New England Journal of Medicine, Vol. 317, July 16, 131-136.; Burke, D.S. / Brundage, J.F. / Bernier, W. / Gerdner, L.I. / Redfield, R.R. / Gunzenhauser, J. / Voskovitch, J. / Herbold, J.R. (1987): Demography of HIV infections among civilian applicants for military service in four counties in New York. In: New York State Journal of Medicine, Vol. 87, No. 5, 262-264.; Cowan, D.N. / Brundage, J.F. (1988): Prevalence and demographic determinants of HIV infection among U.S. army reserve personnel. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 222.

14 Centers for Disease Control (1988): Prevalence of Human Immunodeficiency Virus antibody in U.S. active-duty military personnel, April 1988. In: Morbidity and Mortality Weekly Report, Volo. 37, 461-463

Tab. 2: Prevalence of HIV antibody among active-duty military personnel, by age, ethnic group, sex, marital status and rank

Group	No. tested	No. positive	Seroprevalence (per 1,000)	Seroprevalence rate ratio (95% CI)	
Total	1,752,191	2,232	1.3		
Age group (years)*					
≥40	94,343	87	0.9	6.6	(4.5,9.3)
35-39	165,740	224	1.4	9.7	(6.9,13.1)
30-34	234,267	455	1.9	13.9	(10.2,18.6)
25-29	366,156	759	2.1	14.9	(10.9,19.8)
20-24	568,920	662	1.2	8.3	(6.1,11.1)
17-19	322,506	45	0.1	1.0	
Race/Ethnicity					
Black	337,300	988	2.9	3.6	(3.3,3.9)
Hispanic	71,917	144	2.0	2.5	(2.1,2.9)
Other	79,603	72	0.9	1.1	(0.9,1.4)
White	1,263,371	1,028	0.8	1.0	
Sex*					
Male	1,571,912	2,166	1.4	3.8	(2.9,4.8)
Female	180,278	66	0.4	1.0	
Marital status					
Other†	44,732	102	2.3	2.6	(2.1,3.2)
Never married	690,738	1,255	1.8	2.1	(1.9,2.3)
Married	1,016,721	875	0.9	1.0	
Rank*					
Enlisted	1,515,659	2,061	1.4	1.9	(1.6,2.2)
Officer	235,521	171	0.7	1.0	

*Age unknown for 259 persons, sex unknown for 1 person, rank unknown for 1,011 persons; all were seronegative.
†Includes divorced, widowed, separated, and unknown.

Source: Centers for Disease Control (1988): Prevalence of Human Immunodeficiency Virus antibody in U.S. active-duty military personnel, April 1988. In: Morbidity and Mortality Weekly Report, Vol. 37, 461-463 (taken from: JAMA, Vol. 260, No. 9, 1205)

(c) Sexually Active Population:

Margaret Fischl et al. have analyzed a sample of 346 sexually active individuals, predominantly representative for the inner city population of Miami, USA.[15] Students from several college campuses and visitors of health centers and clinics for sexually transmitted diseases dominated in this sample. Homosexual men, i.v. drug users and prostitutes were excluded from the sample. The only potential risk factor identified was *multiple heterosexual contact*. The results were alarming: 5% (!) of persons tested positive for HIV. According to the authors, this points to the fact that the heterosexual transmission of HIV is already occurring among sexually active inner city populations in the U.S.A..

Probably the most seriously affected geographical areas are Africa[16] and the Caribbean. In several African countries south of the Sahara a substantial proportion of the *general* (urban) population seems to be HIV-infected: prevalence rates have been of between 0.5 and 20% among truck drivers, those attending STD clinics, medical

15 Fischl, M. / Trapido, E. / Stevens, R. / Fayne, T. / Flanagan, S. / Resnick, L. / LaVoie, L. (1988): Seroprevalence of HIV antibody in a sexually active heterosexual population. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 276.

16 Heilig, G. (1987): Demographische und gesellschaftliche Aspekte der AIDS-Pandemie in Afrika südlich der Sahara. In: Afrika-Spektrum, Jg. 22, Nr. 1, 23-45.

personnel and pregnant women.[17] At the 4th International Conference on AIDS in Stockholm this year *N'Galy* (from the Department of Public Health in Zaire) reported recent HIV contamination rates for various population groups and areas in Africa. According to his figures the HIV prevalence among pregnant women in Kinshasa was 7% at the beginning of 1988. In Kigali (Uganda) and Lusaka (Zambia) HIV testing of blood donors uncovered HIV prevalence rates of up to 18%.[18] Heterosexual activity is the major mode of HIV transmission in Africa and the Caribbean; prostitution[19] and promiscuity[20] are playing a central role in the spread of the epidemic.

Estimates of the total number of HIV infected persons not infrequently vary by several hundred per cent: For the U.S.A. the Centers of Disease Control calculated that 1 to 1.5 million people could be infected with HIV. In Europe, another 300,000 to 500,000 people might be carriers of the AIDS virus. The total number of HIV carriers in Africa and the Caribbean can only be the subject of speculation: if results of sample surveys were to be applied generally, then one would have to reckon with several millions being infected with HIV. According to estimates of experts, some 10 to 20 Million people in 150 countries worldwide might be HIV infected.[21] This certainly is a vast potential for future AIDS mortality.

2.2 Progression to AIDS

Only a few years ago many experts were convinced that just a small fraction of those infected with HIV would develop AIDS. In the Federal Republic of Germany for instance millions of Deutschmarks were spent by the Federal Ministry of Health in informing the public that a mere 5 to 16% of those infected ran the risk of developing the Acquired Immunodeficiency Syndrome. Today it is obvious that this was a tragic misconception of the natural history of this disease. Now there is overwhelming evidence that at least 50% of those infected with HIV will develop AIDS in the course of the next 10 years.

The progression to AIDS seems to be only a matter of time. While only a small fraction (< 5%) of HIV-infected persons develops AIDS during the first 12 months after contamination, 20 to 25% reach the fatal stage of the disease within 5 years. The asymptomatic latency period after initial infection with HIV seems to be not a stable state. Several studies among seemingly "healthy" HIV infected homosexuals in the United States of America have demonstrated that the immune system of these patients

17 Clumeck, N. / Robert-Guroff, M. / Van de Perre, P. / Jennings, A. / Sibomann, J. / Demol, P. / Cran, S. / Gallo, R.C. (1985): Seroepidemiological studies of HTLV-III antibody prevalence among selected groups of heterosexual Africans. In: Journal of the American Medical Association, Vol. 254, 2599-2602.

18 N'Galy, B. (1988): Epidemiology of HIV infection in Africa. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, Abstracts, Book 1, Final Programm, 106

19 D'Costa, L.J. / Plummer, F.A. / Bowmer, I. / et al. (1985): Prostitutes are major reservoir of sexually transmitted disease in Nairobi, Kenya. In: Sexual Transmitted Disease, 12, 64-67.

20 Clumeck, N. / Van de Perre, P. / Carael, M. / Rouvroy, D. / Nzaramba, D. (1985): Heterosexual promiscuity among African patients with AIDS. In: The New England Journal of Medicine, Vol. 313, No. 3, 182-183.

21 Koch, M.G. (1988): AIDS - die maligne Pandemie. In: Verdauungskrankheiten, Jg. 6, Nr. 3, 89-105

gradually deteriorates.[22] Today, the majority of AIDS researchers are convinced that **all** HIV infected persons will develop AIDS if they are given enough time. Of course some HIV patients might die of other causes than AIDS (such as from another disease, or through an accident or suicide) before they reach the final stage of their HIV related disease.

2.3 Survival Rate of AIDS Cases

There is still some debate whether the immune defense system might not eventually neutralize the virus in a certain proportion of unsymptomatic HIV carriers and thus save them from AIDS. As the *average* latency period after HIV infection seems to be some 10 years there has not yet been enough time to prove this hypothesis of "natural immunity to HIV" right or wrong. The progression of HIV infection to AIDS has been under study only for some 6 to 7 years. During the next decade, however, we will definitively learn what proportion of HIV carriers is developing AIDS.

Whereas there might be a small, theoretical, chance for an HIV infected person to avoid the development of AIDS, there is certainly not much hope for an AIDS patient. AIDS is the *terminal stage* of this infectious disease; and we find evidence for the thesis that *all* AIDS patients will die within only a few years. Up to the present no therapy has been able to eliminate HIV, the causal agent of AIDS, once it had invaded its host cells. Those AIDS drugs which have so far been tested (AZT) merely suppress the replication of the virus and thus stabilize the condition of the AIDS patients for a few months or years.

Depending upon risk group and primary manifestation, the average life expectancy of AIDS patients varies between 1 and 2 years after diagnosis. *George F. Lemp* and his co-authors evaluated the survival of 3,661 AIDS patients in San Francisco between July 1981 and August 1987. They found a median survival period of only 12.1 months, with a three-year survival rate of just 11%.[23] Almost identical results were reported by *Hwa-Gan Chang* et al., who conducted a study of 934 adult AIDS cases, reported as residents of upper New York State.[24] Based on an analysis of 337 cases of AIDS in Lousiana, USA, *Susan E. Hassig* found that the overall period of survival was even less than one year. 73% of these AIDS cases, diagnosed between January 1984 and December 1986, were dead at the time of analysis (1987/88).[25]

22 Edison, R. / Feigal, D.W. / Kim, D. / Abrams, D.A. (1988): Progression of laboratory values, AIDS morbidity, and AIDS mortality in a 6-year cohort with PGL. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 296.

23 Lemp, G.F. / Barnhart, J.L. / Rutherford, G.W. / Temelso, T. / Neal, D.P. / Werdegar, D. (1988): Trends in the length of survival for AIDS cases in San Francisco. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 2, Final Program, 208.

24 Chang, H.G. / Mikl, J. / Morse, D. / Kain, S. / Putman, D. / Truman, B. (1988): Survival experience of upstate New York's adult Acquired Immunodeficiency Syndrome cases. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 209.

25 Hassig, S.E. / Atkinson, W.L. / Rice, J. / McFarland, L. (1988): Survival in AIDS cases, Louisiana, 1985-1986. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 2, Final Program, 208.

This high lethality of AIDS can also be demonstrated by means of epidemiological data. Table 1 gives the number of AIDS cases and case-fatality rates by half-year of diagnosis for the United States of America:

Tab. 3: USA: Cases of AIDS and case-fatality rates by half year of diagnosis[26]

Year of Diagnosis	New Diagnoses: Number of Cases	New Diagnoses: Number of known Deaths	New Diagnoses: Case-fatality Rate	Cumulative Total: Cum. No. of Cases	Cumulative Total: Cum. No. of known Deaths	Cumulative Total: Cum. Case-fatality Rate
< 1981	82	71	87%	82	71	87%
1981/1	95	87	92%	177	158	89%
1981/2	197	181	92%	374	339	91%
1982/1	386	342	89%	760	681	90%
1982/2	667	592	89%	1427	1273	89%
1983/1	1264	1143	90%	2691	2416	90%
1983/2	1619	1440	89%	4310	3856	89%
1984/1	2517	2096	83%	6827	5952	87%
1984/2	3285	2728	83%	10112	8680	86%
1985/1	4638	3742	81%	14750	12422	84%
1985/2	5967	4613	77%	20717	17035	82%
1986/1	7611	5402	71%	28328	22437	79%
1986/2	9049	5491	61%	37377	27928	75%
1987/1	11009	5547	50%	48386	33475	69%
1987/2	11718	4209	36%	60104	37684	63%
1988/1	10170	2176	21%	70274	39860	57%
1988/Aug.15	428	38	9%	70702	39898	56%
Total	70702	39898	56%			

During the second half-year of 1981, 197 AIDS cases were diagnosed in the USA; 181 (or 92%) of these patients have already died of AIDS in the meantime. From all the 37,377 cases of AIDS which were diagnosed between 1981 and 1985, some 75% had already been killed by this infectious disease by August 1988. This very high lethality of AIDS can best be seen from the mortality rate of AIDS cases most recently diagnosed. By August 15, 1988, 21% of the AIDS cases diagnosed between 1 January and 30 June 1988 had died of AIDS; so one AIDS patient out of five was killed by the disease during the first 6 months (!) after diagnosis.

2.4 AIDS-related Mortality

Several studies have tried to estimate AIDS-related mortality. *R. Aubert* and co-authors have analyzed multiple cause-of-death data for California and found an 85% increase of deaths among sufferers from AIDS-related illnesses between 1980 and 1984. As the authors conclude, this supports the hypothesis, that the AIDS epidemic in California became apparent in mortality statistics after 1981.[27]

While the overall mortality rate or life expectancy for the total population in Europe has not (yet) been affected by AIDS-related deaths, significant effects can be

26 Source: Center of Disease Control (1988): AIDS Weekly Surveillance Report - United States AIDS Program. Center for Infectious Diseases, Centers for Disease Control. August 15, 1988.

27 Aubert, R. / Maldonado, Y.A. / Perkins, C. (1988): Use of multiple cause-of-death data to estimate AIDS-related mortality in California. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 204.

demonstrated for certain groups of the population. *Massimo Galli* and his co-authors have evaluated the causes of death among 3,127 i.v. drug abusers in Italy between 1980 and 1987: during the last year, AIDS became the *leading cause of death* and is responsible for a substantial increase of mortality in this sample population.[28]

2.4 Years of Potential Life Lost due to AIDS

The HIV epidemic will have a significant effect on average life expectancy in the future, not only because of the rapidly increasing number of AIDS deaths, but even more because of the *age structure* of the victims. Since AIDS patients die young, they lose many years of potential life.[29] The following table gives the official CDC list of the leading causes of death in the United States of America for 1985. Measured in years of potential life lost before age 65, AIDS was the 11th leading cause of death. At this time just some 17,000 patients had died from AIDS in the course of the epidemic. Today, in August 1988, the American death toll from AIDS has risen to some 40,000 cases. It can thus be seen that AIDS is among the first 5 or 6 leading causes of death in the United States of America.

Tab. 4: U.S.A.,1985: Estimated years of potential life lost (YPLL) before age 65 and cause specific mortality, by cause of death

Rank	Cause of mortality[30]	Years of Potential Life lost	Cause-specific Mortality Rate
1	Unintentional Injuries[31]	2,235,064	38.6
2	Malignant Neoplasms	1,813,245	191.7
3	Diseases of the Heart	1,600,265	325.0
4	Suicide, Homicide	1,241,688	20.1
5	Congenital Anomalies	694,715	5.5
6	Prematurity	444,931	2.9
7	Sudden Infant Death Syndrome	319,386	2.0
8	Cerebrovascular Disease	253,044	64.0
9	Chronic Liver Disease	235,629	11.2
10	Pneumonia and Influenza	168,949	27.9
11	AIDS	152,595	2.3
12	Chronic Obstructive Pulmonary diseases	129,815	31.2
13	Diabeti Mellitus	128,229	16.2

Source: Centers for Disease Control (1987): Morbidity and Mortality Weekly Report, Vol. 36, No. 15, April 1987, 235

28 Galli, M. / Carito, M. / Crucu, V. / Zampini, L. / Ciacci, D. / Villa, A. / Pacini, S. / Zaini, G. / Corsi, L. / Codini, G. / Saracco, A. / Lazzarin, A. (1988): Causes of deaths in i.v. drug abusers (IVDAs): A retrospective survey on 4883 subjects. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 2, Final Program, 191.

29 Stevens, A.J.H. / Searle, E.S. / Winyard, G.P.A. (1987): AIDS and life years lost: One district's challenge. In: British Medical Journal, Vol. 294, No. 6571, February 28, 572-573.

30 According to the Ninth Revision of ICD. The disease categories are equivalent to the following ICD-codes: (1) E800-E949; (2) 140-208; (3) 390-398, 402, 404-429; (4) E950-E978; (5) 740-759; (6) 765,769; (7) 798; (8) 430-438; (9) 571; (10) 480-487; (11) Reflects CDC surveillance data. No ICD code has been assigned for AIDS. (12) 490-496; (13) 250

31 Equivalent to accidents and adverse effects.

This, however, is only the "status quo". There can be no doubt that the number of AIDS cases and deaths will increase dramatically in the course of the next decade. Even if health education were able to stop the further spread of the Human Immunodeficiency Virus *immediately*, we would experience a further rapid increase of AIDS cases. This is the result of a momentum effect which is built into the long latency period of the HIV infection. Most AIDS cases which we will see during the 1990s will be only the terminal stage of HIV infections contracted in the late 1970s and early 1980s.

2.4 Projections

It is difficult to project AIDS morbidity and mortality on a worldwide basis, since our knowledge of the present state of the HIV epidemic is considerably limitted.[32] In particular, we do not know how far the virus has already spread in the less developed countries of Black Africa and the Caribbean. Furthermore, it is impossible to tell whether there will be a cure and a vaccine in the future which would slow down or stop the epidemic.[33]

In the short run, however, there can be hardly any doubt that the number of AIDS patients and deaths will increase dramatically. For June 1993, *George F. Lemp* and his co-authors have predicted 12,349 to 17,022 cumulative cases of AIDS in San Francisco. This would be an increase of 107 to 185% compared to the present (August 1988) 5,965 AIDS cases. According to this projection, the number of cumulative deaths from AIDS would be 9,966 to 12,767 in 1993.[34]

P. Flandre and A.-J. Valleron have used a regression analysis to evaluate the **expected decrease of life expectancy** due to AIDS in France between 1988 and 1990.[35] Compared with the major causes of death in 1988, AIDS mortality will have a substantial demographic effect due to the young age distribution of AIDS patients (see Table 5).

32 Bailey, N.T.J. (1988): The modelling and prediction of HIV/AIDS. In: Journal of the Royal Statistical Society, Vol. 151; Koch, M.G. / L'age-Stehr, J. (1987): Möglichkeiten der Prognose im Rahmen der AIDS-Epidemiologie. In: AIDS-Forschung, Jg. 2, Heft 2, 94-99.

33 Brundage, J.F. / Burke, D. / Gardner, L. / McNeil, J. / et al. (1988): Estimating the dynamics of the HIV infection epidemic from serial seroprevalence data. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 222.

34 Lemp, G.F. / Hessol, N.A. / Rutherford, G.W. / Payne, S.F. / Chen, R.T. / Winkelstein, W. / Wiley, J.A. / Moss, A.R. / Feigal, D. / Werdegar, D. (1988): Projections of AIDS morbidity and mortality in San Francisco using epidemic models. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 232.

35 Flandre, P. / Valleron, A.J. (1988): Decrease of life expectancy from AIDS in France between 1988 and 1990 compared to other major causes of death. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 2, Final Program, 204.

Tab. 5: France: Projected decrease of life expectancy and loss of potential years of active life due to AIDS

Cause	Loss of general life expectancy (in years) 1988	1989	1990	Loss of active life expectancy (in years) 1990
AIDS	-	0.33	0,67	0.38
Motor vehicle crashes	0.74			0.42
Cancer	3.85			0.54
Suicide	0.57			0.25
Heart diseses	2.26			0.27

Source: Flandre, P. / Valleron, A.-J. (1988): Decrease of life expectancy from AIDS in France between 1988 and 1990 compared to other major causes of death. In: IV. International Conference on AIDS, Stockholm, Sweden, June 12-16, 1988. Abstracts, Book 1, Final Program, 204.

3. Conclusion

The basic characteristics of the worldwide spread of the HIV virus can be seen from the studies mentioned above: in short, the "AIDS epidemic" is actually the result of *three* successive epidemics. The first, most vigorous, happened among homosexual and bisexual men in highly developed countries and among heterosexual urban populations with high-risk behavior (such as promiscuity and prostitution) in East and Central Africa and the Caribbean.[36] A substantial proportion of these persons are HIV infected today. Many of them became contaminated with the virus even before they knew of its existence. Behavioral changes, to avoid high-risk behavior, came too late in these groups to stop the spread of the virus. The second wave of the epidemic is now under way among i.v. drug abusers in several industrialized countries. Transmission of the virus happens through contact with infected blood ("needle sharing") and sexual activity. While the "first epidemic" was "male" (some 90% of the cases were homosexual or bisexual men), the second is "feminized". Among HIV infected drug addicts, some 50% are females. Heterosexual transmission of the virus (to the partners of drug abusers or bisexual men) is the most rapidly growing mode of infection in the USA. This heterosexual transmission could trigger a third wave of the HIV epidemic in developed countries, one which would affect very sexually active groups of the population, especially in urban areas.

The dynamics of these three epidemics are overlapping. In the light of the long incubation period of the disease, we are confronted at present with the HIV epidemic among homosexual and bisexual men from the early 1980s who now are developing AIDS. During the 1990s we will witness increasing numbers of female AIDS patients who are presently contracting the virus as drug addicts or their partners. As a result of

36 The HIV infections of haemophiliacs and transfusion patients resulted from contaminated blood (clotting factor), given to them in the course of therapy. In the developed countries their "contribution" to the epidemic is neglectible, since all blood donated for medical treatment is now screened for HIV. In less developed countries (especially in Africa), however, this is still a source of spreading the virus.

AIDS prevention campaigns, the spread among the heterosexual population in developed countries will certainly be much slower, than among homosexuals or drug abusers. Due to the disease's long incubation period, however, it is unlikely that the epidemic will "dry out" by itself. One has only to bear in mind the fact, that with an average (more or less) *infectious* incubation period of 10 years the probability of transmitting the virus to at least one other person is rather high.

It would be a gross misunderstanding to estimate the demographic impact of the HIV epidemic on the basis of the relatively "small" number of AIDS cases that are presently registered by the World Health Organization. No captain steering his ship, would ignore the unseen body of an iceberg. At a time when mortality statistics are beginning to register a significant increase in mortality due to AIDS, it is already too late.

Name: Dr. Thomas Klein

Title of Paper: On Future Potentials of Extending the Human Life Span

Summary:

In the future, mortality is still expected to decrease in most countries. This decrease can be attributed to the reduction of several very different causes of death, each of which varies in incidence and target age groups. Thus, the effect on life expectancy may be very different.

First, the impacts of any reduction of various causes of death on life expectancy and on survival funktions are analyzed in this paper with respect to F.R.G. current mortality data as well as to the post-war period of 1950-85. Among other causes of death, the so-called "avoidable" deaths, for which future reductions might be considered most likely, are treated separately in this context. The computations are based on the widely accepted method developed by Preston, Keyfitz and Schoen in the early 70ies and modified slightly by the F.R.G. Federal Institute for Population Research.

Second, the paper gives some general considerations on the future of life expectancy and on the possible human life span. Essentially, these considerations refer (1) to the impacts of slowing the rate of aging versus reducing vulnerablility, (2) to the impacts of heterogeneity and (3) to the possible bias of period life tables as opposed to cohort life tables.

To summarize, the German data suggest that, in terms of life expectancy, a gain of serveral years could be achieved by reducing specific causes of death, whereas the maximum human life span seems relatively stable. However, the evaluation of future potentials for life extension should consider that individual life expectancy is very unlikely to coinside with the official life table, but might be lower as well as higher, depending on the relative importance of heterogeneity versus the long-term mortality variation.

Name: L.H. Day, Dept. of Demography, Australian National University, Canberra, A.C.T. 2601, Australia

Title of Paper: Upper-age Longevity in Low-mortality Countries: A Dissenting View

Summary: Increased concentration in the upper age categories among European populations (both in Europe and overseas) has led, in some quarters, to considerable unease. Two assumptions underlie this unease: (i) that old age is essentially synonymous with ill-health, disability, mental deterioration, and uselessness, and (ii) that old age entails particularly high financial costs. Neither of these assumptions is more than partially true. Moreover, defining old age in terms of longevity rather than chronological age lessens somewhat the extent of ageing to be anticipated.

Current forecasts are unanimously of further increases in longevity among European populations, particularly at the uppermost ages. These are based on one or the other of three assumptions: (i) an almost mechanistic continuation of current downward trends in mortality, (ii) improvements in the prevention of disease and trauma, and (iii) improvements in therapy. These assumptions are, in turn, predicated on: (i) further development in science and its application, (ii) improved access to services and care, and (iii) changes in lifestyle.

Not all of these can necessarily be relied upon to take place to the extent anticipated by those who forecast continued improvement. Moreover, those who make such forecasts are leaving out of account certain elements in the equation that could have a counterbalancing effect, e.g.: (i) the possibility of heightened virulence in some disease organisms, (ii) the possibility of new diseases, (iii) worsened environmental conditions, (iv) increased stress.

Contrary to expectations, mortality among the elderly in European populations may well stop declining and commence increasing within another decade or two - partly because of differences between the current generation of old people and those who will succeed them, and partly because of the allocation of social resources. In contrast to those who will follow, today's elderly: (i) are biological survivors of periods of higher mortality, (ii) are emotional survivors of two world wars, depression, massive social change, (iii) have had less exposure to certain deleterious environmental conditions the unhealthful consequences of which take a long time to manifest themselves, (iv) have benefitted from the allocation of social resources in ways unlikely to be continued when old people become a higher proportion of the total.

Neither the ageing of European populations nor their decrease in numbers is likely to be as extreme as is commonly projected. Nor are these societies' general conditions of life likely to be adversely affected by either the numbers of elderly or their share of the total population. Far greater importance can be expected to attach to: (i) the physical and mental condition of the elderly themselves, and (ii) the political, economic, environmental, and social conditions in the societies of which they are a part.

Name: Josianne Duchêne and Guillaume Wunsch

Title of Paper: Population Aging and the Limits to Human Life

Summary:

Demographers and actuaries have not found a satisfactory answer concerning the maximum longevity of the human species or its limit life table. After a brief overview of the demographic and actuarial literature concerning mortality "laws" and limit life tables, we present results from the biological literature on aging and senescence.

Longevity and senescence are programmed into our genes; even if we were able to eliminate all diseases and accidents, death would still occur. According to present evidence, the maximum lifespan of the human species would be ± 115 years, and the average age at "natural" death would be between 85 and 100 years of age. This limit mortality would vary by age according to a Gompertz or, more probably, a Weibull distribution.

On the basis of the biological evidence available, we have constructed a hypothetical limit life table common to both sexes. This table leads to a mean length of life of 91.6 years, the age-specific force of mortality following a Weibull distribution.

Various demographic consequences of this limit life table on future population aging are derived in the final section of the paper, taking Japan as an example of a low mortality country. Combined with the present fertility schedule, the limit life table would ultimately yield an age structure where more than 1/3 of the population would be over 65, and one person out of five would be over 75. Even if fertility reached replacement level, the percentage of persons over 65 would still increase from the present level of ± 12 % to nearly 30 %.

Name: Tuija Martelin

Title of Paper: Trends in elderly mortality in the Nordic countries

Summary:

This study describes the development of elderly mortality in the Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden) during this century. Long-term trends in total mortality are examined on the basis of life table statistics. More recent trends (from the 1950s onwards) are described by means of annual mortality rates according to a rough classification of causes of death. The series of vital statistics have been utilized as the data source for the long-term trends, and the original data for annual trends have been obtained from the mortality data bank files of the WHO. Marked improvements were observed in survival at advanced ages in the Nordic countries. However, the development has not been stable as in recent decades the elderly mortality rate has fluctuated, roughly comparable to the fluctuations in mortality among the younger age groups. The fact that the rate of recent improvement has been greatest in Finland where there, traditionally, is a high mortality level, and low in Norway and Sweden, where mortality levels are low, is in accordance with the idea of approaching a certain biological lower limit to mortality. However, certain characteristics seem to suggest that further advances are possible. Marked improvements have taken place recently in Iceland even though its mortality level at the end of the 1960s was already low. In addition, a large proportion of the differences in mortality rates between the Nordic countries may be due to external factors related to living conditions or life-style. Recent trends in mortality from several causes of death may also be primarily linked to such factors. Further research focusing particularly on a more detailed classification of causes of death and socio-demographic differentials within the national elderly populations is suggested.

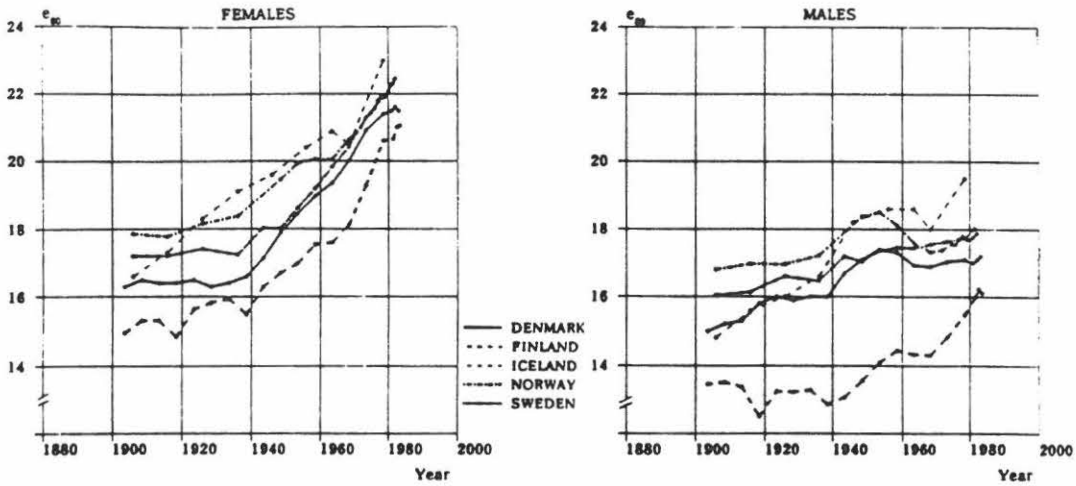


Fig. 1. Development of life expectancy at the age of 60 years since 1900 in the Nordic countries.

Name: MAREK KUPISZEWSKI

Title of Paper: Spatial aspects of past and future changes of life duration in the light of single- and multiregional life tables: A case study of Poland 1977-1995

Summary:

For the purpose of analysing the past and the future of mortality patterns in Poland single- and multiregional life tables were computed, based on data from 1977, 1978, 1980, 1981, 1983, 1984 and 1985. Methodology and computer program published by Willekens and Rogers (1978) were used. Spatial division adopted in the investigation was identical with one used by Dziewoński and Korcelli (1981) for multiregional demographic analysis.

Over the last decade we witnessed in Poland an increase in the death number and death rates. It is easy to asses the phenomena mentioned in the scale of the whole country, but its spatial aspects are neglected. The aim of the paper is twofold: (1) an assessment of the changes in spatial patterns of mortality during the 1977-1985 period; (2) an attempt to create hypothetical life tables for 1990 and 1995.

In the first part of the paper an analysis of the stability of parameters of the life tables is presented. The main stress was put on the e(0) values in different regions and for data sets referring to different years. The analysis gives an insight into the problem of changes of mortality patterns in the regions over time and additionally allows to assess to what extent changes in migration patterns influence mortality.

In the second part of the paper an attempt to project age-dependent migration and death rates for 1990 and 1995 is made, and based on this projection a hypothetical single- and multiregional life tables are computed. The life tables could serve as a simple forecast of the changes in the mortality patterns over time. A comparison of observed life tables (based on the 1985 data) and two hypothetical life tables (for 1990 and 1995) is presented.

Willekens F., Rogers A., 1978. Spatial Population Analysis: Methods and Computer Programs, RR-78-18, IIASA, Laxenburg.

Dziewoński K., Korcelli P., 1981. Migration and Settlement: 11. Poland. RR-81-20, IIASA, Laxenburg.

Name: Eta Daróczi - Emil Valkovics

Title of Paper: Checking the Stability of Spatial Variations in Mortality for Estimating Future Trends of Mortality in Hungary

Summary:

A possible approach for estimating future changes in mortality levels is based on the hypothesis that the relationship between the logit l_x values of the individual regional life tables and those of the national life tables would remain unchanged on the short run. (This approach was used to estimate regional life tables for intercensal periods in other countries.) It is, however, a question whether this hypothesis holds true in a period of <u>increasing</u> mortality.

In Hungary the life expectancy at birth of the male population decreased from 66.52 to 65.04 years and that of the female population changed from 72.38 to 73.13 years between 1974 and 1984. As a first step, abridged national life tables of each sex were decomposed into 21 'spatial units': Budapest, 19 counties and others (unknown residence or abroad) for 1974 and 1984. As a second step, life tables of these individual counties were reintegrated to result the initial national life table. The method of double standardization was used for isolating the effects of the varying structure of the deceased population by place of residence from the impact of changing mortality levels in various parts of the country. Testing the hypothesis of stable spatial variations in mortality is based on the above calculations.

Some other variations in mortality (e.g. the variations of the level and structure of mortality by causes) will be also taken into account for estimating future trends of mortality in Hungary.

Name: Otto Andersen, Danmarks Statistik, Sejrøgade 11, 2100 Copenhagen
Denmark

Title of Paper: Reduction of mortality among the occupational active population in the Nordic countries: effect on life expectancy and number of deaths

Summary:

The data used in this study are from the registers on mortality and occupation established in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden). The study covers all individuals who were aged 20-64 years on the first of January, 1971. That is more than 12 million people, whose mortality was followed during exactly 10 years, i.e. until the end of 1980. During this period approximately 775,000 deaths were recorded.

In the basic study mortality and occupation is analysed by indirect standardization, calculating the SMR (Standard Mortality Ratio), showing the excess mortality as an index figure. The standardpopulation is chosen as all economically active males or females in the Nordic countries.

The study clearly shows that there are considerable mortality differentials between the individual countries and within each country there are considerable mortality differentials between the individual occupational groups.

For the economically active men mortality is by far the highest among Finnish men - index is 133. For the economically active women mortality is highest among the Danish women - index is 120.

Among the 37 occupational groups for men mortality is lowest among teachers and highest among deck and engine room crew. Among the 14 occupational groups for women mortality is lowest among teachers and highest among workers in food industry.

The analysis of causes of death shows that the excess mortality of Finnish men is mainly due to diseases of the circulatory system. For Danish women malignant neoplasms is the cause of death responsible for a large part of the excess mortality.

One of the main conclusions is that occupations with low overall mortality have low mortality from most causes of death, and that occupations with high overall mortality have high mortality from most causes of death.

In order to evaluate the concequences of a future reduction in mortality two kinds of calculations have been made.

Firstly,the life expectancy has been calculated showing the average number of years lived between age 22.5 and age 72.5. Thus, the maximum number of years lived is 50 years, and the difference between 50 years and the actual number of years, is the number of years lost. As example, teachers i Sweden lose 3.22 years, while deck and engine room crew in Denmark lose 8.84 years.

Secondly, it has been calculated the number of deaths that could have been avoided if all occupational groups had had the same low mortality as teachers. For the economically active population of males, the number of deaths is as high as approx. 100,000 out of approx. 375,000 deaths. For the female economically active population the number is approx. 16,000 out of approx. 96,000 deaths. The calculations have been carried through for each country and each cause of death.

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Name: Dhruva Nagnur

Title of Paper: Cause-deleted Entropies and Future Course of Cause-specific Mortality in Canada

Summary:

The study examines the time series of cause-deleted entropies (H s) derived from the cause-deleted life tables for Canada for the past six decades. It discusses the shifts in the cause-pattern of canadian mortality during the past sixty years and the impact of these shifts on the life expectancy and survivorship to older ages. The impact of reductions in mortality by cause on the future life expectancy gains is quantitatively assessed in terms of the cause-specific entropies (H s).

The importance of the two disease categories - cardiovascular diseases and neoplasms, in determining the future gains in life expectancy is stressed as also the importance of taking into considerations the epidemiologic shifts in future mortality projections. The significance of the index H in the assessment of epidemiologic shifts in time series perspective as well as in disaggregating the total effect by cause is briefly studied with respect to Canadian mortality data for the past sixty years.

Name: Aslak Herva

Title of Paper: Future Mortality of Finland's North Karelia Province

Summary:

The Province of North Karelia is wellknown for its high incidence of cardiovascular diseases and the related mortality. After an effective and efficient health policy programme the risk curves are now lower than before. But a big question remains. Why is the difference of life expectancies between the sexes now 9.6 years at birth? This may be the highest in the world.
The most common causes of death are still cardiovascular, and cancer is relatively as common as in most of the developed countries. However, special types of neoplasmata, especially of the lung, differ remarkably between the sexes. Smoking habits are clearly the main reason for this. Women in North Karelia do not smoke as much as other Finnish women. This is because of the culture and passive contact network compared with more densely populated areas. (There are only 10 inhabitants per square kilometre.) The raw winter weather may also have something to do with the morbidity. The temperature may often reach minus 40 degrees Centigade. Another noticeable risk factor is nutrition. The everyday diet, especially earlier, contained a lot of fat and men's drinking habits were "classical Russian."
In this study a special emphasis will be put on carcinogenic mortality development because of the expanding number of work environment exposures to carcinogens and potential health policy measures. It is true that the life expectancy difference is wide, but as such the year-values are not so bad. In 1984 for 0-years female babies life expectancy was 78.0 years and for males 68.6 years. The total population was only 177,642, so the numbers are subject to quite a lot of random variation from year to year. On the other hand, the quality of demographic statistics in Finland is high, so the effect is not magnified by lack of information.

Name: Peter Findl

Title of Paper: A Cohort Model for Mortality Projection in Austria

Summary:

In the context of the 1987 population projection of the Austrian Central Statistical Office an extrapolation of age-specific trends in period mortality was conducted. For males the base period 1971-1986 showed the best fit to the data. The only age group where no mortality reduction could be measured over the period was 50-55. On the other hand mortality declined substantially in the age group 60-65. For this reason a simple trend extrapolation resulted in a strange future age-pattern of death probabilities: 65 year old men would have a lower mortality risk than those aged 55.

Next, possible cohort effects were studied by the means of a multiple regression with dummy-variables for age, period (1951-86), and cohort and the log of the death probability as dependent variable. The results show a favorable effect for the cohort born 1911-20 and an unfavorable effect for those born 1926-35. This regression model was also used to extrapolate the probabilities of death into the future. However, because of the presumed low prognostic quality of (mainly exogenously determined) mortality of children and young adults, this cohort model will not give valid results for the very long run.

NOTES

SESSION 5

The Future of Regional Differentials in Growth and the Composition of the Population

Organizer: Antonio Golini

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The Future of Regional Differentials in Growth and the composition of the Population

An overview and introduction

by
Antonio Golini and Frank Heins
Istituto di Ricerche sulla Popolazione, Rome, Italy

0. Foreword

The topic of this session is closely linked to those of other sessions i.e. the future of demographic change. However, in this session we particularly focus on the regional aspect. Needless to say the findings and results of the other sessions will also be given consideration here.

We will approach the subject by looking back to recent developments to find indications for the future. This leads us to the discussion of the political implications of regional differentials in demographic change.

The first section of the paper is an outline of the basic methodology of the subject.

The measurement of regional differentials as ratios or as absolute differences is considered in the second section.

The third section discusses the possible effects of regional differences in the actual population structure, fertility, migration and mortality on the future regional growth of the population.

This is followed by a discussion of the basic political responses to these future differentials. Can a goal, like zero population growth for example, be formulated and implemented at a regional level?

To conclude we summarize the findings regarding future regional differentials in population growth.

1. Some basic thoughts on the subject

Regional differentials of demographic change consist of two aspects, the spatial and the demographic. Any observation of these two aspects depends on the approach. The more approximate the measure and the smaller the scale the less likely it is that regional diversities will be pronounced. Regional diversity will be increased if the scale is enlarged and finer measures are used.

How can we define a region or a regional perspective? We can give a wide range of regional divisions: a Continent - Nations- Regions - Provinces - Cities or Communities. As demographers our main concern will be with administrative regional divisions, as political authorities usually provide data and will be able to give policy responses to findings.

We should be aware that the size of the region being looked at influences the observation of patterns of past growth and future development. The larger the region the less homogenous ceteris paribus the behavior in this region. Therefore our task should also be to perform an intra-regional analysis aimed at identifying differentials in sub-regional homogeneous areas in which policy action could be more urgent and/or effective.

How should demographic differentials be measured? Increasing the detail of the measures used will increase the observable diversity. The problem is to find adequate, standardized and comparable indices. Synthetic indicators, like the total fertility rate, might give us clear trends at a regional level. This clarity could vanish if we increase the detail of observation, for example, by using age and birth order specific fertility rates.

What do we understand by growth of the population and its composition? In the first place we have to take into account all demographic characteristics such as population size, sex and age structure and marital status. Family and household structure are relevant, too. In addition social, economic, ethnic and racial aspects also define the composition of a population. In general, these are all aspects of economic, social, cultural and political importance. Often these are data which are collected during a population census, where the census reflects the official and/or public interest in these population groups. No doubt, interest in subpopulations or in the composition of populations will certainly increase in the near future.

With the above remarks we tried to recall some basic considerations. It appears impossible to define a single approach to the study of regional differentials of population change. Each study depends on the definition of the research goal and the special interest or approach of the individual researcher or research group.

In any case there is an advantage to a regional approach. Such an approach might add to the quality of our studies and policy recommendations, because the number of observations made increases. The national population is the sum of regional populations. With a better demographic knowledge at a regional level our understanding at a national level will thereby improve. Therefore the preparation of regional population projections, for example, becomes a very fruitful exercise. By using the latter we can expect to improve national population projections.

2. Ratios versus absolute differences in regional demographic indicators

With regards to regional differentials the relative approach seems to be more appropriate and indeed is the more used. To measure the relative differentials we standardize the regional values by setting the national value to 100, for example. The national value would be the denominator for index numbers or standardized indicators. But also here a word of caution: the smaller the value of the indicators the higher the relative differences.

This becomes obvious in the case of mortality/survivorship. If the age specific probabilities of dying, or of surviving, are not close to 0.5, which is usually the case, we will observe very different results regarding which of the two probabilities we chose to calculate the standardized indicator. The same absolute difference, 0.05 for example, is very different in relative terms if we consider it either from the point of view of mortality (0.10 versus 0.15 for example) or from the point of view of survivorship (0.90 versus 0.85).

In any case, if we only look at the ratio between regional values and not at their absolute differences, this is demographically misleading, as the effects on population size and structure of regional differentials are functions of ranges and not ratios.

The permanence or the increase in the relative distance between the demographic indicators is certainly a sign of the permanence of social and biological differences regarding demographic behavior. This also signals the failure of policies aimed at eliminating differentials and inequalities between disadvantaged regions and the other regions.

By looking at the demographic consequences of regional differentials in demographic behavior we find that in many cases the range or the absolute difference, is the appropriate way to measure these differentials. This is true for instance for regional differentials in the growth rate and in demographic rates, like the mortality rates, as shown in table 1 and table 2 for two hypothetical situations. In both cases the absolute differences are the decisive indicator for the demographic consequences of regional differentials. We observe the apparent paradox that the situations with marked relative regional differentials in demographic behavior have resulting demographic situations with fewer differentials.

Table 1: Effect of regional differentials in growth rates.
(Comparison of two theoretical situations)

Region	Population at t=0 abs.	Population at t=0 %	Growth rate r	Growth rate total=100	Population at t=100 abs.	Population at t=100 %
Situation 1 (growth rates - ratio: 2 to 1 ; difference: 1.5)						
A	100	50.0	3.00	120.0	1922	81.3
B	100	50.0	1.50	60.0	443	18.7
Total	200	100.0	2.50	100.0	2365	100.0
Situation 2 (growth rates - ratio: 4 to 1 ; difference: 0.3)						
A	100	50.0	0.40	153.8	149	57.3
B	100	50.0	0.10	38.5	111	42.7
Total	200	100.0	0.26	100.0	260	100.0

Table 2: Effect of regional differentials in rates on the population composition.
(Comparison of two theoretical situations)

Region	Live births abs.	Live births %	IMR (‰) rate	IMR (‰) total=100	Population age 0-1 abs.	Population age 0-1 %
Situation 1 (rates - ratio: 2 to 1 ; difference: 50.0)						
A	100	50.0	100.0	133.3	90.0	48.6
B	100	50.0	50.0	66.7	95.0	51.4
Total	200	100.0	75.0	100.0	185.0	100.0
Situation 2 (rates - ratio: 4 to 1 ; difference: 15.0)						
A	100	50.0	20.0	160.0	98.0	49.6
B	100	50.0	5.0	40.0	99.5	50.4
Total	200	100.0	12.5	100.0	197.5	100.0

3. Components of the regional differentials in population change

Today it seems more and more inadequate to consider only a growing population. We are reaching a situation in which population change can be zero (stagnation), or show an increase or a decrease. Consequently we prefer to talk about population change instead of population growth or to make at least clear that we should allow for a negative growth.

What are the main demographic factors influencing future differentials in the growth and composition of the population? Besides, future demographic behavior, including family or household formation, fertility, migration and mortality, the existing structure and composition of the population are important components.

Using recent Italian data we can add some data to the more general discussion of factors which may determine future regional differentials. The Italian data we present relate to the regional level of the 'regione'. Italy is divided into 20 'regione'. This number is reduced to 18 regional divisions, because data for Valle d'Aosta are presented with Piemonte and the regions of Abruzzi and Molise are shown together. All data are by actual place of residence and by calendar year.

Differentials in the inertia of the population

The first factor is the inertia of the existing structure and composition of a population.

From a political point of view it is very important to understand and to get policy makers to understand how large and how long the population momentum is. As a consequence of its structure the Liguria population (with a current TFR of 0.9) will continue to decrease for at least 50 years (the time span of the projection) even if its fertility increases over the next 10 years to replacement level. On the other hand, the Campania population (with a current TFR of 1.8) will increase for not less than 15 years even if its fertility continues to decline.

Again, from a political point of view (strictly speaking) the number of members of parliament from Liguria could strongly decline over next decades: the ratio between Campania and Liguria population in 1971 was 2.73 and could reach in 2038 (with constant fertility) 7.14.

In social terms we must consider that, according to this hypothesis, in 2038 the percentage of people aged 65 and over will be 22 % in Campania and 42 % in Liguria. In this latter region we will observe in 2033-2038 a 6 to 7 times higher number of deaths than of births.

At this point of demographic behavior and trends we can ask ourselves if there do exist regions or areas with such a low fertility and pronounced aging process that they are reaching a point of no-return regarding population decline. A recent Italian study found two simple demographic indicators which are a sure and clear sign of a vicious circle between low fertility, aging and population decline [Golini, 1987].

When a population shows a child-woman ratio of under 20 per cent and the percentage of people 60 year old and over reaches a value of 30 % we can expect a natural decrease of at least 1 % in the next decade. After 10 years the percentage of people aged 60 and over will reach 35 % and the natural decrease in the following decade will be 1.5 % to 2.0 % and so on.

The study of these relationships will be very important for the European population at a regional level in the next century.

Fertility differentials

Fertility depends on the decision of the individual or couple. Depending on trends in favor of diversification or homogenization in behavior we will observe more/less regional differentials.

We can observe regional differences in intensity and timing, based on the total fertility rate, mean age of mother at child birth and age and birth order specific fertility rates.

Figure 1 and 2 show trends for selected Italian regions from 1952 to 1985 (see also table 3). The most striking problem is the amazingly low level of fertility reached in some regions (TFR less than 1.0). How low might the TFR drop in the future making 'realistic' assumptions?

Migration differentials

Migration depends on personal decisions or decisions at the household level. Different types of migration and its motivation have various effects on population structure.

In some countries of Europe the intensity of migration has decreased recently. However, typical migration schedules, as discussed by Castro and Rogers and in Bonaguidi, are still to be observed. How large will both international and interregional migration flows be in the future? Will the age-profile of migration be the same, or will some regions attract just migration of specific subpopulations like the elderly, for example? Will there

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be a replacement of births through immigration? A recent contribution of Blanchet [1988] sheds some doubt on this possibility.

Mortality differentials

Mortality depends on a wide range of factors, usually not in the reach of personal decision.

Life expectation measures both aspects (intensity and timing) of mortality. Age specific mortality rates or probabilities might give additional detail regarding regional mortality differentials.

Table 4 and 5 show trends of the regional mortality differentials in Italy. And again the most important question is what could be the levels of life expectancy at birth and especially at older ages in the near future? How large will the spatial differentials remain?

With regard to the composition of the population there are further aspects to be discussed: marital status differentials; nuptiality or socioeconomic composition of the population; labor force participation or economic activity.

4. Policy implications of regional differentials in population change

After discussing the possible alternatives with regard to regional differentials in population change we have to turn now to the political implications. In recent years this aspect of our profession - policy consulting - has become more and more important. After clarifying the aspects involved in observing regional differentials of demographic development we now discuss the political assessment of these changes.

The actual economic and social structure of a region is usually adapted to a specific population size and composition, if not we observe frictions in social and economic development. Regional differentials in population growth and its composition imply regional differences in this adaptation process. A balanced regional population change is one condition for a balanced regional development.

However, regional and national situations and policy goals are often divergent. The difference in demographic development between regions and in regions can lead to changes in the political system or balance of a nation. How different and effective can economic and social regional policies be to tackle and come to grips with strong regional demographic differentials? Or how can we make flexible policies to tackle differentials at a local level?

What can be considered positive? What is considered negative? Are there criteria to assess regional population changes? These questions are certainly linked to the controversial problem of population optimum. Can we define a dynamic optimum population of a region or a nation? Knowing that the optimum population is not a simple function of one factor but interrelates with a variety of socioeconomic and other factors we refrain from discussing this further. Can we at least individuate regional demographic paths or scenarios to be avoided?

However the question of balanced regional demographic development also depends on the regional division under examination. It seems very likely that there are conflicts of interest between the national level and regions or regional subdivisions.

For example a balanced demographic development among regions of a nation might be in the interest of national policy. The goal would be to avoid the growing importance of a large regional variability based on a feedback action, as described above. The share of a region with positive demographic indicators (higher than national fertility, lower than national mortality and a positive migration balance) tends to increase. National policy usually favors the convergence of regional demographic changes. In addition, national policy might aim at an age structure which provides a more balanced revenue/expenditure situation for the social security system.

A balanced demographic development in the regions would try to balance the socioeconomic structure and development with regional demographic changes. Balanced demographic change can have different implications at different regional levels. At the community level housing might be an issue. Smaller regions might see a functioning labor market as a prime target. Larger regions would give greater consideration to the overall economic, social and political development.

Balanced demographic change might be defined by a path close to zero population growth (with a more or less wide range). Like shown above we have to account for regional differentials and we cannot expect a unique 'optimum' demographic growth path in all regions.

5. Summary and conclusions

Whither regional differentials of population growth? No doubt, regional differences will continue to exist.

An increased awareness regarding regional differentials might lead to more data and more studies in this field of interest. The proliferation of studies on regional mortality differentials over the last years might be an indication. An increased sensibility regarding regional differentials will lead more and more countries to try to measure these differentials.

But recent socioeconomic developments in various countries indicate a tendency in favor of the homogenization of values and attitudes or behaviors. This would lead to a convergence of regional variations.

We are still far from formulating policies to influence regional differentials of demographic change. However, their objective should be a balanced demographic development, which might be found in more or less close range of zero population growth.

Some population policies are implemented, but their formulation is usually not concerned with regional differentials in population growth. Indeed the nation-state is no longer able of tackling regional problems because in many cases it is to big for "small" problems. The nation-state becomes increasingly unresponsive to the variety and diversity of local needs. On the other hand local political centers often lose the ability to effectively control resources and make their own decisions.

Demographers can provide information to help to devise policies in this area. Thanks to early information and discussion we might be able to provide enough time to allow for adaptation to demographic changes and variations. Regional population projections seem to us a very important tool in this regard.

We think that the political responsibilities of the demographer has to be stressed in undertaking studies, in establishing population projections and in making known findings.

In the introduction we spoke of caution regarding a hasty judgment about the future of regional differentials in growth and the composition of the population. We tried to clarify some basic concepts and we discussed possible policies regarding regional demographic changes. The following invited and contributed papers will provide us with more information, further methodological discussion, several case studies and more empirical examples.

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Table 3: Total fertility rate, Italy 1954, 1964, 1974 and 1984.

	1954	**1964**	**1974**	**1984**
Maximum	3.79 Sardegna	3.50 Campania	2.94 Campania	2.03 Campania
Minimum	1.32 Liguria	2.00 Umbria	1.82 Liguria	1.01 Liguria
Italia	2.32	2.64	2.32	1.46
Max/Min ratio	2.87	1.75	1.62	2.01
Min/Max difference	2.47	1.50	1.12	1.02

Sources: 1954 - [Rallu, 1983]
1964-1984 - ISTAT, various Demographic Yearbooks

Table 4: Life expectancy at birth of men, Italy 1920/22, 1950/52, 1960/62, 1970/72 and 1979/83.

	1920/22	1950/52	1960/62	1970/72	1979/83
Maximum	52.8 Toscana	67.0 Umbria	69.5 Sardegna	71.4 Calabria Abruzzi e Molise	73.0 Marche
Minimum	44.1 Puglia	61.0 Basilicata	64.9 Trentino- Alto Adige	67.2 Friuli- Venezia G.	69.3 Friuli- Venezia G.
Italia	49.3	63.9	66.9	69.0	71.0
Max/Min ratio	1.20	1.10	1.07	1.06	1.05
Min/Max difference	8.7	6.0	4.6	4.2	3.7

Table 5: Life expectancy at birth of women, Italy 1920/22, 1950/52, 1960/62, 1970/72 and 1979/83.

	1920/22	1950/52	1960/62	1970/72	1979/83
Maximum	55.2 Liguria	70.8 Liguria	74.2 Toscana	76.8 Toscana	79.3 Marche
Minimum	44.8 Puglia	61.7 Basilicata	69.9 Campania	72.9 Campania	75.7 Campania
Italia	49.3	63.9	66.9	69.0	71.0
Max/Min ratio	1.23	1.15	1.06	1.05	1.05
Min/Max difference	10.4	9.1	4.3	3.9	3.6

Sources: 1920/22 - [Di Comite, 1974]
1950/52, 1960/62, 1970/72 - [Golini, 1977]
1979/83 - [ISTAT, 1987]

Figure 1: Total fertility rates, selected Italian regions, 1952 to 1985.

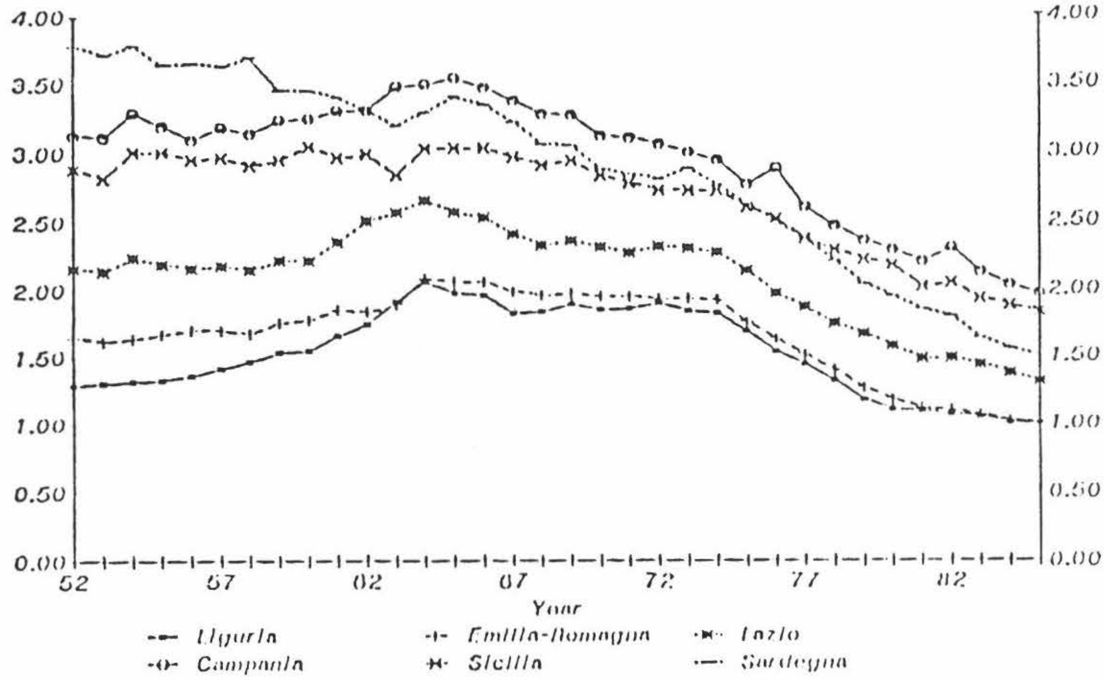
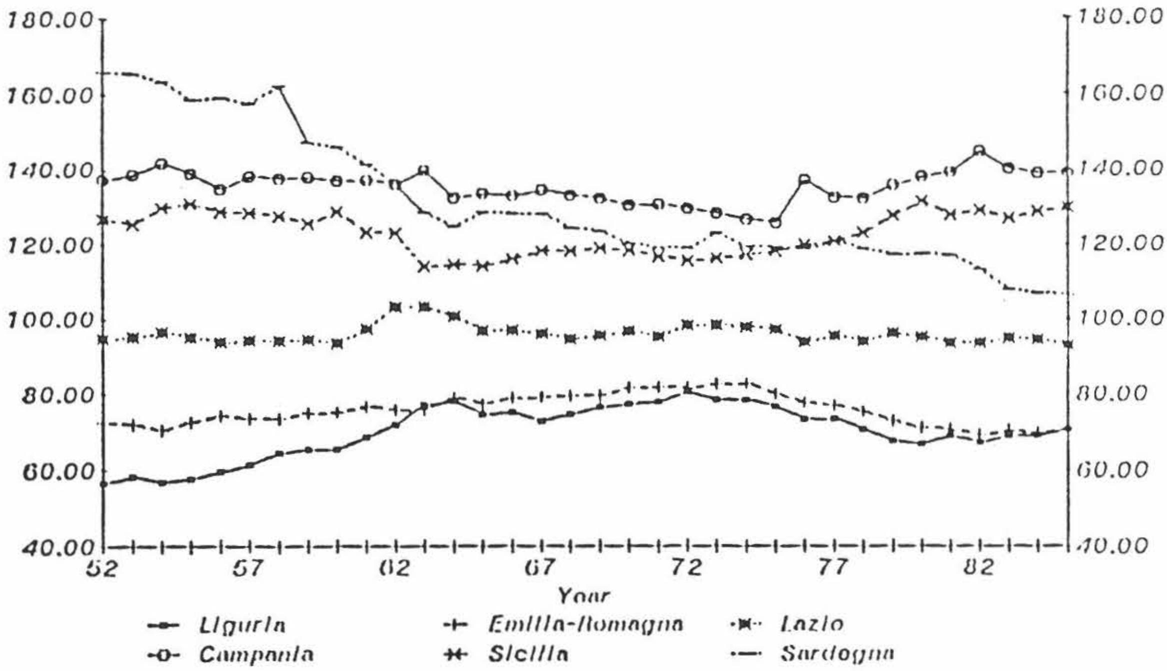


Figure 2: Total fertility rates, selected Italian regions, 1952 to 1985, Italy = 100.0.



The impact on births, deaths and migrations of demographic rates and population size and composition

An introduction to exposure analysis

Frans Willekens

1. INTRODUCTION

The size and composition of a population change due to demographic events that occur to people. People migrate, reproduce and die. The rate at which an event occurs, the event rate, depends on the personal attributes of people as well as on contextual factors. The personal attributes of a person determine the population category or subpopulation to which he belongs. The number of events (births, deaths, migrations) during a given period changes because the composition of the population changes. In addition, the rate associated with a given subpopulation may change. To differentiate the effects of compositional changes from the effects of changes in rates, standardization techniques are traditionally used in demography. Standardization is however not directly applicable if the occurrence of one event depends on the (non-)occurrence of another event. This is however the case if we wish to investigate how fertility, mortality and migration interact to generate changes in the size and the composition of a population.

In this paper, another method is presented to disentangle the effects of each of the components of change on the growth path of a population. The basic idea of the method is to project simultaneously the population and the exposure of members of the population to the risk of experiencing the demographic events. The length of time during which a person may experience a particular event will be referred to as the <u>exposure function</u>. The unit of exposure is a person-year. The exposure function depends of course on the attributes of the person and on the event rate, associated with the set of attributes. All persons with the same set of attributes are said to occupy the same state and experience a given event at the same rate. Unobserved heterogeneity is assumed to be absent. The exposure function will be estimated for a given time interval from t to t+h, where h denotes the length of the interval. A change in attribute during the interval results in a change of state and generally implies an exposure at a different rate. The exposure function represents the fraction of the interval that one lives in each state and is exposed to an event at a given rate. It is equivalent to what is known in demography as Chiang's "a" (Chiang, 1984, pp. 142 ff).

The exposure function is particularly easy to estimate if the events are uniformly distributed over the interval. The assumption of uniform distribution of events is generally used in demographic projection models.

Section 2 presents the method for simultaneously projecting the number of people and the exposure function of an aggregate population. Several of the issues that arise in the design of projection models of complex populations, consisting of several interacting subpopulations, also arise in the construction of models of aggregate populations which are not divided in subpopulations. To emphasize the issues, we first derive a projection model of an aggregate population. In section 3, a model is presented for the projection of the number of people and the exposure function of a population categorized by region of residence.

2. EXPOSURE ANALYSIS IN AN AGGREGATE POPULATION

The purpose of this section is to show how the number of people in a population and the person-years lived during a unit interval by the people is determined by an initial population and by a set of birth, death and migration rates. We also show how the numbers of events of different types are interrelated. The number of deaths depends on the number of births and migration, even if the rates of birth, death and migration are independent. A change in the migration rate or the birth rate may not affect the death rate, but it does affect the number of deaths that occur during a given period because of its impact on the person-years lived (total duration of exposure) during the period. In order to differentiate the effect on the event count of an exogenous change in the population size from the effects of changes in the demographic rates, we must show the exposure time is affected by these changes. In Section 2.1, a model is proposed to analyze changes in exposure times. The model is directly related to a population projection model. Section 2.2 presents a numerical illustration.

2.1 The model

Let K(t) denote the size of the population at time t. The population changes due to births, deaths, migration and immigration. Let B(t,t+h) denote the number of births during the interval from t to t+h, with h the length of the interval; $D(t,t+h)$, $E(t,t+h)$ and $I(t,t+h)$ represent the number of deaths, emigrations and immigrations, respectively. The projection model of the number of people and the person-years lived is derived in 4 steps. First, an accounting equation is established relating the number of people at time t+h to the number of people at t and the demographic events during the period from t to t+h. Second, the event rates are defined. Third, the person-years lived are approximated by introducing appropriate assumptions. This results in a model of the exposure time. Finally, the population projection model is obtained.

The population size at t+1 is given by the accounting equation:

$$K(t+h) = K(t) + B(t,t+h) - D(t,t+h) - E(t,t+h) + I(t,t+h) \qquad (1)$$

To translate the accounting equation into a projection model, the numbers of events must be expressed in terms of the population and the parameters of the projection model. The parameters are occurrence-exposure rates. An occurrence-exposure rate is the ratio between the number of events during a time interval and the total duration of exposure during the interval by those at risk of experiencing the event. The duration of exposure is denoted by $L(t,t+h)$. The occurrence-exposure rates are given by the rate equations:

- birth rate:

  $b(t,t+h) = B(t,t+h)/L(t,t+h)$

- death rate:

  $d(t,t+h) = D(t,t+h)/L(t,t+h)$

- emigration rate:

  $e(t,t+h) = E(t,t+h)/L(t,t+h)$

The population at risk of immigration is the population of the rest of the world. Instead of estimating an emigration rate for the rest of the world, the number of immigrants are included in the model as count.
The estimation of the occurrence-exposure rates requires information on the duration of exposure L(t,t+h). Suppose the available data consist of the initial population K(t) and the number of events during the (t,t+h)-interval. The end of period population K(t+h) is therefore also known. Assume that the events are uniformly distributed over the interval of length h. The exposure function is then:

$$L(t,t+h) = \tfrac{1}{2}h[K(t) + K(t+h)] \qquad (2)$$

and, substituting (1) for K(t+h):

$$\begin{aligned} L(t,t+h) &= \tfrac{1}{2}h[K(t) + K(t) + B(t,t+h) - \\ &\qquad O(t,t+h) - E(t,t+h) + I(t,t+h)] \\ &= h\,K(t) - \tfrac{1}{2}h[-b(t,t+h) + d(t,t+h) + \\ &\qquad e(t,t+h)]L(t,t+h) - \tfrac{1}{2}hI(t,t+h) \end{aligned}$$

$$L(t,t+h) = \frac{h}{1 + \frac{1}{2}hm(t,t+h)} K(t) + \frac{\frac{1}{2}h}{1 + \frac{1}{2}hm(t,t+h)} I(t,t+h)$$

$$= \frac{h}{1 + \frac{1}{2}hm(t,t+h)} [K(t) + \tfrac{1}{2}I(t,t+h)] \qquad (3)$$

where

$$m(t,t+h) = d(t,t+h) + e(t,t+h) - b(t,t+h) \qquad (4)$$

Since the events are uniformly distributed over the interval, the exposure function is also equal to the product of the mid-period population, $K(t+\frac{1}{2}h)$, and the length of the period, h:

$$L(t,t+h) = h\ K(t+\tfrac{1}{2}h).$$

From (3), we observe that

$$K(t+\tfrac{1}{2}h) = \frac{1}{1 + \frac{1}{2}hm(t,t+h)} [K(t) + \tfrac{1}{2}I(t,t+h)] \qquad (5)$$

The number of events during the (t,t+h)-period may easily be obtained once the exposure function is known. For instance, the number of births is:

$${}_bN(t,t+h) = b(t,t+h)\ L(t,t+h)$$

and the number of deaths is

$${}_dN(t,t+h) = d(t,t+h)\ L(t,t+h),$$

which is equal to

$$\frac{d(t,t+h)}{1 + \frac{1}{2}hm(t,t+h)} [K(t) + \tfrac{1}{2}I(t,t+h)]$$

The number of deaths in the absence of migration is

$$\frac{d(t,t+h)}{1 + \frac{1}{2}h[d(t,t+h) - b(t,t+h)]} K(t)$$

The difference between this number on ${}_dN(t,t+h)$ is due to deaths of migrants. The number of deaths in the absence of fertility and migration is

$$\frac{d(t,t+h)}{1 + \frac{1}{2}hd(t,t+h)} K(t).$$

It excludes the deaths to children born during the year under study.

Substitution of the rate equations and the exposure function (1) into the accounting equation (1) results in the projection model:

$$K(t+h) = K(t) - \tfrac{1}{2}hm(t,t+h)[K(t) + K(t+h)] + I(t,t+h)$$

$$[1 + \tfrac{1}{2}hm(t,t+h)]K(t+h) = [1 - \tfrac{1}{2}hm(t,t+h)]K(t) + I(t,t+h)$$

$$K(t+h) = \frac{1 - \frac{1}{2}hm(t,t+h)}{1 + \frac{1}{2}hm(t,t+h)} K(t) + \frac{1}{1 + \frac{1}{2}hm(t,t+h)} I(t,t+h)$$

or

$$K(t+h) = S(t,t+h)K(t) + {}_{*}S(t,t+h)I(t,t+h) \qquad (6)$$

with

$${}_{*}S(t,t+h) = 1/[1 + \tfrac{1}{2}hm(t,t+h)] \qquad (7)$$

$$S(t,t+h) = [1 - \tfrac{1}{2}hm(t,t+h)]{}_{*}S(t,t+h) \qquad (8)$$

${}_{*}S(t,t+h)$ is the population growth ratio over half a period. $S(t,t+h)$ is the population growth ratio over a whole period. Notice that

$$S(t,t+h) \neq [{}_{*}S(t,t+h)]^2 \qquad (9)$$

Since the events are assumed to be uniformly distributed over the period, the birth, death and emigration rates are not constant during the interval, but follow a hyperbolic distribution. Consequently, the growth ratio is not the same at each point of time in the interval. For (9) to hold requires the assumption of constant intensities instead of the assumption of constant probability densities (for a discussion in the context of life table analysis, see Willekens, 1988).

The coefficient of $I(t,t+h)$ is ${}_{*}S(t,t+h)$ in (6). The immigrations are uniformly distributed over the entire interval. On average, immigration occurs at $t + \tfrac{1}{2}h$ and immigrants are exposed to fertility, mortality and emigration for half a period only. The growth equation

(6) assumes that all immigrations take place in the middle of the period. The uniform distribution of immigrations may also be interpreted as follows: half of the immigrations take place at the start of the interval and half at the end of the interval. The model becomes:

$$K(t+h) - \tfrac{1}{2}I(t,t+h) = [K(t) + \tfrac{1}{2}I(t,t+h)] - \tfrac{1}{2}hm[K(t) + \tfrac{1}{2}I(t,t+h) - K(t+h) - \tfrac{1}{2}I(t,t+h)]$$

$$K(t+h) = \frac{1-\tfrac{1}{2}hm}{1+\tfrac{1}{2}hm}[K(t) + \tfrac{1}{2}I(t,t+h)] + \tfrac{1}{2}I(t,t+h)$$

$$= (1 - \tfrac{1}{2}hm)K(t + \tfrac{1}{2}h) + \tfrac{1}{2}I(t,t+h) \qquad (10)$$

The coefficient $(1 - \tfrac{1}{2}hm)$ is the growth ratio over the second half of the period for those present at the beginning of the period.

Equations (5) and (10) may be generalized to the population size at any point of time $t+\tau h$ of the interval from t to t+h, where τ is a fraction of h. The accounting equation is

$$K(t+\tau h) = K(t) + \tau B(t,t+h) - \tau D(t,t+h) - \tau E(t,t+h) + \tau I(t,t+h) .$$

The generalized projection model is derived from this equation and is:

$$K(t+\tau h) = \frac{1-(\tau h-\frac{1}{2}h)m}{1+\frac{1}{2}m}[K(t) + \tfrac{1}{2}\tau I(t,t+h)] + \tfrac{1}{2}\tau I(t,t+h) \quad (11)$$

The survival function is

$$_{*}S(t,t+\tau h) = \frac{1-(\tau h-\frac{1}{2}h)_{*}m}{1+\frac{1}{2}h_{*}m} \quad (12)$$

where $_{*}m = d(t,t+h) + e(t,t+h)$.

The survival function may also be written as

$$_{*}S(t,t+\tau h) = 1 - \tau[1-{}_{*}S(t,t+h)]. \quad (13)$$

To show this, note that the probability of not surviving the interval is

$$\frac{h_{*}m}{1+\frac{1}{2}h_{*}m} = 1-{}_{*}S(t,t+h).$$

From the survival function at $t+\tau h$ and the assumption of constant probability density, we may estimate the instantaneous rate of attrition at any time point within the interval. It is the ratio of the probability density and the survival function:

$$\mu(t+\tau h) = \frac{1-{}_{*}S(t,t+h)}{1-\tau[1-{}_{*}S(t,t+h)]} \qquad 0 \le \tau \le 1 \quad (14)$$

The instantaneous rate is a hyperbolic function of time.

The duration of exposure between t and $t+\tau h$ is

$$L(t,t+\tau h) = \tau \tfrac{1}{2} h[1+{}_{*}S(t,t+\tau h)]\ K(t)$$
$$= \tau \tfrac{1}{2} h[2-\tau[1-{}_{*}S(t,t+h)]]\ K(t).$$
$$= [h\tau - \tfrac{1}{2}\tau^2[1-{}_{*}S(t,t+h)]]\ K(t). \quad (15)$$

The exposure function is quadratic in τ.

The duration of exposure between τ and η $(\eta>\tau)$ by the population at t is

$$L(t+\tau,t+\eta) = \frac{\eta-\tau}{2}[{}_{*}S(t,t+\tau h) + {}_{*}S(t,t+\eta h)]\ K(t)$$
$$= (\eta-\tau)[1-\tfrac{1}{2}(\eta+\tau)\frac{h_{*}m}{1+\tfrac{1}{2}h_{*}m}]\ K(t),$$

where the expression between brackets is the probability of surviving from t to $t+\tfrac{1}{2}(\eta+\tau)h$. The duration of exposure may also be written as a quadratic function of the (τ,η)-interval:

$$L(t+\tau,t+\eta) = [(\eta-\tau)-\tfrac{1}{2}(\eta-\tau)^2\frac{h_{*}m}{1+\tfrac{1}{2}h_{*}m}]\ K(t)$$
$$= [(\eta-\tau)-\tfrac{1}{2}(\eta-\tau)^2\ q]\ K(t). \quad (16)$$

where q is the probability of attrition within the interval of length h.

2.2. Numerical illustration

A numerical illustration may clarify the points raised in this section. First, we assume the presence of mortality only. Fertility will be introduced next. Consider an initial population of 10,000 persons, 100 of which die within a year. The probability of dying within a year is

therefore 10 per thousand. The uniform distribution of events implies that 50 deaths occur the first 6 months and 50 deaths the second half of the year.
An average of 8.33 persons die each month (8.33 = 100/12). The probability of dying during the first six months is 50/10,000 = 5 per thousand; the probability that a person who survives the first six months dies before the end of the year is 50/9,950 = 5.025 per thousand. The probability of dying during a given sub-interval therefore increases when the deaths are uniformly distributed. The reason is an increase in the instantaneous death rate, as will be shown shortly. The average occurrence exposure rate is

$$d(t,t+h) = D(t,t+h)/\tfrac{1}{2}[K(t) + K(t+h)]$$

$$= 100/\tfrac{1}{2}[10,000 + 9,900]$$

$$= 10.05 \text{ per thousand}$$

with h = 1.
During the first month (January), the death rate is

$$12 * 8.33/\tfrac{1}{2}[10,000 + 9,991.67] = 10.003 \text{ per thousand}$$

The death rate during the last month (December) is

$$12 * 8.33/\tfrac{1}{2}[9,908.33 + 9,900] = 10.093 \text{ per thousand.}$$

The death rate is 10.0251 per thousand during the first half of the year and 10.0756 per thousand during the second half.

At mid-year, the death rate is

$$12 * 8.33/9,950 = 10.050 \text{ per thousand.}$$

The average death rate is equal to the "instantaneous" death rate at mid-year only.

The probability of surviving the first half of the year is:

$$\frac{1}{1 + \frac{1}{2}d(t,t+h)} = \frac{1}{1 + \frac{1}{2}0.01005} = 99.500 \text{ percent}$$

The probability that someone, who survives mid-year, survives the complete year is

$$1 - \tfrac{1}{2}d(t,t+h) = 1 - \tfrac{1}{2}0.01005 = 99.4975 \text{ percent}$$

which is smaller since the instantaneous death rates get larger after six months. The assumption of uniform distribution of deaths over the period, or constant probability density, is incompatible with the assumption of a constant instantaneous death rate.

The duration of exposure by the population during the entire year is

$$\tfrac{1}{2}[K(t+1) + K(t)] = \tfrac{1}{2}[10,000 + 9,900] = 9,950 \text{ person-years}$$

or, equivalently,

$$\frac{1}{1 + \frac{1}{2}d(t,t+h)} K(t) = 0.995 * 10{,}000 = 9{,}950 \text{ person-years.}$$

Once the exposure function is known, the number of events (deaths) may easily be estimated:

$$D(t,t+h) = d(t,t+h)L(t,t+h)$$

$$= 0.01005 * 9{,}950 = 100.$$

The number of survivors at the end of the year is

$$K(t+h) = \frac{1-\frac{1}{2}hd(t,t+h)}{1+\frac{1}{2}hd(t,t+h)} K(t)$$

$$= 0.99000 \; K(t). \qquad (17)$$

The probability of surviving one year is 99 percent. The probability of dying is 1 percent. The probability of surviving the first half of the year is

$$1-0.5 * 0.01 = 0.995.$$

The probability of surviving the second half, given survival at mid year is

0.99/0.995 = 0.994975, or 99.50 percent

which is the same figure as the one obtained earlier using a different appraoch.

Suppose 200 children are born during the year [B(t,t+h) = 200] and that they die at the same rate as the general population. Since births are uniformly distributed over the year, the probability that a child survives to the end of the year is:

$$S(00;t,t+h) = \frac{1}{1 + \frac{1}{2}hd(t,t+h)} = \frac{1}{1 + \frac{1}{2}h0.01005} = 0.995 \qquad (18)$$

Consequently, 199 children survive. Each of the surviving children is exposed to the risk of dying for half a period. Infants who die are exposed for half the time. The total duration of exposure is therefore

$$L(00;t,t+h) = 199 * 0.50 + 1 * 0.25 = 99.75 \text{ person-years.}$$

This amount may also be obtained by the usual formula:

$$L(00;t,t+h) = \tfrac{1}{4}h[B(t,t+h) + K(t)]$$
$$= \tfrac{1}{4}[200 + 199] = 99.75$$

The death rate of newly-born children is therefore

$$d(00;t,t+h) = d(00;t,t+h) / L(00;t,t+h)$$
$$= 1/99.75$$
$$= 0.010025,$$

which is different from the average death rate during the period (0.01005). The difference is due to the changing instantaneous death rate, associated with the assumption of constant probability density or uniform distribution of events. This assumption implies that the rate at which children born in the (t,t+h)-period die in that period is equal to the rate at which members of the general population die during the first half of the (t,t+h)-period. This rate was calculated earlier by dividing the number of deaths during the $(t,t+\frac{1}{2}h)$-period by the person-years lived during that period. The rate may also be obtained by applying equation (14):

$$d(t,t+\tfrac{1}{2}h) = \mu(t+\tfrac{1}{4}h) = \frac{0.01}{1-0.25 * 0.01} = 0.010025$$

Given that the average death rate of newly-born children is $d(t,t+\frac{1}{2}h)$, the survival probability may also be expressed as

$$S(00;t,t+h) = \frac{1-\frac{1}{4}hd(t,t+\frac{1}{2}h)}{1+\frac{1}{4}hd(t,t+\frac{1}{2}h)}$$

$$= \frac{1-0.25 * 0.010025}{1+0.25 * 0.010025}$$

$$= 0.995,$$

which is the value obtained by applying equation (13). Note that the person-years lived by a child before the end of the period is

$$\frac{1}{1+0.25 * 0.010025} = 0.9975 \text{ person-years.}$$

In order to determine the birth rate, we must determine who is at risk of childbearing and for how long. If everyone is at risk of childbearing, even the newly-born children, then the exposure function is

$$L = L(t,t+h) + L(00;t,t+h)$$

$$= 9950 + 99.75$$

$$= 10,049.75$$

and the birth rate is

$$b(t,t+h) = B(t,t+h)/L = 200/10,049.75$$

$$= 0.019901.$$

If, on the other hand, only the persons present at the beginning of the period are at risk of childbearing, then the exposure function is $L(t,t+h) = 9,950$ and the birth rate is $200/9,950 = 0.020101$. Which birth rate does model (6) imply? It is the first one. To show this, we project the population one year ahead using model (6) with a death rate of 0.010050 and a birth rate of 0.019901 and without external migration:

$$K(t+h) = \frac{1 - \frac{1}{2}h[d(t,t+h) - b(t,t+h)]}{1 + \frac{1}{2}h[d(t,t+h) - b(t,t+h)]} K(t)$$

$$= \frac{1 + \frac{1}{2}0.009851}{1 - \frac{1}{2}0.009851} 10,000$$

$$= 1.00990 * 10,000$$

$$= 10,099, \qquad (19)$$

which is equal to the sum of the 9,900 survivors of the initial population and the 199 surviving children. Notice that the same number may be obtained by the model:

$$K(t+h) = (1 - \tfrac{1}{2}m)L(t,t+h)$$

$$= (1 + \tfrac{1}{2}0.00985)\ 10{,}049.75$$

The number of events may easily be recovered. The number of births is 0.019901 * 10,049.75 = 200 and the number of deaths is 0.01005 * 10049.75 = 101.

The 200 births during the period can be attributed in part to the population alive at the beginning of the period and in part to the newly-born children. The initial population accounts for

$$b(t,t+h) * L(t,t+h) = 0.019901 * 9950 = 198.015 \text{ births.}$$

The newly-born account for the remaining 1.985 births. It is a peculiarity of the model of the aggregate population that everyone alive is at risk of childbearing. The population decomposition by age removes this peculiarity.

Suppose that the death rate and birth rate remain constant. The population grows then at a constant geometric growth rate of 9.90 per thousand (equation 17). This growth rate is not equal to the difference between the birth rate and death rate (9.851 per thousand), a result of the varying rates within the time intervals and hence of the constant probability density assumption. Equality only holds if the instantaneous rates do not change within the period. The population projection for the first 10 years is shown in Table 1. The duration of exposure in a year grows at the same constant rate as the population, as do the numbers of deaths and births (Table 1). The exposure is 1.00495 K(t). The number of deaths is

$$0.01005 * 1.00495 * K(t) = 0.0101K(t)$$

and the number of births is

$$0.019901 * 1.00495 * K(t) = 0.02000K(t)$$

If fertility is absent, the population grows at a rate of -10.0 per thousand (equation 17). If on the other hand, mortality is removed, then the growth rate is 20.1 per thousand:

$$\frac{1 - \frac{1}{2}[-b(t,t+h)]}{1 + \frac{1}{2}[-b(t,t+h)]} = \frac{1 + \frac{1}{2}0.019901}{1 - \frac{1}{2}0.019901} = 1.02010$$

Table 1. Projection of population, exposure, births and deaths

Period t	Population at t	Exposure (t,t+1)	Deaths (t,t+1)	Births (t,t+1)
0	10,000	10,049.5	101.0	200.0
1	10,099	10,149.0	102.0	201.0
2	10,199	10,249.5	103.0	202.0
3	10,300	10,351.0	104.0	204.0
4	10,402	10,453.4	105.1	206.0
5	10,505	10,556.9	106.1	208.0
6	10,609	10,661.4	107.1	210.1
7	10,714	10,767.0	108.2	212.2
8	10,820	10,873.6	109.3	214.3
9	10,927	10,981.2	110.4	216.4
10	11,035	-	-	-

3. EXPOSURE ANALYSIS IN A POPULATION CATEGORIZED BY REGION OF RESIDENCE

In this section, we repeat some of the discussion of the previous section but add a new dimension; namely, region of residence.

3.1. The model

Let $K_i(t)$ denote the number of people in region i at time t. The number of births, deaths, emigrants and immigrants of region i are denoted by B_i, D_i, E_i and I_i, respectively. The time-argument is dropped for convenience. It is understood that the events refer to the period from t to t + h. A new variable O_{ij} is introduced to denote the number of migrations from i to j during the (t,t+h)-period.
The number of people in region i at time t + 1 is given by the accounting equation:

$$K_i(t+h) = K_i(t) + B_i - D_i - \sum_{j \neq i} O_{ij} + \sum_{k \neq i} O_{ki} - E_i + I_i \tag{20}$$

The duration of exposure in region i by all residents is

$$L_i = \tfrac{1}{2}h[K_i(t) + K_i(t+h)], \tag{21}$$

given that the events are uniformly distributed over the (t,t+h)-period.

The rate equations are:

$b_i = B_i/L_i$

$d_i = D_i/L_i$

$e_i = E_i/L_i$

$o_{ij} = O_{ij}/L_i$

Introduction of the rate equations and the exposure functions in the accounting equation gives:

$$K_i(t+h) = K_i(t) - [-b_i + d_i + e_i + \Sigma\, o_{ij}]\tfrac{1}{2}[K_i(t) + K_i(t+h)] + \Sigma\, o_{ki}\,\tfrac{1}{2}[K_k(t) + K_k(t+h)] + I_i$$

Writing the equation for all i and expressing the set of equations in matrix terms yields the projection model:

$$\mathbf{K}(t+h) = [I + \tfrac{1}{2}h\mathbf{M}]^{-1}[I - \tfrac{1}{2}h\mathbf{M}]\mathbf{K}(t) + [I + \tfrac{1}{2}h\mathbf{M}]^{-1}\,{}_{o}I = \mathbf{SK}(t) + {}^{*}\mathbf{S}_{o}\mathbf{I},$$

where ${}_{o}I$ is a vector of number of immigrants by region during the (t,t+h)-period, **I** is the identity matrix and **M** is:

$$\mathbf{M} = \begin{bmatrix} o_{11} & -o_{21} & -o_{31} & \cdots & -o_{N1} \\ -o_{12} & o_{22} & -o_{32} & \cdots & -o_{N2} \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ \cdot & \cdot & \cdot & & \cdot \\ -o_{1N} & -o_{2N} & -o_{3N} & \cdots & o_{NN} \end{bmatrix}$$

with N the number of regions and

$$o_{ii} = d_i - b_i + e_i + \sum_{j \neq i} o_{ij}.$$

The matrix **M** may be expressed as

$$\mathbf{M} \quad = {}_d\mathbf{M} + {}_e\mathbf{M} - {}_b\mathbf{M} + {}_o\mathbf{M},$$

with

${}_d\mathbf{M}$ a diagonal matrix of regional death rates,

${}_e\mathbf{M}$ a diagonal matrix of emigration rates,

${}_b\mathbf{M}$ a diagonal matrix of birth rates, and

${}_o\mathbf{M}$ a matrix of minus the outmigration rates as off-diagonal elements and with the sum of the outmigration rates in the diagonal.

The matrices $[\mathbf{I} + \frac{1}{2}h\mathbf{M}]$ and $[\mathbf{I} - \frac{1}{2}h\mathbf{M}]$ are commutative, meaning that

$$[\mathbf{I} + \tfrac{1}{2}h\mathbf{M}]^{-1}[\mathbf{I} - \tfrac{1}{2}h\mathbf{M}] = [\mathbf{I} - \tfrac{1}{2}h\mathbf{M}][\mathbf{I} + \tfrac{1}{2}h\mathbf{M}]^{-1}$$

This property is used to estimate the exposure function. The duration of exposure by a member of the initial population is

$${}_*\mathbf{L} = h[\mathbf{I} + \tfrac{1}{2}h{}_*\mathbf{M}]^{-1} = h{}^*\mathbf{S},$$

where

$${}_*\mathbf{M} = {}_d\mathbf{M} + {}_e\mathbf{M} + {}_o\mathbf{M}.$$

An element L_{ij} of **L** represents the average duration of exposure (person-years lived) in region j between t and t+h by a resident of region i at time t. An immigrant and a newly-born child are exposed for a duration of

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$\frac{1}{2}h[\mathbf{I} + \frac{1}{2}h_{*}\mathbf{M}]^{-1}$

on average.

The growth equation may be expressed in terms of the person-years lived in each region.

$$\mathbf{K}(t+h) = [\mathbf{I} - \tfrac{1}{2}h\mathbf{M}]1/h\ \mathbf{L}\mathbf{K}(t) + 2/h\ \mathbf{L}_o\mathbf{I}, \qquad (24)$$

where **L** is the matrix of person-years lived in each region associated with an initial resident in each of the two regions:

$$\mathbf{L} = h[\mathbf{I} + \tfrac{1}{2}h\mathbf{M}]^{-1} \qquad (25)$$

The population distribution at time $t+\tau h$ is given by

$$\mathbf{K}(t+\tau h) = \mathbf{S}(t,t+\tau h)[\mathbf{K}(t) + \tfrac{1}{2}\tau\mathbf{I}(t,t+h)] + \tfrac{1}{2}\tau\mathbf{I}(t,t+h) \qquad (26)$$

where

$$\mathbf{S}(t,t+\tau h) = \mathbf{I} - \tau[\mathbf{I} - \mathbf{S}(t,t+h)] \qquad (27)$$

Expression (26) is a generalization of (11).
The instantaneous rates of transition are given by the generalization of (14):

$$\boldsymbol{\mu}(t+\tau h) = [\mathbf{I} - \mathbf{S}(t,t+h)][\mathbf{S}(t,t+\tau h)]^{-1} \qquad (28)$$

At mid-period, the instantaneous rates are equal to the average occurrence-exposure rates:

$$\mu(t+\tfrac{1}{2}h) = \mathbf{M}(t,t+h) = (2/h)[I - S(t,t+h)][I + S(t,t+h)]^{-1} \tag{29}$$

This formula may be used to estimate the occurrence-exposure rate from census and survey data on transition probabilies.

3.2. Numerical illustration

By way of illustration, consider an initial population of 10,000 persons, 5,000 living in region 1 and 5,000 living in region 2. In each region, 50 persons die and 100 children are born. Region 1 has 1,000 inmigrations and 500 outmigrations, resulting in a net inmigration of 500 persons. The inmigrants come from region 2 and the outmigrants go to 2.

The person-years lived in region 1 during the year is

$$\tfrac{1}{2}[5{,}000 + 5{,}550] = 5{,}275$$

and in region 2 is

$$\tfrac{1}{2}[5{,}000 + 4{,}550] = 4{,}775.$$

The total person-years is 10,050. The occurrence-exposure rates are given in Table 2

Table 2. Occurrence-exposure rates

	region 1	region 2	average
death rate	0.009479	0.010471	0.009950

Table 2. Occurrence-exposure rates

	region 1	region 2	average
death rate	0.009479	0.010471	0.009950
birth rate	0.018957	0.020942	0.019900
outmig. rate	0.094787	0.209424	-

The duration of exposure in each region per resident at time t s given by equation (25) (with h = 1):

$$= \begin{bmatrix} 1.042555 & -0.104712 \\ -0.047394 & 1.099476 \end{bmatrix}^{-1}$$

$$= \begin{bmatrix} 0.96326 & 0.09174 \\ 0.04152 & 0.91348 \end{bmatrix}$$

The results are shown in Table 3.

The total duration of exposure by the initial population and the newly-born children is 10,050 person-years. The person-years lived in region 1 is 5,275, 8.70 percent of which are attributed to people residing in region 2 at the start of the year. The initial population of region 1 contributes only 4.34 percent of the person-years lived in region 2.

An initial resident contributes on average 1.005 person-years, in part through his offspring. An initial resident in region 2 contributes more than average (1.00522 years), due to the higher fertility in region 2. About 9.13 percent of his contribution goes to region 1.

The durations of exposure shown in Table 3 include the exposure of the offspring. The duration of exposure in each region by the initial population is

$$_{*}L = [I + \tfrac{1}{2}\, {}_{*}M]^{-1}$$

Table 3. Duration of exposure in each region during interval from t to t+1

A. Total

		Region of residence at t		
		1	2	Total
Region of residence in (t,t+1)-interval	1	4816.3	458.7	5275.0
	2	207.6	4567.4	4775.0
	Total	5023.9	5026.1	10050.0

B. Per resident in each region at t

		Region of residence at t	
		1	2
Region of residence in (t,t+1)	1	0.96326	0.09174
	2	0.04152	0.91348
	Total	1.00478	1.00522

Tabel 4. Duration of exposure in each region by initial population, in the absence of fertility

A. Total

		Region of residence at t		
		1	2	Total
Region of residence in (t,t+1)-interval	1	4772.6	450.3	5222.8
	2	203.8	4523.9	4727.7
	Total	4976.4	4974.2	9950.6

B. Per resident in each region at t

		Region of residence at t	
		1	2
Region of residence in (t,t+1)	1	0.95451	0.9005
	2	0.04076	0.90479
	Total	0.99527	0.99484

where $\mathbf{M} = {}_d\mathbf{M} + {}_o\mathbf{M}$. The durations are shown in Tabel 4. The total number of person-years lived during the year is 9,950.6. It is slightly higher than the 9,950 person-years estimated previously, since the 100 deaths include the deaths to newly-born children and its effect on the average death rate. The person-years lived in region 1 is 5,223, 8.62 percent of which is contributed by the persons initially residing in region 2. The person-years lived in region 1 is less than one expects from the accounting equation excluding births

$$[\tfrac{1}{2}(5,000 - 50 + 500 + 5,000)] = 5,225.$$

The reason is that some of the deaths and migrations are to the children born during the period. By excluding fertility, the number of deaths and migrations will be less. The number of events is obtained by multiplying the duration of exposure with the occurrence-exposure rates. The number of deaths in region 1 is

$$0.009479 * 5,222.9 = 49.51,$$

the number of out-migrations is

$$0.094787 * 5,222.9 = 495.1$$

and the number of inmigrations is

$$0.209424 * 4,727.7 = 990.1$$

Hence, the births account for 0.49 deaths and 4.9 migrations in region 1 on average. The correct accounting equation for region 1 is therefore

$$5,000 - 49.51 - 495.1 + 990.1 = 5,445.5,$$

which is the end-of-year population. The duration of exposure is the mid-period population times the interval length (1 year):

$$\tfrac{1}{2}(5,000 + 5,445.3) = 5,222.8,$$

which is the value shown in Table 4 and obtained by inverting $[I + \tfrac{1}{2}{*}M]$.

A resident of region 1 at time t lives on average 0.995 years before reaching t+1, 95.9 percent is spent in region

1 and 4.1 percent in region 2. An initial resident of region 2 lives less time because of the higher mortality. If mortality is excluded, and migration is the only remaining component of demographic change, then the total duration of exposure is 10,000 person-years. The duration of exposure in each region per resident of each region at time t is:

$$_0\mathbf{L} = [\mathbf{I} + \tfrac{1}{2}\ {_0\mathbf{M}}]^{-1}.$$

The results are shown in Table 5. The person-years lived in region 1 is 5248.8 years and in region 2 4751.2. The number of out-migrations is

$$0.094787 * 5248.8 = 497.5$$

Tabel 5. Duration of exposure in each region by initial population in presence of migration only

A. Total

		Region of residence at t		
		1	2	Total
Region of residence in (t,t+1)-interval	1	4794.3	454.5	5248.8
	2	205.7	4545.5	4751.2
	Total	5000.0	5000.0	5000.0

B. Per resident in each region at t

		Region of residence at t	
		1	2
Region of residence in (t,t+1)	1	0.95886	0.09089
	2	0.04114	0.90911
	Total	1.00000	1.00000

for region 1 and

0.209424 * 4751.2 = 995.0

for region 2. The accounting equation for region 1 is

5,000 - 497.5 + 995.0 = 5497.5

The end-of-year population in region 1 is 5,498 persons and the person-years lived in that region during the year is

$\frac{1}{2}$[5,000 + 5,497.5] = 5,248.8,

which is the value shown in Table 5.

A comparison of the number of person-years in the absence of mortality with the number in the presence of mortality, indicates the person-years foregone due to mortality, given the migration pattern and the regional differential mortality. It is 26.0 (5248.8 - 5222.8) person-years for region 1 and 23.5 (4751.2 - 4727.7) person-years for region 2. Region 1 loses more person-years although its mortality is the lowest of the two regions. The in-migrants foregone due to the mortality in region 2 account for the difference.

Let us turn to projection and suppose that the rates of birth, death and migration remain constant. During the first year the population grows at a geometric rate of 10 per thousand. The difference between the birth rate and the death is 9.95 per thousand (see Table 2):

$$1.010 = \frac{1+\frac{1}{2}\ 0.00995}{1-\frac{1}{2}0.00995}$$

The combination of initial population, births, deaths and migration results in an end-of-year population of 5,550 in region 1 and 4,550 in region 2. The figures are obtained by applying growth model (22) or, equivalently, (24). The growth matrix is

$$\mathbf{S} = \begin{bmatrix} 1-0.04265 & 0.10471 \\ 0.04739 & 1-0.09976 \end{bmatrix} \begin{bmatrix} 0.96326 & 0.09174 \\ 0.04152 & 0.91348 \end{bmatrix}$$

$$\mathbf{S} = \begin{bmatrix} 0.92652 & 0.18348 \\ 0.08304 & 0.82696 \end{bmatrix}$$

The growth matrix applies to the population as well as to the duration of exposure. The population is

$$\mathbf{K}(t+h) = \mathbf{S}\mathbf{K}(t)$$

and the exposure times are

$$\mathbf{L}(t+h,t+2h) = \mathbf{S}\mathbf{L}(t,t+h).$$

The projected population and exposure times are shown in Table 6. The number of events by region is

$$\mathbf{N}(t+h,t+2h) = {}_{c}\mathbf{M}\ \mathbf{L}(t+h,t+2h),$$

where ${}_{c}\mathbf{M}$ is a diagonal matrix of event rates. The growth matrix cannot be used to project the number of events since ${}_{c}\mathbf{M}$ and $\mathbf{S}$ are not commutative, i.e.

${}_{C}M\ S \neq S\ {}_{C}M.$

The projected number of migrations are shown in Table 7.

Table 6. Projection of population and exposure by region

		Population at t			Exposure in (t,t+1)		
Period 1		1	2	Total	1	2	Total
0	(a)	5000	5000	10000	5275	4775	10050
	(b)	5000	5000	10000	5223	4728	9950
	(c)	5000	5000	10000	5249	4751	10000
1	(a)	5550	4550	10100	5764	4387	10150
	(b)	5446	4455	9901	5599	4253	9852
	(c)	5498	4505	10000	5681	4319	10000
5	(a)	6799	3708	10507	6889	3669	10558
	(b)	6171	3347	9518	6192	3279	9471
	(c)	6477	3523	10000	6531	3469	10000
10	(a)	7492	3543	11035	7542	3548	11089
	(b)	6166	2897	9062	6146	2872	9018
	(c)	6796	3204	10000	6808	3192	10000
15	(a)	7948	3641	11589	7990	3656	11646
	(b)	5930	2699	8629	5904	2684	8587
	(c)	6865	3135	10000	6868	3132	10000

(a) With fertility, mortality and migration
(b) With mortality and migration (no fertility)
(c) Migration only (no fertility nor mortality)

Tabel 7. Projection of number of outmigrations

Period t		Region 1	Region 2	Total
0	(a)	500	1000	1500
	(b)	495	990	1485
	(c)	498	995	1493
1	(a)	546	919	1465
	(b)	531	891	1421
	(c)	538	905	1443
5	(a)	653	768	1421
	(b)	587	687	1274
	(c)	619	726	1346
10	(a)	715	743	1458
	(b)	583	602	1184
	(c)	645	668	1314
15	(a)	757	766	1523
	(b)	560	562	1122
	(c)	651	656	1307

4. CONCLUSION

Exposure analysis is the investigation of the variation in the duration of exposure to the risk of a given event due to changes in the population at risk and in the vital rates. The exposure function measures the lenght of time during which an individual with a given set of attributes may experience a particular event.

To evaluate the impact of vital rates and a population stock on the numbers of vital events, exposure analysis may be useful.

The paper reviews exposure analysis in case the vital events occur at constant probability densities or, equivalently, the events are uniformly distributed in the observation interval. The survival function is linear and the exposure function is quadratic in the interval length. The presentation may easily be extended to the case of piecewise constant probability densities, which is generally assumed in demographic projection models.

A main advantage of this type of analysis is that the effect of vital rates on the total duration of exposure and on the number of events in a given interval is easily separated from the effect of the initial population. A further advantage is the ease with which the varying instantaneous rates at each point of the interval can be estimated.

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Name: Robert Thürmer

Title of Paper: A geographically based population projection model

Summary: As early as 1980 WILLEKENS stated that "... in the second phase ... socioeconomic factors will be introduced to explain the values taken by the model parameters." Consequently, we tested to see if a two-staged geographic approach would be superior to the one-stage demographic approaches previously used.

The geographic orientation is marked by the following features

- taking into consideration a set of territorial conditions in its influence on demographic processes,
- elaborating projections for smaller territorial units (Bezirke, Kreise, towns),
- paying special attention to the explanation given for migration.

The model allows us to explain the modifications of demographic processes, e.g. migration, birth rates, death rates by means of regression equations expressing the influence of territorial conditions on those processes (e.g. total of newly built flats, degree of industrialization, quality of natural environment).

In a second step the results of those projections are modified by taking into consideration the peculiarities of the territorial unit investigated. These peculiarities have been derived from the differences between the real and the projected changes of the population in the past.

Consequently, the results of our projections consists of two components: one expressing general regularities and the other expressing the peculiarities of the territorial unit.

Using our model we obtained results with a diminished error of estimation by more than 50% compared with the results obtained by traditional demographic approaches.

It was also possible to simulate the effect of changing territorial conditions on changes of population.

Name: Janez MALAČIČ, Ph. D.

Title of Paper: POPULATION AGE STRUCTURE AND THE DEMOGRAPHIC TRANSITION OF THE POPULATION OF AUTONOMOUS PROVINCE KOSOVO

Summary:

Today, the population of AP Kosovo is the fastest growing population in Europe. The average annual growth rate for the period 1981-86 was 2,5 percent. Such a population explosion is the consequence of a high natural increase and slightly negative net migration rate. The population of AP Kosovo is nationally mixed. In 1981, the majority were Albanians, 77,4 %, on the second place were Serbs, 13,2 %, followed by Moslems, Romany population, Montenegrins and others.

The population reproduction pattern in AP Kosovo is much more similar to that in Albania than to the reproduction patterns in other parts of Yugoslavia. Similarities are the consequence of the dominance of ethnic Albanians in the national structure of the population of AP Kosovo. With the population of Albania they share a common ethnic origin, language, cultural heritage, similar family formation patterns, economic backwardness and until recently common law and religion.

The Albanian population of Albania and Yugoslavia is the population with the last demographic transition in Europe. Its demographic characteristics are much more similar to the demographic situation in less developed part of the world than to the demographic situation in Europe. In AP Kosovo, the process of demographic transition started in the middle of the 192os with the decline of death rate under 3o per 1ooo population. On the other side, the crude birth rate decreased under 4o per 1ooo population in the middle of the 196os. In 1986, the crude birth rate was 3o,1 and the crude death rate was 5,5 per 1ooo population.

Slow pace of the fertility transition in AP Kosovo was the main cause of the process of juvenilization during the 196os and the 197os. The share of the population above the age of 65 amounted to 4,6 % in 1961, 4,5 % in 1971 and 4,6 % in 1981. This period will be followed by a very slow aging process due to the relatively slow fertility decline. In 2oo1, however, the share of the population above the age of 65 will be slightly over 5 %, only.

The need for faster fertility decline and for the antinatalist population policy in AP Kosovo is more than evident. However, professional, political and other public opinions in AP Kosovo still oppose strongly to the antinatalist population policy.

Name: W. Ward Kingkade

Title of Paper: "Differential Fertility and the Future Ethnic Composition of the Soviet Union"

Summary:

This report presents projections of the population of the USSR by age and sex in 20 nationality groups from 1979 to 2050. The groups include all 15 union republic nationalities, the four largest non-union republic nationalities as of 1979 and a residual comprising the remainder of the population.

Our principal results are:

- Russians, currently comprising a bare majority (51%) of the Soviet population, will become a minority by the turn of the century. They will remain a minority even under an unlikely scenario of substantially rising fertility among European nationalities coupled with sharply declining fertility among non-European nationalities.

- Russians will remain the largest Soviet nationality well into the future, comprising upwards of 45 percent of total population as late as 2010 and more than 30 percent in 2050.

- Central Asians, who comprise only 11-12 percent of the current population, will contribute a disproportionate share of total population growth in the USSR: roughly half of all growth though 2010 and nearly two thirds of growth through 2050. Nevertheless, the Central Asian share of the population will become substantial only after 2000, reaching about a quarter in 2050.

- The European nationalities currently enjoy age distributions favorable to the economy, with about 4 working age members for every 3 non-working age members. This fortunate situation will dissipate as the working and non-working shares among these nationalities will become more equal.

The findings on which these results are based include:

- Fertlity in European republics has risen after the adoption of a set of incentives by the 26th party congress in 1981 to levels high enough to ensure zero population growth in the longrun.

- The high fertility of Central Asian nationalities, implying 5-6 children per mother, has begun to decline.

- Mortality, which rose slightly during the 1970s, has begun to decline in the 1980s.

Name: *Alexander Hanika*

Title of Paper: **Projected population structure of Vienna as compared to other Austrian provinces**

Summary:

In the past decades a convergence in fertility levels between Vienna and the rest of Austria could be observed. In 1934 the TFR in Vienna had been only 0,6 which was 38% of the Austrian level of that time (i.e. 1,6). In 1987 Vienna with a TFR of 1.35 had reached 94% of the Austrian fertility level. Our projection model shows that on the basis of this positive fertility trend Vienna may expect to experience rather stable annual series of births in the future. In contrast to that the population under age 15 in the predominantly agricultural province of Burgenland will decrease to half of its current size. Aside from low fertility levels out-migration of young adults from Burgenland and in-migration of such families into Vienna plays a major role in these differentials.

Vienna today has still the oldest age structure of all Austrian provinces, but it has past the maximum of its population aging. In 2030 Vienna will have the lowest proportion above age 60 of all Austrian provinces. Vorarlberg which has the youngest population today will then be slightly older then Vienna.

Name : L. Eichperger, W. Relou, A. Op ´t Veld

Title of paper: Future regional differences in growth and of the population of the Netherlands.

Summary:
In this paper a exploration has been made of the future regional population-growth in the Netherlands according to different hypotheses of demografic, economic and social influences.
An improved version of the IIASA multi-regional demographic model has been used in combination with an explanatory migration model. Map 1 shows the regional population growth which may be expected if present trends continue. The majority of the 44 regions show a slight decrease in population size in the period 1987 - 2000. A limited number of regions are confronted with population growth which in some cases even assumes considerable proportions. These regions are mainly in the north-east, the east, the centre, the west and the south-east of the country and the new province of Flevoland (reclaimed land from the former Zuiderzee). The growth of the regions in the north-east is partly brought about by internal migration to attractive residential areas, partly by natural increase resulting from the high level of fertility. Growth in the west and centre of the country is mainly the result of the inflow of foreigners. Many foreigners congregate in the large cities in the west of the country. Growth in the east and south-east is mainly the result of internal migration.
Concentration or dispersal of economic growth and related changes in internal migration exert a clear influence on population development. Concentration of economic growth in the regions in the west of the country would imply a more marked decline of the population in the regions in the north-east of the country than was foreseen if present trends should continue (see map 2). If economic growth should be fairly evenly distributed over the country, this would mean a less marked reduction of the population of the regions in the north-east than is expected if present trends continue.
The regions in the south of the country benefit most from a more even distribution of economic growth over the country. In these regions this would mean heavier population growth than present trends indicate. The reason for this is the proximity of these regions to the west of the country. Increased economic growth in these regions would exert a greater pull on migrants from the west than would economic growth in more peripheral regions (see map 3).

With the present combination of the multiregional population model and the migration simulation model, it is not yet possible to calculate the effects of the various scenarios on the age structure of the regional populations. At the moment the models are being improved in order to make this possible.

Name: Sergei Scherbov and Wolfgang Lutz

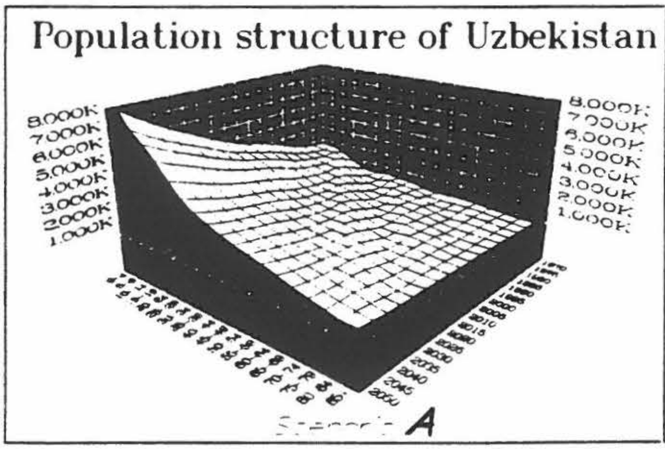
Title of Paper: [redacted]

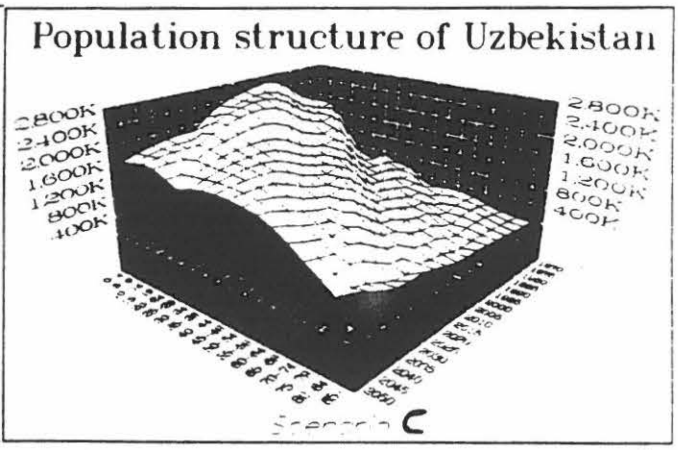
Impacts of Fertility Trends on Regional Population Distributions: Scenarios to 2050.

Summary:

This paper has essentially two parts. In the first part we discuss recent trends in age-specific fertility rates in the republics of the Soviet Union. By visual analysis of the trends and quantitative assessment of the extent of family limitation in the republics we are able to classify the republics according to their standing in the process of fertility transition. As a next step we try to assess the demographic consequences of future trends in fertility and mortality in the republics of the Soviet Union. For this purpose we define 3 alternative scenarios representing 3 different lines of future demographic development: A: Continued diversity (fertility and mortality remain at current levels); B: Continued diversity in fertility (life expectancy converges to 75 years in all republics by 2020); C: Convergence in fertility and mortality (fertility also converges to replacement level in all republics by 2020).

The different scenarios have great impact on the future population composition of the Union. In all cases the Asian republics will increase to a greater share of the Soviet population than the have today, but in the case of continued diversity the change in weights will be most dramatic. But the scenarios do not only affect the proportions of people in the various republics, they also influence the extent and the speed of population aging and the differences in aging between the republics. The figures below illustrate the changes in the population age structures in Uzbekistan 1970-2050 according to scenarios A and C.





NOTES

SESSION 6

Measuring and Projecting Discontinuities in Age-specific Growth Patterns and Decomposing them into Fertility and Mortality Effects

Organizer: Nathan Keyfitz

Nathan Keyfitz

INFERRING THE PROFILE OF INTERCOHORT INCREASE

2 What Can Be Done With Census-Type Data

Given censuses at five year intervals from 1950 onward, what can we infer about past fertility and mortality? Without other inputs of data or assumptions it is impossible to identify fertility and mortality separately from such limited data, but we can infer a certain combination that I will call intercohort increase.

In fact we do not have censuses at five year intervals for the postwar period for more than a very few countries, but there are some censuses nearly everywhere, and the United Nations has used these to establish a quasi official set of estimates at five year intervals, 1950, 1955, etc., that will here be treated as though they are actual counts. Errors in these estimates will appear as noise in the calculations to be made below, of the same character as irregular accurately recorded fluctuations in census age distributions, due for example to epidemics or migration. The theory will be for a population closed to migration, and the technique is such that variation arising from migration and other kinds of error clearly reveals itself.

2.1 Formal Representation of the Intercohort Difference

In terms of the five-year interval as the unit, call $p_{a,t}$ the population aged a at last birthday at time t. This is the data, and the entity to be inferred is some combination of B_{t-a} the births at time $t-a$, B_{t-a} and the survivorship $L_{a,t-a}$; we will be able to infer sums of the products of two such elements.

We start with the intercohort increase, a simple function of the population data:

$$\Delta_t p_{a,t} = p_{a,t+1} - p_{a,t}$$

This is the increase of a given age over one time period and constitutes the basic data of this paper. The usefulness of the simple age by age increase has been noted by Preston and Coale (1985) and others. Since 5 years is made the unit of time and age, 5 will not appear in the formulas.

The population aged a is here taken to mean the people recorded in a census at time t from exact age a to exact age $a+1$ (or $a+5$ if expressed in single years). In symbols, with the continuous form of the functions indicated by parentheses,

$$p(a,t) = \int_0^1 B(t-a-\delta)\,l(a+\delta)\,d\delta,$$

if the life table survivorship $l(a+\theta)$ is unchanging through the relevant time interval. In the usual approximation the integral of the product is assumed equal to the product of the separate integrals, or

$$p(a,t) = B_{t-a}L_a,$$

L_a being the integral of $l(a+\theta)$ over the ages a to $a+1$, and B_{t-a} the births from time $t-a-1$ to $t-a$. (The quantity L_a is defined as one fifth the usual life table ${}_5L_a$
). With mortality changing over time as well as by age we need to indicate which life table is referred to, that will require a second subscript on L_a. The symbol $L_{a,t-a}$ is survivorship of the cohort born at time $t-a$.

In terms of the entities we are seeking to infer, then, the increase at age a from time t to time $t+1$ is

$$\Delta_t p_{a,t} = B_{t+1-a}L_{a,t+1-a} - B_{t-a}L_{a,t-a}, \tag{1}$$

supposing a closed population. Now adding and subtracting the quantity $B_{t-a}L_{a,t+1-a}$, we obtain

$$\Delta_t p_{a,t} = \left(\Delta_t B_{t-a}\right)L_{a,t+1-a} + B_{t-a}\Delta_t L_{a,t-a}. \tag{2}$$

or alternatively, by adding and subtracting $B_{t-a+1}L_{a,t-a}$,

$$\Delta_t p_{a,t} = \left(\Delta_t B_{t-a}\right)L_{a,t-a} + B_{t-a+1}\Delta_t L_{a,t-a}. \tag{3}$$

Of the two terms in (2) or (3), the first is the survivors among the increase over a 5-year period of the absolute number of births that took place t-a periods earlier, and the second is the improvement of survivorship over a 5-year time period multiplied by the births.

2.2 The Two Terms

For purposes of examining the relative sizes of the two terms of (2) divide by $B_{t-a}L_{a,t-a}$ to obtain the quantity

$$\frac{\Delta_t p_{a,t}}{p_{a,t}} = \left(\frac{\Delta_t B_{t-a}}{B_{t-a}}\right)\left(\frac{L_{a,t+1-a}}{L_{a,t-a}}\right) + \frac{\Delta_t L_{a,t-a}}{L_{a,t-a}}, \tag{4}$$

or expanding the second factor of the first term as a Taylor series, and neglecting second differences, we have approximately

$$\Delta_t \frac{p_{a,t}}{p_{a,t}} \sim \frac{\Delta_t B_{t-a}}{B_{t-a}} + \frac{\Delta_t L_{a,t-a}}{L_{a,t-a}}. \tag{5}$$

The first term of (5) is the relative change of births from one 5-year interval to the next and the second the relative change of the probability of surviving, both referring to a time a periods before the present time that is designated as t. One can imagine circumstances where the first term dominates, and other circumstances where the second does.

When births are changing rapidly they might rise or fall by 5 percent over a 5-year period, and when mortality is improving rapidly survivorship might go up by 5 percent during a 5-year period, and if this is so the two terms are of similar magnitude. Survivorship keeps rising in the populations with which we are concerned, so the second term is positive; the first term can be positive or negative depending on whether births are in a rising or falling phase.

3 Constancy of Intercohort Differences

The usefulness of the method here proposed depends on the invariance among estimates of any given intercohort difference. Indonesia is a large population for which this constancy can be determined. It had censuses taken in 1961, 1971 and 1980, on the basis of which the UN has calculated numbers at five year intervals from 1950 to 2020. With interpolation between the censuses and extrapolation beyond them we cannot say that each 5 year point is completely independent of the others, and yet there must be a measure of independence in the errors.

Table 1 is an extract from the current estimate (UN 1986) provided by the United Nations for Indonesia along with 190 other populations.

TABLE 1. INDONESIA: EXTRACT FROM ORIGINAL UNITED NATIONS (1986) POPULATION NUMBERS IN FIVE-YEAR AGE INTERVALS FROM AGE 0 TO 29, 1950 TO 1985, (HUNDREDS OF THOUSANDS OF PERSONS)

Age	1950	1955	1960	1965	1970	1975	1980	1985
0-4	114	136	162	175	199	222	224	226
5-9	101	103	124	150	163	187	211	212
10-14	96	98	100	121	146	160	184	207
15-19	86	94	95	98	118	144	157	181
20-24	74	82	90	92	95	115	140	154
25-29	59	70	79	86	89	92	112	136

TABLE 2. INDONESIA: INTERCOHORT DIFFERENCES (EXCESS OF EACH COHORT OVER PREVIOUS COHORT) AS ESTIMATED FROM DATA SIMILAR TO THAT OF TABLE 1, AT DIFFERENT TIMES AND AGES (HUNDREDS OF THOUSANDS OF PERSONS)

	Cohort born in five years starting with the year									
Age	1925	1930	1935	1940	1945	1950	1955	1960	1965	1970
0						22	26	13	24	23
5					2	21	26	13	24	24
10				2	2	21	25	13	24	22
15			8	2	2	21	25	13	24	22
20		9	8	2	3	20	25	14	24	22
25	11	9	8	2	3	20	25	14	24	22
30	10	9	8	3	3	20	24	14	24	23
35	10	9	8	3	4	20	24	14	24	23
40	10	8	8	3	4	20	24	14	24	23
45	10	8	8	4	4	19	24	14	24	23
50	9	9	8	4	4	19	23	14	23	22
55	9	8	8	4	4	18	22	14	23	
60	9	8	8	4	4	17	21	13		
65	8	7	7	4	4	16	20			
70	7	7	6	4	4	14				

From Table 1, in units of 100,000, the survivors to 1950 of the births of 1945-50 are 114, and the survivors to 1955 of the 1950-55 births are 136, a difference of 22. This last is the increase at age 0 to 4 from 1950 to 1955, the figure shown at the top of the column under 1950 in Table 2, that gives the differ-

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ence over time of given age groups as shown in (1) and subsequent formulas. Similarly, the number at the top of the column headed 1970, 23 when expressed in hundred thousands, is the difference between the children 0-4 in 1970 (199) and the number 0-4 in 1975 (222).

One can well be surprised at the near constancy in each column of the inferred intercohort differences of Table 2. One would not expect absolute constancy, since there is some migration, the several estimates of the cohorts are based on censuses that suffer differently from errors of enumeration and tabulation. That is in addition to the multiplication of B_{t-5} by a diminishing survivorship $L_{5,t-5}$, which also contributes some variation to the columns of Table 2.

Some of the columns of Table 2 gently increase, some gently decrease. Decreases will be shown where the first term of (2) or (3) dominates, with what may be called the survivorship effect; increases will appear where the second term (what we may call the survivorship improvement effect) is important enough to overcome the survivorship effect. Improving survivorship shows in the 1940 and 1945 cohorts, while the 1930 cohort declines.

In short, the first term of (2) or (3) includes a factor of survivorship that multiplied by the essentially constant B_{t-5} causes a decrease in the counts as one estimates the same increase from older and older cohorts, while the second is a function of improving survivorship that causes a rise in the overall value of (2) or (3) and offsets or more than offsets the change in the first term. On the whole the first term dominates, but during the middle ages of life the two are more or less in balance.

4 Reconstruction of the Age-Time Table.

The closeness to constancy of the differences within columns of Table 2 means redundancy in Table 1, the original age-time data. Hence we should be able to average numbers in each coloumn of Table 2, and reconstruct Table 1 without loss of information. The result of such averaging is the profile of intercohort differences over historical time until about 1970. We hesitate to go beyond 1970 because most of the numbers subsequent to that are projections, and for our present method merely reads out the assumptions made in calculating the projections. And though in principle the method provides information back as far as the ages of the oldest group of people living in 1950, yet one is disinclined to use the information for any group in which the number of persons alive is not large, and for which enumeration is notoriously inaccurate. Hence the method is mainly useful in telling about the first half or two thirds of the 20th century.

For Indonesia the averages of the intercohort differences of Table 2 are given by Table 3. Thus the average of the column headed 1950 in Table 2 is in the row for 1950 in Table 3.

TABLE 3. AVERAGE OF THE COLUMNS OF TABLE 2 SHOWING THE AMOUNT BY WHICH EACH COHORT IS LARGER THAN THE PRECEDING (HUNDREDS OF THOUSANDS OF PERSONS)

Cohort five years beginning	Cases	Total	Average
1895	4	1	0
1900	5	15	3
1905	6	25	4
1910	7	21	3
1915	8	11	1
1920	9	46	5
1925	10	93	9
1930	11	90	8
1935	12	92	8
1940	13	40	3
1945	14	47	3
1950	15	289	19
1955	14	334	24
1960	13	177	14
1965	12	286	24
1970	11	250	23

The averages of Table 3 can be expressed in general form in terms of births and the life table. Suppose we average from α periods of 5 years back to $\beta-1$ periods ago, $\beta-1>\alpha$. If the entity to be averaged is (3), we have as the mean intercohort difference

$$D_{t-\alpha-1} = \Delta_t B_{t-\alpha}\left(\frac{\sum_{u=\alpha}^{\beta-1} L_{u,t-\alpha}}{\beta-\alpha}\right) + B_{t-\alpha+1}\left(\frac{\sum_{u=\alpha}^{\beta-1} \Delta_t L_{u,t-\alpha}}{\beta-\alpha}\right). \tag{6}$$

The coefficient of $\Delta_t B_{t-\alpha}$, the average of the survivorships to age

u, is much less than unity in a high-mortality population. The coefficient of $B_{t-\alpha-1}$ is the average increase of the $L_{\alpha,t-\alpha}$ as mortality improved over time from $t - \beta$ to $t - \alpha$.

On the right hand side of (6) the usual convention

$$\Delta_t f_t = f_{t+1} - f_t$$

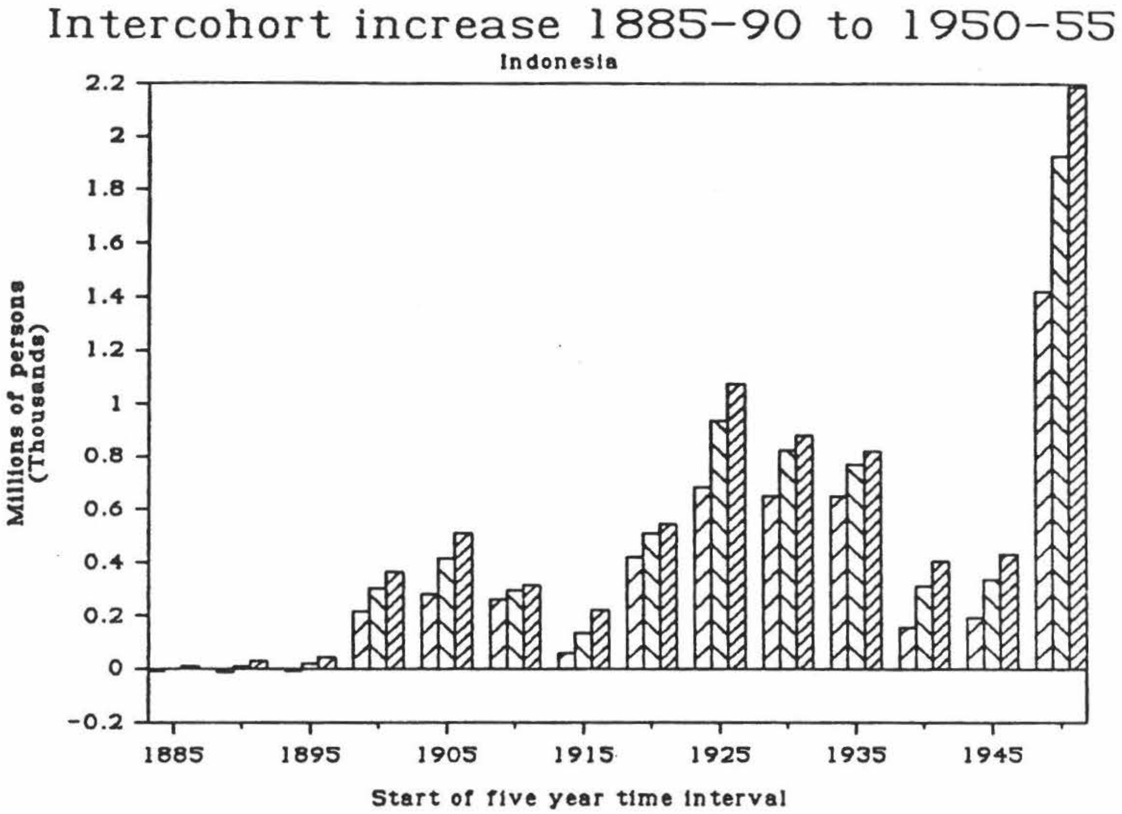
has been followed. But for the left side it seemed better to step back one period. That corresponds to the way that Table 3 and the corresponding figures have been set up. Thus D_{1945} is the amount by which the 1945-50 cohort is greater than its predecessor 1940-45, etc.

Figure 1 shows the numbers of Table 3 as the middle of the three bars for each year. The left-hand bar for each year is the lowest of the values in each column of Table 2; the right-hand bar is the highest. The profile of intercohort increase is much the same for the low, average, and high values.

5 Demographic Significance

Table 3 and Fig.1 (expressed in hundreds of thousands of persons) show the cohort of 1915-20 larger than that of 1910-15 by only 0.1 million, while the cohort of 1920-25 is larger than that of 1915-20 by 0.5 million, and this is followed by an increase of 0.9 million; this latter jump is much more than any preceding five-year period shown. Similarly the 1950-55 cohort is larger than the 1945-50 by 1.9 million persons, a further large step over the preceding history.

FIG. 1



6 Reconstruction of the age-period table

From the averages of Table 3 (the middle bars of Fig. 1) we can reconstruct the original Table 1 using relatively little data. Aside from what is contained in Table 3 for the average intercohort difference, we need only the age distribution of one cohort as a starting point. If the reconstitution comes close to the original we can say that the original age-period table contains a corresponding degree of redundancy.

TABLE 4. RECONSTRUCTION OF TABLE 1: POPULATION IN FIVE-YEAR AGE GROUPS (HUNDREDS OF THOUSANDS OF PERSONS)

Age	1950	1955	1960	1965	1970	1975	1980	1985
0-4	114	133	157	171	194	217	220	225
5-9	100	103	122	146	160	184	206	209
10-14	94	97	100	119	143	157	181	203
15-19	84	91	94	98	117	141	154	178
20-24	72	81	88	91	95	114	138	151
25-29	60	69	78	85	88	92	111	135

7 Redundancy

The sense in which the usual age-period table is redundant is seen by comparing the extract shown as Table 1 with the reconstruction of Table 4. The central cohort of Table 4 is copied from Table 1: 114, 103, 100, 98, etc. The part of Table 4 for the more recent cohorts is made by adding the intercohort differences of Table 3 to the central cohort. Thus the 133 at the top of the 1955 column is equal to 114 plus the 19 given opposite 1950 in Table 3.^ The part of Table 4 for cohorts preceding that born 1945-50 is made by subtracting the intercohort differences from the 1945-50 cohort.

FIG.2

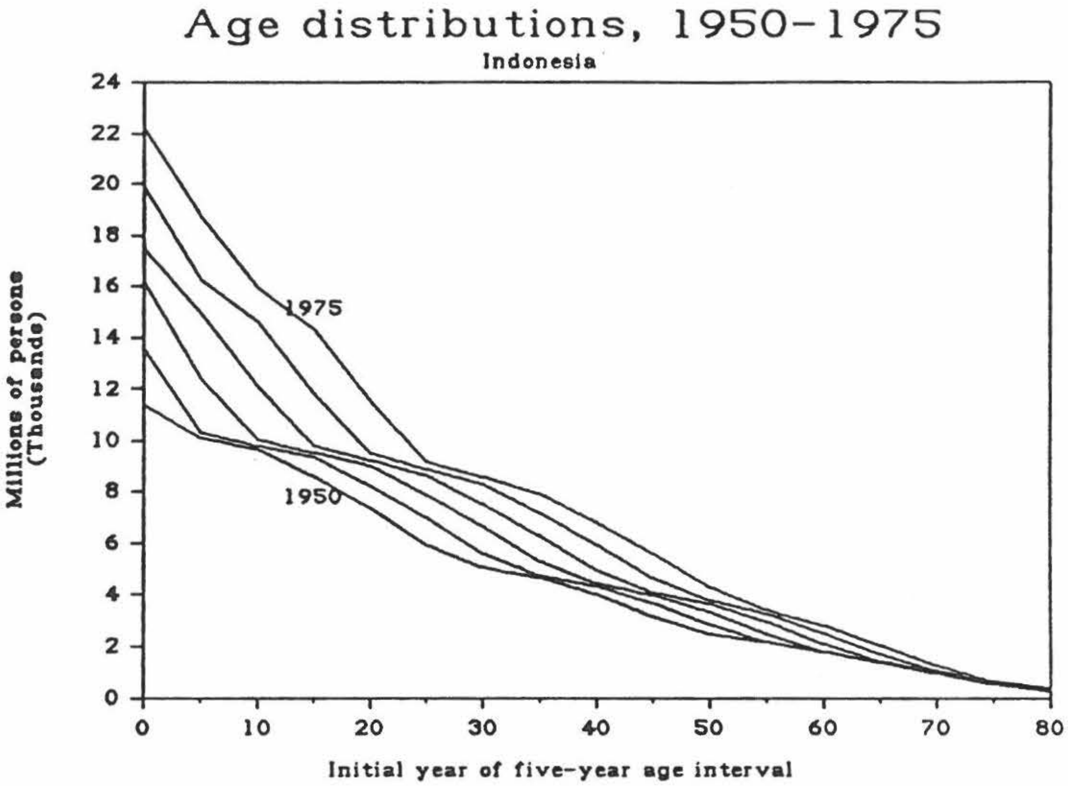
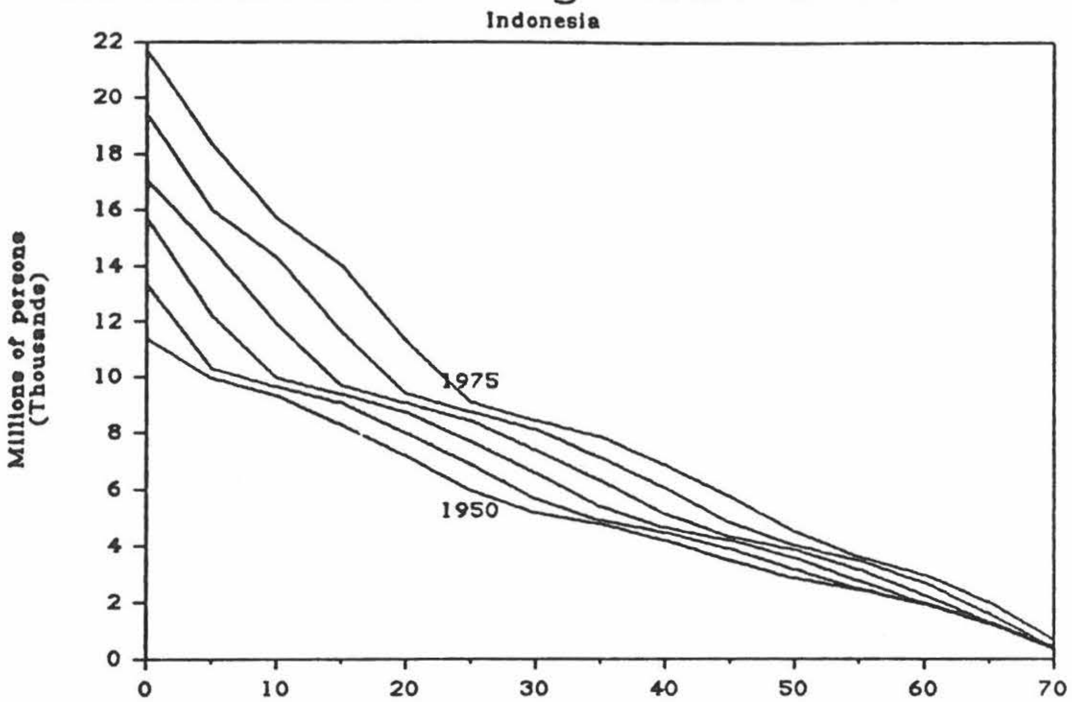


Table 1 contains t x a items, where t is the number of its columns (points of time) and a the number of its rows (age groups). Table 4 has been made by the t items of Table 3 plus the a items of the first main diagonal of Table 1. The degree of redundancy in Table 1 is thus the difference between t x a and t + a.

FIG.3 Reconstruction of age-time distribution



Compare Fig. 2, which shows the original numbers provided by the United Nations for 1950-75, and Fig. 3, which shows the reconstruction using intercohort differences. In all essentials the two sets of curves are identical. Both show the same two bends, one after each of the World Wars, and have otherwise similar configurations. This way of compacting the age-time table is useful for comparing populations in respect of their acceleration after World War II and other features.

Expressed in symbols, the reconstruction consists in taking the central cohort, say $P_{a,-a}$, and adding to it or substracting from it the quantities expressed as the right hand side of (6).

That is the reconstructed population, say $P'_{a,t-a}$, is

$$P'_{a,t-a} = P_{a,-a} + \sum_{v=1}^{t} D_{v-a}$$

when we go forward in time, and similarly, with minus rather than plus, when we go back.

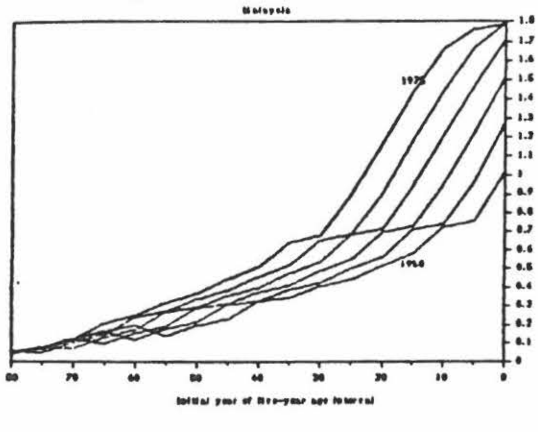
7 Other populations

Fig. 4 is made up of pairs of charts corresponding to Fig. 1 and Fig. 2 for Malaysia, Burma and India. Visual comparison shows how the profiles of intercohort differences correspond to age distributions. The three sets of profiles are placed alongside charts of the data on which they are based; the age distributions turned left to right help to understand the respective profiles. Corresponding to each sharp bend on the left there is a sharp rise in the bars on the right.

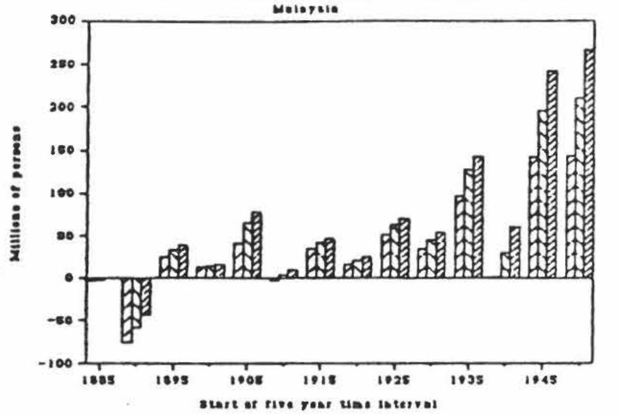
Evidently the change from slow to rapid growth took place earlier for Burma than for India. Malaysia shows considerable growth for the cohorts of the late 1930s, that resumed after a short interruption in the late 1940s.

FIG. 4

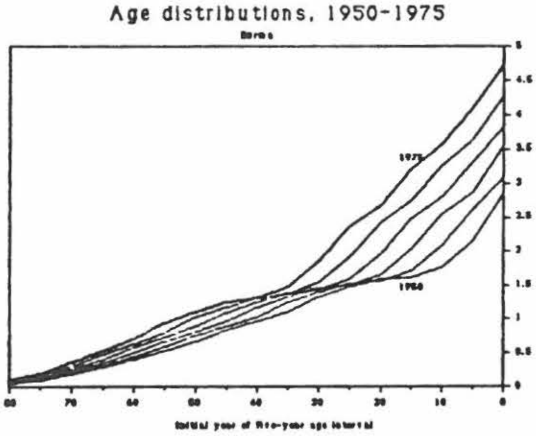
Age distributions, 1950-1975



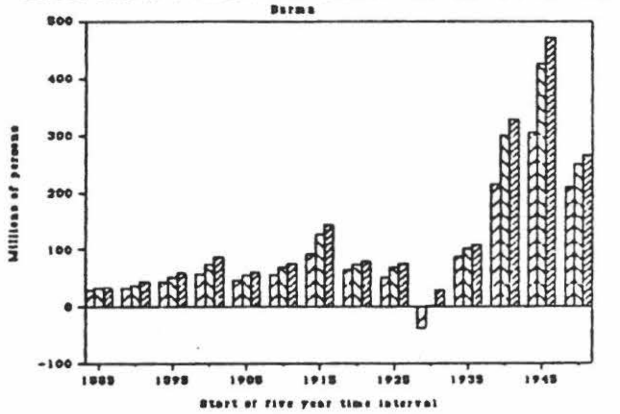
Intercohort increase 1885-90 to 1950-55

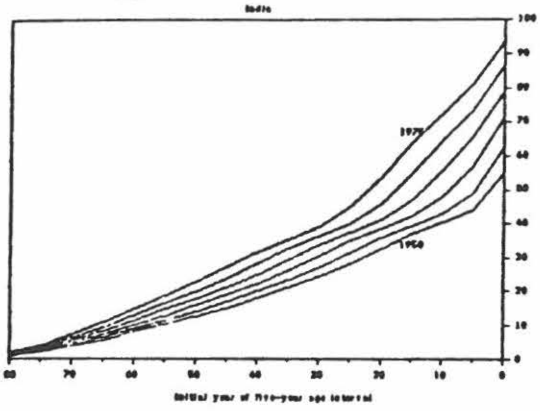


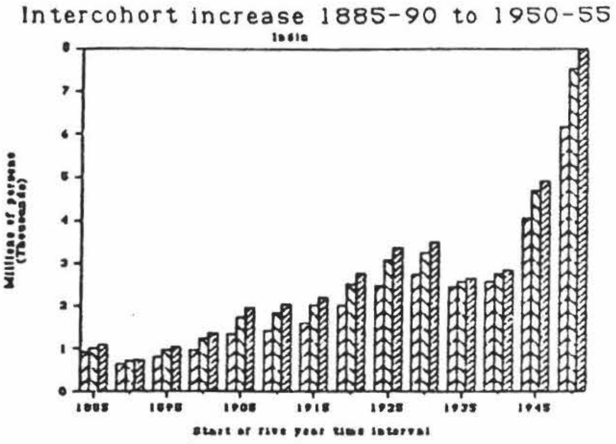
Age distributions, 1950-1975



Intercohort increase 1885-90 to 1950-55







Looking at the age distribution for Malaysia on the upper left of Fig.4, we can see by the vertical distance between the bottom curves that there is a large increase between 1950 and 1955 in the 0-4 age group, as well as in the 5-9, but the 10-14 group increases little if at all. That is to say that the births less deaths of 1945-50 must have been much greater than those of 1940-45, while the births less deaths of 1940-45 must have been about the same as those of 1935-40.

Corresponding to all this, still for Malaysia, we have on the right hand side low bars for the year 1940, which means a low increase for the cohort born 1940-45, i.e. the cohort 1940-45 was not much greater than that of 1935-40; but on the other hand there was a large increase up to the cohort born 1945-50, i.e. it was much greater than the 1940-45 cohort.

8 A Three Dimensional Portrayal

A three dimensional portrayal makes clearer what the algebra and the numbers given above tell us. In Fig. 5 we can think of years as the t-axis, ages as the a-axis, and the number of individuals as the p(a,t) axis. This is a graphical representation in space of the familiar age-time distribution of Table 1.

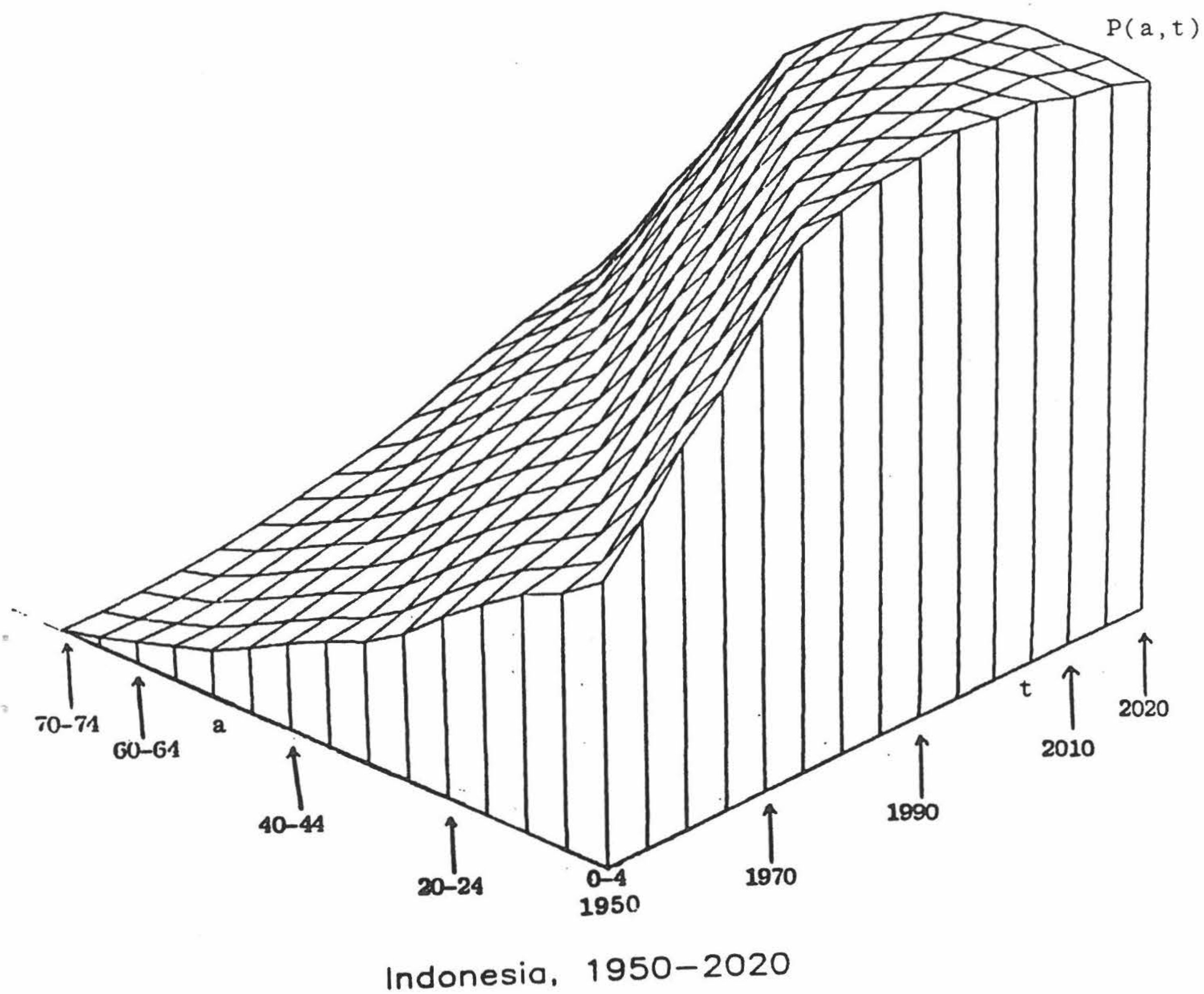
The diagonal vertical section from the nearest corner, at the middle of the diagram, identified by age 0-4 and year 1950, is what has above been called the central cohort of Table 1. Other cohorts are planes parallel to this one.

On the other hand the diagonal plane at right angles to this main one, connecting the extreme left and the extreme right of the diagram, i.e. connecting age 70-74 in 1950 with 0-4 in 2020, is the profile shown in Table 3 and Fig. 1 and represented algebraically in (6). The shape of the surface is such that we can reconstruct the whole of it once we know these two diagonals. Any of the sections parallel to the main diagonal, along with any of the sections at right angles to this main diagonal, in principle allow at least a part of the top surface to be reconstructed.

For a country in which the fluctuations of births have been more irregular, the point comes out even more strikingly. Consider the three dimensional diagram for Canada shown as Fig. 6. Once again we can construct the whole solid figure knowing only a pair of diagonals at right angles to one another, say as before (1) a vertical plane drawn through the points in the base age 0-4 in 1950 and age 70-74 in 2020, and (2) the plane at right angles to this one through the point in the base 70-74 in 1950 and 0-4 in 2020. The baby boom after each of the two world wars stands out conspicuously, as does the echo of the peak in the 1960s that is now starting to appear.

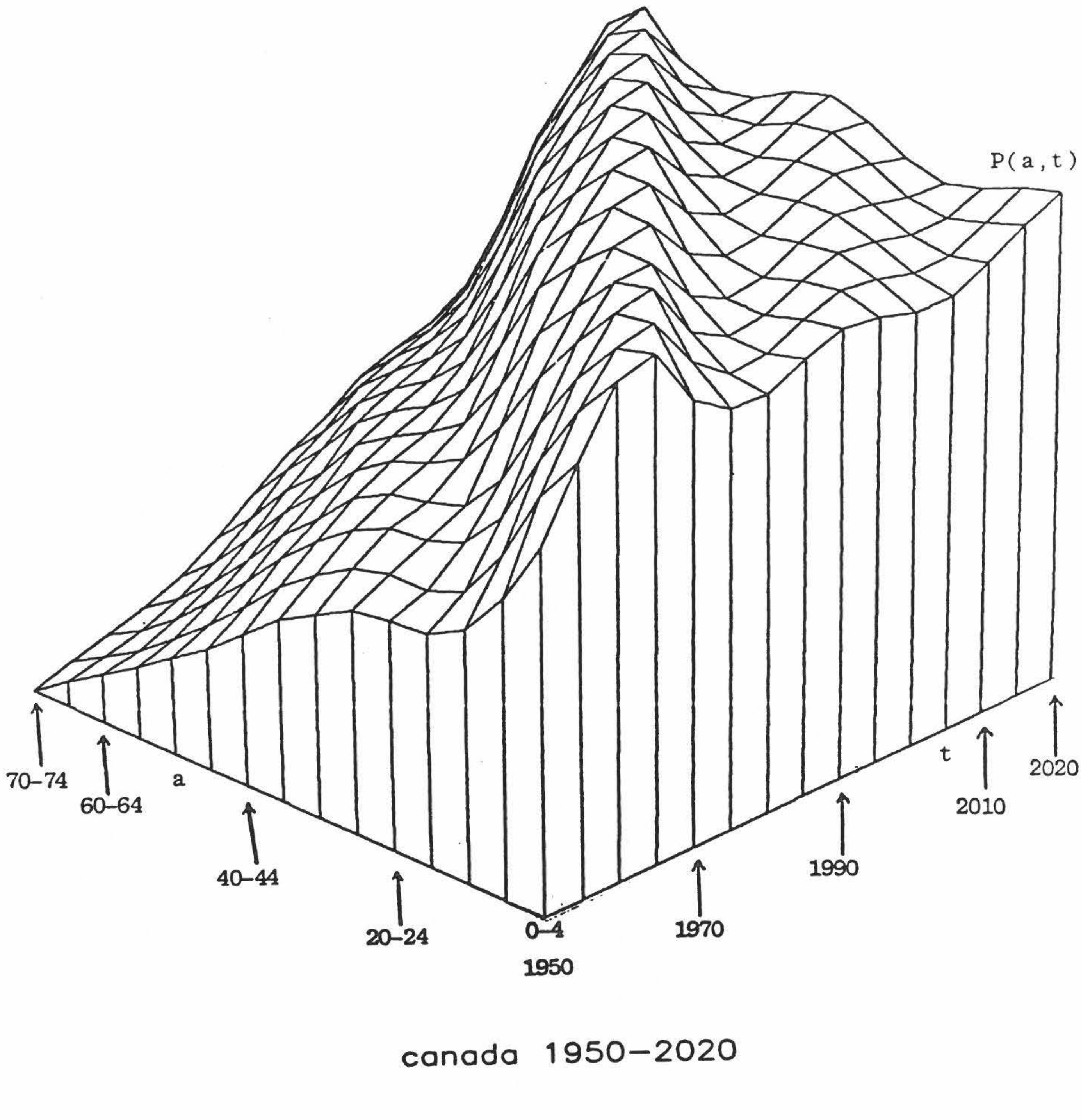
As throughout this paper the source of the numerical data used is the estimates of population by age at five year intervals provided by the United Nations in 1986 on the basis of data up to 1984. It is left to another place to comment on the quality of that data, and especially on the projections included in it.

Fig. 5. Age-time diagram, showing three dimensions of age (a), time (t) and number of persons P(a,t)



Indonesia, 1950–2020

Fig. 6. Age-time diagram, showing three dimensions of age (a), time (t) and number of persons P(a,t)



Name: Alícia M. Bercovich

Title of Paper: Age-Sex Structure in Brazil: Apparent Contradictions

Summary: Analysis of the results of the 1980 Demographic Census in Brazil shows that the age structure presented a peculiar configuration: the concavity of the sides of the population pyramid, both nationally and for most of the states that make up the country, changes direction twice. In the 1970 pyramid the concavity changes once, while in 1960 the sides of the pyramid were approximately concaves.

This change observed in 1980 had been predictable in the period between 1976 and 1979 from the results of nationwide sample surveys.

The phenomenon can be characterized as urban, since a separate analysis of the urban age structure shows that the sides of the pyramid fold inwards for the 5-14 age bracket, whereas no such occurrence is observed for the rural population.

The characteristics mentioned occur most conspicuously for the economically most developed states of Brazil. In some of these, even when the effects of migration are removed, the 5-9 and 10-14 brackets are smaller than the 0-4 and 15-19 brackets.

The thesis put forward in this paper is that the Brazilian age structure in 1980 is a result of the combined effects of an intensification in the drop in mortality in the 1950s and, with a time lag, an accelerating drop in fertility starting in the second half of the 1960s.

Thus the widening of the base of the 1980 pyramid can be seen as caused by the existence of children born to a large proportion of women of childbearing age, in turn the result of a drop in mortality and consequent population increase in the 1950s, but not by an increase in fertility.

On the other hand, the shrinking width of the 5-14 age bracket is a reflection of the drop in fertility and a natural consequence of the evolution of the 1970 structure.

Since the decline in fertility and mortality occurred with greater intensity in the economically more developed states and in the urban zones, the characteristics underscored above in the age-sex structure were naturally more intense in these same areas.

For the same reason, the age structures for several subgroups also presented differences in accordance with the intensity and the period in wich the drop in mortality and fertility occurred in each group. The effects of these differences on the population pyramids for whites and nonwhites, and for varying levels of the head of family's schooling and socio-occupational category, are analyzed in the paper.

It should be stressed that in spite of the widening of the base of the pyramid, groups between 0 and 14 years of age increased less than the population as a whole; this was a natural consequence of the drop in fertility, a drop which has continued through the 1980s. For this reason the relative weight of the under-15 group has been diminishing since 1960, when it had considerable weight because of the population increase of the 1950s.

Name : Jean BOURGEOIS-PICHAT, Chairman of CICRED

Title of Paper : The age distribution of the world as a whole (1950-2025)

Summary :

If the age distribution of the population of the world as a whole published by the UN Population Division every five years from 1950 to 2025 is rearranged by group of cohorts, it is possible to calculate the differences in the size of two succesive groups at different ages. This has been done by Nathan Keyfitz in his working paper (IIASA WP 87-92). When mortality remains constant the difference is following the survival curve and diminishes with age. But as mortality is declining, instead of a diminution of the differences, Keyfitz has found a slight increase. He made the average of these differences for each group of cohorts and looked at the variation of the average through time. Then he was able to detect what he called the discontinuity of the 1940's.

The average of Keyfitz for a given group of cohorts is very close to the difference of the same group of cohorts at 0-4 years. This age is very close to birth and the difference at birth differs from the difference at 0-4 years only by the effect of mortality during the first five years of life. We can expect therefore that the difference at birth will tell us the same story as the average of Keyfitz.

By using various estimates made in the past by the UN Population Division, it is possible to reconstruct the trend of births by quinquennual periods for the world as a whole from 1850 to 1950. After 1950 the births are given in the UN publications. Graph. (1) shows that the difference at birth permits to detect the discontinuity of the 1940's as well as the average of Keyfitz.

Having the size of each group of cohorts at birth, it is possible to calculate for each group a part of its survival curve. Graph. (2) shows the result. It gives a vivid illustration of the decline of mortality which occurred in the world as a whole during the last 100 years. Graph. (3) presents the same result in a different way. It shows the rapid decrease of mortality which took place after the second world war, a decrease which has been followed by a stagnation.

If the absolute difference between two successive cohorts remains constant or even increases slightly, the relative difference is increasing with age. Graph. (4 and 5) permit to quantify the phenomenon. In the older cohorts, this penomenon has a very strong effect : cohorts having slight relative difference at birth find themselves with relative big differences at old age. The semi-stable population model can be used to understand the underlaying phenomenon.

Name: Roberto HAM-CHANDE

Title of Paper: Age structure and other differentials at the US-Mexico border region

Summary:

The United States and Mexico share a common border 3,300 kilometers long which divides two countries with sharp differences in their degree of socioeconomic development. These differences have an impact on each nation's respective population sizes and demographic structures. With a median age of 30.0 years the age composition of the US population reveals that it is close to high levels of aging, while Mexico's median age of 17.6 indicates that this nation will be considered young for still some time to come. The differences between the two societies, populations, and their age structures is not as clearly defined as the political boundary, in view of a high degree of interrelatedness across the border.

Inside the big ethnic mosaic that is the US population, the Hispanic group, in which a majority are of Mexican origin, is gaining importance not only in numbers but also as a socioeconomic and political force. The relevancy of Hispanics is particularly high in the states of the southwest, where they compose 20 % of the population, and their presence is even more significant in the region that borders Mexico where they make up more than half of the inhabitants, including subregions of the border where they constitute more than 90 % of the population. Hispanics and Mexican-Americans in the US have younger demographic structures that resemble those of Mexico and contrast with non-Hispanics, composed mainly by anglos, who show higher aging indexes.

The vast region of the US-Mexico border is a truly binational zone with strong commercial, social, cultural, family and demographic interrelations, creating a socioeconomic and political environment that is unique in the world. This gives rise to problems and opportunities in the development for the region and for both countries.

The population of the border, on both sides, has grown at rates several times higher than the national levels. This remarkable growth has a determinating migration input. On the Mexican side of the border immigrans come from the rest of Mexico; on the border of the US side a great part of the immigration also comes from Mexico, particularly from the Mexican border zone.

The transborder demographic dynamics and the differences in ethnic composition and age structures of the border populations have economic, social and politic consequences not only for the border region but also for each country, creating the need for binational involvement, commitment and solutions.

Name: Shiro Horiuchi

Title of Paper: Measurement and analysis of changes in cohort size

Summary: This paper focuses on two measures that are useful in the analysis of cohort size changes. The first measure is the standardized cohort size, which is obtained by reverse-surviving to birth the current cohort size using the current life table. Characteristics of the measure is discussed in relation to the stationary age distribution, population projection, and age-specific growth rates. The second measure is the growth rate of the number of births. Its usefulness in studying cohort size changes due to LDC's fertility decline in the 1970s is demonstrated.

Name: Karol J. Krotki

Title of Paper: QUASI-STABILITY IS STILL VALID FOR LDC-S

Summary: An attempt is made to assess the meaning behind the statement made by the organizers of some sessions at this conference focusing on "discontinuities in population growth ... and the resulting large youth cohort".

The less developed countries are divided into those with a change in the proportion at young ages since the mid-1950s and without such a change. There was a change in numbers at young ages in all less developed countries, but not much change can be expected in the proportions. Such change in proportions as took place cannot always be traced back to the most appropriate cause: change in fertility, usually decline; change in mortality, usually improvement; methodological adjustments of census enumeration, usually upward for young ages.

In fact, such changes as can be identified are well within the limits indicated by departures from stability to quasi-stability by Demeny 1962. Thus, there is no marked change in the relative position of age groups to each other. The well-known argument is used, that there is no waste due to mortality at young ages before they join the labour force. The burden is in the dependency ratio; thus, once more the period argument wins and the cohort argument loses. Contrary to the finding of Krotki jr 1987 it is shown that it is premature to worry about the proportions at older ages and the increasing burden they exert on the younger age groups.

The real changes that take place are in the few countries where declines in fertility can be observed, but otherwise all is well with quasi-stability in less developed countries!!

Demeny, Paul

1965 "Estimation of vital rates for populations in the process of destabilization." Demography 2:516-530.

Krotki, Karol J., jr

1987 "Is it too early to study the elderly in the Third World?" Pp. 781-803 in volume II of Contributions to demography: methodological and substantive. Edmonton, Canada: Department of Sociology, the University of Alberta, vi (+ 567) + 1011 pp.

1988.08.19

Name: Zenji Nanjo and Kazumasa Kobayashi

Title of Paper: A Method of Measuring Demographic Discontinuity

Summary:

As a study on the discontinuity in age-specific growth patterns of population we tried a few ways of measuring discontinuity, that is, by use of differences, curvature and some others. We used, in the present study, age-time data for World total, China, Indonesia, Japan, Philippines and Thailand taken from the United Nations population estimates (as assessed in 1984). The UN data are given by five-year age group at five-year time intervals from 1950.

1. Let the five-year interval and the five-year age group be the unit, respectively. The population aged a years at last birthday at time t is denoted by $P_{a,t}$. We calculated differences by the following formulae for certain ranges of age and time period we thought necessary.

First differences: $\Delta_t P_{a,t} = P_{a,t} - P_{a,t-1}$ (1)

$\Delta_a P_{a,t} = P_{a,t} - P_{a+1\ t}$ (2)

Second differences: $\Delta_t^2 P_{a,t} = P_{a,t-1} + P_{a,t+1} - 2P_{a,t}$ (3)

$\Delta_a^2 P_{a,t} = P_{a-1,t} + P_{a+1,t} - 2P_{a,t}$ (4)

For a fixed t, there may exist ages at which the values of difference given by (1) to (4) change suddenly as age a advances. We denote them by $a_0, a_1, ...$ in the curve of age distribution at time t.

The second differences are more useful here than the first differences. The measure $\Delta_a^2 P_{a,t}$, in particular, is usable even when age distributions are available only at a few points in time.

2. The formulae (1) to (4) have the same properties as shown in 1 above, with $P'_{a,t} = \log_e P_{a,t}$ in place of $P_{a,t}$. We obtained several relations among formulae (1) to (4) with $P'_{a,t}$. The measure $\Delta_a^2 P'_{a,t}$ is expressed in the form of a sum of fertility and mortality components. We explained each term of the expression numerically using the UN data.

3. As a more general way of measuring discontinuity, we used curvature and others, which correspond to the second difference $\Delta_a^2 P_{a,t}$. We, thus, discussed how to estimate ages at which sharp bends occur in the age curve (based on single-year of age interpolations) at five-year interval of time.

4. We also calculated backward estimates of population under one year of age (in place of the number of births) on an annual basis from 1935 to 1950.

Name: FENG SHAN

Title of Paper: Age Distribution Changes in China - Magnitude and Economic Effect

Summary:

In the last few decades, China experienced two baby booms. Each of them produced a significant demographic bulge in the 1982 Census Age-Sex Pyramid, and counts for 16.4% (age 25-34 cohorts) and 36.7% (age 5-19 cohorts) of the total population. Between the bulges is the valley cohort (age 20-24) and the size ratio of the largest and smallest cohort is 2.54. These distinctive features of the existing age structure will primarily determine China's prospective demographic evolution under any specific set of assumptions about fertility and mortality. It will also affect the need for age-related goods and services and create shortages and surpluses in human and material resources that can add to the costs of economic development.

This paper demonstrates the common population trend resulting from the two series of projections A and B, which have the same mortality assumptions and different family planning schedules aimed to a stable population size of 1.44 and 1.20 billion respectively. The trend shows that from the year 2010 onward will be an era of rapid population aging, next to the successive periods of rapid growing school-age children, youth and working-age population, since the late 1960's up to the turn of this century. And no makeshift arrangement is likely to be very satisfactory in coping with the problems caused.

As it can be observed, demographic hetrogeneities were enlarged by the implementation of a strict family planning policy and the most difficult to assess of its long-run consequences are those that lie in the political and social sphere. Neither is really calculable. If the effects prove more adverse than anticipated, there may be little that can be done to overcome them, when the policies have been sustained for a long period. Although the projections foreshadow an era of hard choices, they offer the authorities with an overall view of the problem to improve their decision making.

Selected data from the two series of projections are tabulated

Year	TPOP 10^6	percentage of age group			ratios over 15-64		
		0-14	15-64	65+	0-14	65+	both
A2002	1.288	25.0	68.2	6.8	36.6	10.0	46.6
A2022	1.440	20.3	65.6	14.1	31.0	21.4	52.4
A2042	1.470	19.6	62.5	18.0	31.2	28.8	60.0
B2002	1.210	21.10	71.7	7.2	29.4	10.6	39.4
B2022	1.318	18.90	65.6	15.5	28.8	23.6	52.5
B2042	1.230	16.20	62.4	21.36	25.6	34.2	60.2

Title of Paper: **The Changing Pattern of Age Structure in Taiwan**

Summary:

In less than seventy years starting around 1920, Taiwan underwent the demographic transition from high birth rates and death rates to low birth and death rates. This paper deals mainly with issues on measurement and projections relevant to age-structural changes in Taiwan, as well as the decomposition of the changes into fertility and mortality effects. It aims to (1) examine the trends and patterns of demographic changes, and (2) assess their effects on age structure in pre- and post-war Taiwan.

The results of empirical analyses reveal that the aged dependency has been rather low in Taiwan. Except for 1940, the number of those aged 65+ per 100 working age population did not exceed 5 until the 1960's, after which it has been steadily increasing. The index reached 8.0 in 1986 and is expected to exceed 10 in this century. The young dependency index was increasing before approaching a high level of 83.1 persons aged 0-14 per 100 productive-age population in 1940. It decreased somewhat and then soon arrived at the peak of 88.8. The index dropped sharply afterwards and appeared at the level of 44.1 in 1986. These statistics reflected Taiwan's changes in vital rates from high to low mortality (esp. infant and childhood mortality) with a delayed but accelerated decline in fertility within a rather short period of time.

The demographic changes have also been directly reflected in changes in the index of aging (those aged 65+ to those aged 0-14). It showed a generally downward trend before 1961, although there were several minor fluctuations. After reaching its lowest value of 5.43 persons aged 65+ per 100 young population in 1961, the index shows a clearly continuous rise. Moreover, it took 15 years for this index to increase by 5 percentage points from its trough, but it required only a half of the time to increase by another 5 percentage points. These results imply that the population of Taiwan started its aging process around 1961, and that the speed of this process accelerated in recent years.

Fertility reduction induces a relative decrease in the number of young persons, thus accounting for "aging from the base." On the contrary, improvements in infant and childhood mortality contribute to population rejuvenation, while those in older age groups contribute to population aging. Comparisons of projections with different fertility/mortality assumptions indicate that declines in fertility were the principal propellant for Taiwan's population aging starting from 1961. Although improved mortality affected the aging process to a lesser extent, the magnitude of its effect has been increasing in recent years, and is expected to continue this trend in the future.

Name: Yeun-chung Yu

Title of Paper: The Estimation of Past Age Distributions Using Age-Specific Growth Rates

Summary: Sharp rises and declines of fertility and mortality in a population tend to generate successive birth cohorts that are quite different from each other, showing certain discontinuity in the age distribution. However, inter-cohort differences have a highly regular age pattern and on the basis of which the age-specific growth rates for past cohorts may be reasonably estimates and past age distributions may be reconstructed. The paper demonstrates that there was a demographic discontinuity in the 1970s in the population of the world and the less developed countries. Based on estimated age-specific growth rates for 1930-35 to 1940-45, age distributions of 1930-1945 for the world, the more developed countries and the less developed countries were reconstructed.

Name: J-P Gonnot

Title of Paper: The Demographic Discontinuity in Southern Europe

Summary:

This paper is aimed at documenting the post-war path of population growth in Southern Europe by applying the intercohort differences reconstruction method developed by Keyfitz. The case of Southern European countries is of special interest because it offers a pattern of evolution which differs from those observed in both developed and developing countries: limited or no baby-boom and high international migration.

Calculations and comparative analysis are carried out for four countries: Bulgaria, Greece, Italy and Spain. In addition, the impact of migration and mortality changes on average intercohort growth rates is estimated using projection techniques and serves as a basis for assessing the validity of the method in a context of high migraton. Finally, the issue of the demographic discontinuity vis-a-vis the growth of the overall population is addressed.

SESSION 7

Economic, Social, and Political Consquences the Youth Cohort has had and will have on Societies: Country Case Studies and General Considerations

Organizer: Nathan Keyfitz

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YOUTH COHORTS, POPULATION CHANGE AND POLITICS: FIVE INTERVENING VARIABLES

Paper prepared for a Conference on
Future Changes in Population Age Structure

Sopron, Hungary; 18-21 October, 1988

W. Howard Wriggins
Columbia University

ABSTRACT:

POPULATION CHANGE, EXPANDED YOUTH COHORTS AND POLITICS: INTERVENING VARIABLES

Successive larger youth cohorts impose additional fiscal and organizational "loads" on governments. These loads change from simple dependency as the larger cohorts move up the population pyramid. If youths are absorbed into the work force or public or military service, they can add to a polity's net capabilities.

Their affect on political stability will depend upon five variables:

(1) The "loads/capabilities" equation which depends upon the size and abruptness of the increased loads and the economic performance of the polity. The latter depends in turn upon the natural resources, the capital, technology, the general organizational capability of the polity and the impact of the international economy upon it.

(2) The "employment/unemployment ratio" profoundly affects life's chances for successive youth cohorts. If large proportions find few opportunities, competition becomes more severe, intensifying class, ethnic and tribal rivalries, complicating political processes and adding public order loads as well.

(3) The "expectation/reality" contrast affects the youth cohorts' response to (2). It will be shaped by the gap between (a) the "expectations" they have acquired from their families and communities, their educational experience and the polity itself, and (b) the opportunities or lack of opportunities they perceive to be within their reach.

(4) The character of the political system - it's ideology, its structures, its accommodative processes and the political mobilization it permits or inhibits also affect expectations and the way the youth cohorts act out their grievances.

(5) The qualities of political leadership and the policies governments pursue will also affect the perceived size of the gap between expectations and available opportunities, the targets youth cohorts will choose for their agitation and the vigor with which they will express their resentments in politically consequential ways.

Qualifications to the model include the numerous differentiations of interest and ascription and the group rivalries which can divide particular age cohorts, diverting their resentments from the government to one another.

Admittedly, to operationalize such variables for research purposes will not be easy. They are, however, the variables that political leaders take into account and earnestly seek to influence.

DRAFT FOR COMMENT

September 20, 1988
Howard Wriggins
Columbia University

YOUTH COHORTS, POPULATION CHANGE AND POLITICS: INTERVENING VARIABLES

I - INTRODUCTION:

My task today is to consider possible connections between the rapid expansion in the youth cohort and political outcomes. How do the phenomena we will be discussing today - changes in the size of the youth cohort, those under 25 - affect the political life of nations?

My interest in this subject dates back to over 15 years ago when some 15,000 Sri Lankan young people sought through a one-night rising, to seize leading political figures, capture police stations and take over the government of Sri Lanka. There were many factors at work, as careful analysis showed.[1] (Obeysekera). It was a romantic, "Left-wing infantile" enterprise. But it surely was not mere coincidence that some 25 years earlier Sri Lanka's youth cohorts had begun to grow very rapidly ~~(look at Keyfitz article~~), and that the overwhelming bulk of the activists arrested or killed had all been between the ages of 15 and 25. Similarly, could it be entirely coincidence that the dramatic and militant support for secession of Tamil areas came some 10 years later, as the more tardy growth of Tamil youth cohorts came to

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[1] Wriggins and C.H.S. Jayewardene, "Youth Protest in Sri Lanka (Ceylon)" in Wriggins and Guyot, <u>Population, Politics and the Future of Southern Asia</u> (Columbia University Press, 1973); see also Nathan Keyfitz, "The Youth Cohort Revisited" (in Indonesia), <u>ibid.</u>

its peak?*

It is almost conventional in historical analysis that where there is political upheaval, usually youthful militants have been at the forefront of events. One is reminded of the role of young activists in the Cuban revolution, in the anti-Marcos movement in the Philippines. In Korea, student protests sparked such riots that the old Syngman Rhee stepped down sooner than he wished. More recently their successors challenged a strong police state until its leaders reluctantly conceded elections. In Turkey, the end of the dramatic rule of Adnan Menderes began with student riots joined by thousands in the streets. In my own country, the peak of the first baby boom coincided with riots and political eruption in many American cities and shortly thereafter on American campuses.

No doubt, others of you have encountered instances where sharply increased youth cohorts have affected political life, sometimes in dramatic ways.

To explore such connections is no easy matter.

Firstly, I take it for granted that the connections we will be exploring are "complex", not simple. There are few one-to-one connections between demographic phenomena and political outcomes. Such multiple interactions and positive and negative feedback loops are difficult to be precise about. As will be seen, each of the intervening variables I identify in themselves are the result of highly intricate phenomena. Their roles as connectors change over time, often rather abruptly. Each has a dynamic of its own,

* See Appendix II

and their interactions are hard to capture. [2]

Secondly, most of these intervening variables are difficult to state in quantitative terms, since in political life, many of them relate to people's perceptions, expectations, fears and identities. Quantitative measures can accurately report head counts, but in themselves they may tell us little about the political significance of the quantitative measure.

Thirdly, since I have only lived within open, democratic systems, with a good deal of political contention, in which ruling elites are periodically challenged at election time, and often under rather constant if fluctuating challenge, my "model" may assign more of a role to a legitimate "counter-elite" than may be useful in considering other types of governmental regimes, where institutionalized opposition are strange indeed. It may also give too much stress to the psychological dynamics of individuals than may be appropriate where individuation is less pronounced than in these polities. [3]

Fourthly, at one level of abstraction, all political systems face a similar problem. As Harold Laswell put it,

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[2] For early discussions of these problems, see Myron Weiner, "Political Demography: An Inquiry into the Political Consequences of Population Change", in Roger Ravell, ed. <u>Rapid Population Growth</u> Vol 2; (National Academy of Sciences/Johns Hopkins Press, 1971), pp.576-581; Neil Chamberlain, <u>Beyond Malthus</u>: <u>Population and Power</u> (Englewood Cliffs, NJ, Prentice-Hall, 1970); Nazli Choucri, <u>Population Dynamics and International Violence</u> (Lexington, Mass., Lexington Books, 1974); Nazli Choucri (ed) <u>Multidisciplinary Perspectives on Population and Conflict</u> (Syracuse, Syracuse University Press, 1984);

[3] See for example, Adda Bozeman, "The International Order in a Multicultural World,"in Hedley Bull and Adam Watson (eds), <u>The Expansion of International Society</u> (Oxford, Clarendon Press, 1984),Ch. 26.

politics is the study of "who gets what when and how;" there is never enough of what people want to go around. A viable political system has evolved arrangements for handling the distribution of scarcities and of what people value. Some individuals and groups receive more of what is wanted than others; and in well-established political systems, the government is responsible for seeing that those arrangements persist; or put more exactly, that they are not frivolously upset. It is also responsible for supplying channels through which inevitable differences of interest and of values can be argued about. Successful governments also facilitate the resolution of such differences - through legal, mediatory, or other politically acceptable modes of debate and compromise. Where mutual accommodation proves impossible, the government needs to be able to set limits to disputes and to define what is to be for now, the official, authoritative resolution of these differences.

With these introductory comments, I now turn more directly to connections between successively larger youth cohorts and politics, an exploration which takes us quickly into the realm of personal and group aspirations, economic opportunity and political institutions and processes.

II - YOUTH COHORTS AND POLITICAL OUTCOMES: Some Variables:

A) THE DEMOGRAPHIC CIRCUMSTANCE:

As our discussions here have shown, demographic problems posed by the larger youth cohorts are very many. But for our purposes, I want to state the matter simply to begin with.

When successive youth cohorts are larger than their predecessors, demographics first adds "loads" onto the political system as numbers in specific cohorts increase and age group proportions change. These added loads at the outset derive from dependency during the years before the more numerous young enter the work force. Later, as the larger cohorts move beyond the years of dependency, they may become politically more consequential by asserting their own interests, making claims upon the politico-economic system, perhaps even seeking to affect public affairs in other ways. Their increased numbers may intensify competition between individuals and groups, affecting the polity in still other ways. To be sure, increased numbers of the elderly may also add dependency loads, but at least in many Less Developed Countries (LDC's), most of such loads in practice are at first taken up by families willing to care for their elderly members.

These and other demographic phenomena are linked to political outcomes through a number of intervening variables.

B) INTERVENING VARIABLES:

1) The "loads/capabilities" equation

These additional loads that a system must be able to bear in operational practice are weighed against a government's or political system's capabilities for carrying these loads. Ideally, the system should be able to supply these additional goods and services that are required during the years of dependency. It should also provide the openings and opportunities that alone can ease the transition to productive adulthood when they reach an age to begin to contribute to a government's capability.

For instance, during the first years of the "youth surge", child care facilities, medical care for infants and nursing mothers and other forms of help for mothers may be necessary. As these larger cohorts enter school years, a rapid expansion of the school system may be necessary, with implications for government budgets, probably requiring a change in allocations perhaps at the expense of other national purposes or others in the society. Hopefully, governments can organize means for moderating those conflicts that are likely to arise.

These are the years for acquiring life skills that can turn the dependent into a potentially productive member of society, able to find a satisfying place for him or herself in adult roles. Such years are "loads", but how these are dealt with can have an affect on the problems posed to the society by the larger youth cohorts as they mature.

In an ideally informed world, there would be for our purposes some equation that could reflect the loads/capabilities balance in relation to any particular cohort at a particular time. Our expanded "youth cohort" affects the terms of that equation. In the real world of insufficient data, we can only hypothesize such an equation. We can be sure, however, that as the larger youth cohorts proceed up the population pyramid, they add successively different loads to the system; and after a certain age, if favorable conditions prevail, they ultimately make a net contribution to capabilities.

Capabilities depend upon two distinguishable but related variables. One concerns economic performance; the other, political organizational considerations.

a) Economic performance hinges upon the relation between resources, organization and technology within a sufficient political order.

A stagnating economy has difficulty carrying these additional loads; an expanding economy can meet them easily. Where resources are plentiful, meeting these additional elementary loads is not difficult, depending a good deal on the capital and other resources that can be brought to bear. In agricultural areas there may be a finite amount of land, but where capital, know how and a minimum of water exist, irrigation and agricultural technology may make a great deal of difference to the productivity of that land. Technology, organizational skills and capital can make every pair of hands far more productive in industrial enterprises.

b) Secondly, a sufficient political order presupposes a degree of reliable public order and predictable governmental authority. There must also be means for resolving unavoidable differences over public policy. And all this with a minimum misuse of individual positions in the public domain for private gain. There is a wider range of political structures within which these requirements can be found than we used to think; but they are difficult to establish and to sustain.

c) Thirdly, the international political economy may ease the tasks of both the economic and political orders. More likely, it can gravely complicate governments' efforts to deal with both, becoming a source of highly consequential influences.

For some systems, meeting these basic needs of the growing youth cohorts poses few difficulties; for others even meeting minimum food requirements can be uncertain, as was seen in Ethiopia prior to the overthrow of the archaic Halie Selassie regime.

2) The "employment/unemployment ratio": Jobs for young adults

It is no accident that the next "load" or requirement for political stability most frequently cited as the larger cohorts proceed up the population pyramid, is the need to provide remunerative and appropriate job opportunities for those now ready to enter adulthood. Before, when the youth cohorts grew only slowly, it was not so difficult to absorb the young in useful and satisfying occupations. They often continued to do what their fathers had done. But when for a period, successive cohorts are each larger than their predecessors, cumulatively, other things being equal, it becomes very difficult to provide worthwhile employment to a significant proportion of the now much more numerous young.

Moreover, competition among the young is likely to intensify. Competition in the upper schools and universities may become more severe. More individuals contend for what may be a limited number of places on the land, for urban jobs, for housing. Youths who earlier were tolerant and mutually accepting can become antagonistic protagonists contending to better their own life's chances. Under such circumstances, families, neighbors, clans, tribes, castes and ethnic communities may become more aware of their distinctness from one another. When such social identifications become associated with demographic numbers, often deep primordial fears become more salient. Individuals who before were seen simply as individuals, perhaps even friends, often become transformed into representatives of the "other" ethnic community or tribe. As suspicion displaces friendship, a "load" of sustaining public order may be added to the debit side of the load/capability equation.

Political stability can be upset by large numbers of un- or under employed youths if they remain unabsorbed into the political-economy. Put simply, young people without employment are easily led to be politically disruptive. Understandably, they resent having to postpone forming a new family; they can be bitter as they see others ahead of them already established. They lack the life shaping discipline that regular employment - rural or urban - provides. They have little to lose; they are prone to take risks. Youth enjoys the thought of quick transformations; by a bold stroke, the world can be made much better. Having had little experience of the complexity of these affairs, they are often overconfident that they have all the answers. All the more reason then, that unemployed youth should have a propensity to political disruption.[4] In contrast, people who can meet their own needs may be challenged by the work that also serves their own interests; they may be tired after their daily labors; they are less likely to risk their small stake in life's chances by engaging in significant political protest; they are more likely to avoid violence. Those who find their way into constructive participation, by their very youth can contribute their energy,

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[4] Neil Chamberlain, op.cit., p.55.

their flexibility and a readiness to innovate that their less flexible elders may have long since lost.

Nazli Choukri neatly synthesizes these factors in the following proposition:

> "The higher the proportion of youthful population and the greater the unemployment, the greater the possibilities of dissatisfaction, instabilities and violence."[5]

However, in itself these are insufficient to "explain" links between these demographic phenomena and major political developments, because of a number of other considerations.

3) The gap between Expectations and youth cohorts' reality experience: "satisfaction/resentment" equation.

The real magnitude of the loads imposed upon the community and government by the expanded youth cohorts, depends also upon highly subjective variables. These magnitudes are shaped in part by expectations among the young, subjective realities that define for the energetic, restless young people what they can legitimately anticipate, at whatever age they leave educational and family institutions to enter the adult world.

If expectations are low, if individuals expect little from their circumstances, if they assume that life as it is is the natural order of things, then an increase in the size of the youth cohort will not make much difference beyond the practical pressures and strains already noted. But should the increased

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[5] Choucri, Population Dynamics, p.72.

numbers have among them individuals whose expectations about the future are for something considerably better than the reality obviously within their reach, then added numbers can be a source of political restlessness and perhaps disruption. Cohorts with vaulting expectations can be an added burden, a severe challenge.

Expectations are shaped by many aspects of their life. Observing their parents' life experience in their local communities or the experience of those who are just ahead of them, how they perceive their own experience as they mature; above all, what they learn from one another, and if they go that far, from their school and university communities which together help shape the values and aspirations they make their own along the way, out of all this they fashion an image of what it is reasonable to expect. What political leaders - or counter-elites - publicly promise or allege; what the media stress or downplay also have their unpredictable effects on expectations.

Regardless of the character of the political system, such "expectations" take shape; they represent the alert or lethargic individual's reaction to what he or she sees, hears, experiences and argues and comes to look forward to. To the extent that their "real" world comes close to their expectations, it is likely, other things being equal, that these successive cohorts will move forward without politically disruptive resentments. But should there be a marked gap between expectations and reality, between goals and plausible achievement, one can expect unrest, resentment and possibly politically disruptive behavior. [6]

[6] Ted Gurr's discussion of "relative deprivation", where optimistic hopes of improvement are shattered by a reality that is worse than expected, with little hope of improvement, is a

In a number of the Less Developed Countries, there is a notable and pernicious form of the generation gap. In many of the states that gained independence shortly after World War II, there was a sudden burgeoning of opportunity for those with high school and college education to move into highly responsible governmental positions, replacing the colonial officials who for the most part went back to the metropoles. Those who graduated from colleges and university soon thereafter easily entered into lesser bureaucratic positions that also carried high status, career security and numerous opportunities to supplement public service pay with various forms of "speed money." Unless the economies were rapidly expanding and public service positions growing with them, at some point within the next two decades governmental positions became fully staffed and such opportunities became more scarce just as the successive maturing cohorts became more heavily populated. For the thousands who came later, it would be a long wait before these recruits would retire and make room for those who arrived later on the scene.

<u>4) Character of the Political System:</u>

It takes little imagination to propose that the political side effects in any specific polity of rapid growth in the youth cohorts will also depend significantly upon the political system in that country.

Given the variety of political systems represented here today it is unnecessary to stress that mankind has created many structures, processes and ideologies to justify, explain and help

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particular form of this gap. See Ted Robert Gurr, <u>Why Men Rebel.</u>(Princeton, Princeton University Press, 1970).

sustain that variety. And I do not propose here to attempt a typology, a favorite pastime of many political science colleagues. I will venture, however, that a polemical two-variant typology - capitalist-socialist or dictatorship-democracy is far too simple-minded and undiscriminating to be useful for our - and most other - purposes. But it is obvious that distinctions among political systems are relevant for us on several counts.

a) In the first place, political ideologies and theories prevalent in any one political system have an affect on expectations - they may stress equality of opportunity, the duty of all citizens to do as they are told, or the legitimacy of vertical ascribed distinctions as preference is given to participants in great events like war or those who formed the cadres of a revolution. They may underline the government's responsibility to see that all are taken care of somehow or emphasize the individual's responsibility to shape his or her own fate. They may argue that most of life's important chances should (or they may in fact) depend upon an individual's relationship with officialdom; in contrast, they may hold (or in practice demonstrate) that government may have little affect upon a person's opportunities or difficulties.

b) Political systems as well as ideologies usually have opportunity implications and are likely to have an affect on individuals' life chances, and how these are distributed. Thus, a political system that promotes equal distribution of what is available may meet at least minimum needs for all, even providing jobs. But it may not leave much room for individual choice. Systems with more individual choice may be less successful at assuring jobs under all circumstances. Where the virtues of the market are stressed, an individual's skills and effort may be rewarded more than in an allocative system which seeks to avoid some of the more obvious "vagaries" and injustices of the market. Where families or tribal links are paramount, whole sectors of a society may be excluded from access to the governmental system and its many fruits. How these variables affect the expectations and behavior of the expanded youth cohorts is difficult to say a priori. But these considerations will affect how these expanded youth cohorts assess their life chances, and the extent to which they perceive them as favorable or unfavorable under given conditions.

c) Political systems also differ in their hospitality to the public expression of dissatisfaction and the organization of interests to influence public policy. It makes a difference whether the political system leaves room for these expanding cohorts to articulate their peculiar needs. Some provide more opportunities for rapidly expanded youth cohorts to have their interests organized and their grievances publicly aired than others. Some, however, allow a recognized political "opposition" to organize; they are the most likely to find unemployed youth being mobilized to bring pressure to bear as they try to change in their favor the allocation of what is desired. Elections are the occasions in such systems, when dissatisfactions are articulated and often exaggerated in efforts to change leaders and alter allocations. As civilian politicians compete against each other, typically, each feels impelled to promise more than his opponent, inflating expectations in the process. By contrast, some systems may be highly effective in discouraging such activities. By strict constraints, they may deter complaint and dampen hope of change except by extreme methods.

Where such regular occasions as elections are not provided in less competitive systems, changes in leadership generations will have to be provided for within official structures, which is not always easy. Otherwise, the restless young may despair of improving their life chances. Coups d'etat by younger officers are the more typical route for accelerated generational changes where civilian structures are not well established or cannot accommodate to changing political pressures from below.

Where interests can be organized, political mobilization contributes to activating those who as yet are uncommitted or passive in the political system. Political mobilization may serve to enlist the emerging youth cohorts into governmental enterprises, particularly if internal or external enemies are targets, or in time of public crisis, such as in war. But within most systems, the young tend to reject the pretensions of the "establishment". They forget the challenges their predecessors overcame; they take for granted what the preceding generation may have considered great accomplishments.

How that mobilization affects their political orientations and activities will reflect in part their "expectations". It will also reflect the organizational structures that give shape and coherence to these activities. Successful mobilization for the most part requires organizational structures of some kind - youth organizations, political parties of many possible types, factional structures, religious zealotry groups, para-military political bodies, civil rights movements, etc. The kind of political mobilization and the direction of their activities, therefore, will depend in addition upon the organizational structures through which that mobilization is organized.

In almost all political systems, there will be individuals and factions who see in the younger cohorts a possible political constituency that if properly inspired by ideological conviction, religious zeal, xenophobic or communal chauvinism can become politically mobilized to form an important political asset in the pulling and hauling of domestic political rivalry. Through this and other mobilizational activities, youth cohorts may gain a sense of their own numbers and no doubt of their distinctness from those who have come before. Once they become aware of themselves as a numerically significant element in the polity they are likely to see themselves as rightfully deserving more influence.

Of importance therefore are the organizations and the tactics used to promote political awareness and shape the political activity of the younger cohorts as they come forward to adulthood.

5) Leadership and Policy:

The four variables we have identified are themselves affected by both leadership and policy.

An inspiring leader, one who evokes loyalty, enthusiasm and energy focused on national tasks, can materially alter the capability of a political system to respond to the demands and grievances of youth cohorts. Even where there are many jobless and expectations have been profoundly contradicted by a harsh reality, resentment can be assuaged by a Franklin Roosevelt who can induce hope in the despairing and energize a lethargic bureaucracy into innovative ways of tackling unprecedented problems. Conrad Adenauer for a critical period, could represent the deeper sources of a defeated people's self-respect and hopes. A Tito can inspire a diverse population and draw its youths forward in collaborative activities.

To touch the springs of loyalty in the disaffected young requires special skills, and these will change with time. What calls forth a response in one generation of youth cohorts leaves subsequent cohorts unmoved, or positively repelled. Leaders who stay in place too long usually discover that formulae that worked at the beginning of their terms fall flat and set up a distance between them and the new young people who take the place of those who cheered them when they first came to power.

Where competition is intensified by growing numbers and a parallel contraction of individual and group opportunity,, there may be individuals who find it politically useful to stress the contrast between one group's advantages and another's disadvantages. Such invidious comparisons incidentally intensify group rivalries and mutual bitterness. In this way, as young men of differing affiliations may gain in group self-consciousness, they may also come to blame other ethnic groups or tribes for their present difficulties. In both India and Sri Lanka, at least, these ethnically-based youth cohorts become politically mobilized personnel available virtually on-call for regional or local leaders. They contribute to communal hostilities. When attacks on specific groups or more general riots are being organized, or when they erupt virtually spontaneously in New Delhi, Colombo, Rangoon or elsewhere, these young men are quick to participate with zeal, greatly complicating the "load" on governments to maintain public order and to protect minorities.

The policies a government chooses - or may be 'forced' - to follow will also make a major difference. These are the least predictable. Understandably, policies toward expanding educational opportunities, toward university entrance, toward examinations, graduation and job assignment afterwards are particularly sensitive. But youth cohorts do not care only about their own particular interests. As pointed out above, political ideologies and notions of appropriate political tactics can also become issues of importance. Persisting authoritarian practices that have lost their public legitimacy can intensify resentment. Government policies appearing to contradict cherished traditional political practices that may have been temporarily eclipsed can trigger the ire of youth cohorts. A government that negotiates agreements to bring disorders to an end and then does not implement what they agreed to can provoke igorous antagonism. Policies that encourage the migration of one ethnic group into lands that another considers its traditional territory can turn whole communities against a government. The egregious misuse of police power beyond what is thought in that society to be legitimate or the assassination of a popular opposition leader can be the trigger for political upheaval.

It is not necessary for the young themselves to be the ones who invariably define the issue and set the strategy, nor is it only the unassimilated youth cohorts who make up the protesters. But where numbers willing to run severe risk are needed, typically it is the cohorts of unassimilated young who staff the challenge that governments find difficult to overcome. We only need be reminded of the pressures young South Koreans, Filipinos, Burmese, Assamese, Punjabis or Tamils have brought to bear against their governments to recognize that leadership policy choices can make a profound difference to the way expanded youth cohorts can affect the political stability of established regimes.

Moreover, government policies that appear to lead forward to a better future encourage youth cohorts to acquiesce to current leadership. On the other hand, where government policies are widely believed to lead nowhere; where stalemate and stagnation are perceived as the likely results of continuing the current course; where no new leaders seem to be able to come forward under present institutions, the unassimilated youth cohorts are among the most likely to act against the regime.

Leadership and policy thus can affect the other variables, contributing to either continuing stability or increasing chances of eruption.

These are among the important intervening variables that stand between the fundamental demographics we are here to explore and probable political results. No wonder the political side effects of larger youth cohorts are difficult to predict.

C) TO SUMMARIZE THE ARGUMENT:

We have identified the abruptness and magnitude of the changes in the cohort size as a primary condition, imposing new "loads" on the politico-economic system.

The following intervening variables link these conditions to political outcomes: (1) the "loads/capabilities" equation, is affected by (a) the size and abruptness of the new loads and (b) the economic performance of the polity which in turn is dependent upon (c) the natural resources, (d) the capital, (e) technology and (f) the general organizational capability of the polity brought to bear upon coping with the new "loads" (g) the way the international political economy affects capabilities.

(2) Of critical importance is the availability or lack of remunerative job opportunities (or equivalent life chances) summarized in the "employment/unemployment ratio". Where large percentages find few opportunities, competition becomes more severe, intensifying class, ethnic and tribal rivalries.

(3) Expectations induced in any cohort by experience, education, and public discourse as they relate to the opportunities that are in fact available, does much to shape the "satisfaction/resentment" equation.

(4) The character of the political system, its ideology, its structures and political mobilization, accommodative processes all influence the way particular age cohorts affect the polity.

(5) Finally, the qualities of leadership and the policies governments pursue also affect the way youth cohorts contribute to stability or to political upheaval.

It hardly needs saying that each of these variables has a quasi-independent dynamic of its own, that there will be much "randomness" in the responses of large numbers of human beings to the circumstances they face. The "sport" of skilled or short-sighted leadership, the unpredictability of public passions, and the affects of uncontrollable external events make these matters difficult to predict and equally difficult to manage.

For those of you used to the relatively "hard" data of demographic research, and who like to make firm reliability "tests" of your propositions, moving into such ambiguous terrain as I have touched upon may leave you deeply uncomfortable. I would argue, however, that despite our best endeavors, political history is full of surprises; the unpredictable has to be expected. If one is to speculate about how large numbers of people will respond in a future that cannot be known with precision, we have no choice but to move into such ambiguous realms.

III - ADDITIONAL COMMENTS:

There are some additional observations that ought to be made.

1. While age cohorts do form an analytically distinguishable category of people identifiable by the year of their birth, within any one cohort there are likely to be differentiations that will affect their political behavior. Peasant youths with little education but with jobs to do in the countryside will respond differently than those with GCE "O"level credential who hoped for a white collar job and after two years of waiting have found nothing. Youths in the mountains of the Northwest Frontier have different aspirations for themselves than townsmen on the

Indian plains.

2. Particularly in South Asia and Africa, each cohort is segmented by ascriptive affiliations. Ethnic differentiations lead Tamils and Sinhalese in Sri Lanka, or Sikhs, Hindus, Muslims, Tamils, Malayalams, Assamese or Bengalis in India to look on their own shared interests in particularistic ways. In parts of Africa, tribal affiliations are politically far more consequential than the year of one's birth. In many instances, these exclusivist identifications are more important than age or socio-economic class differentiations.

3. The model has generally assumed that the youth cohort directs its resentments and bitterness against "the government." However, in both South Asia and Africa political resentments and grievances are as often directed against competing ethnic or tribal groups as they are against the government per se. To be sure, in many states, the government has come under the control of one ethnic group or one tribe, and minorities are at a permanent, structural disadvantage. Or they may perceive themselves to be systematically discriminated against. In such cases, ethnic resentments become focused against a government which is seen as an embodiment of the competing ethnic group's unfair privileges. Moreover, where ethnic or tribal groups are regionally concentrated, a desire for greater freedom from central government control can take the form of secessionist movements, sometimes adopted originally as threats for bargaining purposes which then gain a life of their own, as can be seen in India's Punjab or Sri Lanka's northern province.

(4) It would be incorrect to assert that expanded youth

cohorts are the principal source of regionalist, secessionist movements. These have different, more complex sources. But the large numbers, often un- or under employed, provide enthusiastic, often zealous lieutenants and foot soldiers, so to speak, for political leaders seeking secession or threatening it as a bargaining ploy. Before a movement turns violent, the unabsorbed youths can be activists mobilizing opinions in favor of stronger opposition to central governmental rule. Should the movement go further to symbolic riots or beyond that to guerilla resistance, large numbers of young zealots enhance the military power of the secessionist movement.

(5) National traditions also can affect the role of successive youth cohorts. In India, student participation in the independence struggle against Great Britain established conventions which persist to this day. For many, students ought to participate in protest riots at some time in their career if they are to gain self-respect in their own eyes. This tradition has carried forward to make it easier for leaders of ethnic groups to call out students and other youths to protest the privileges granted to other ethnic groups or to seek correction of their grievances by direct action in the streets. In some polities, as in South Korea, students have claimed the role of public critics, defining when a regime has gone "too far".

Unfortunately for those of us who like our analytical problems neat, these observations offer little promise. Each of the "variables" I have identified cannot be captured by a tidy reductionist simplification. They are sufficiently complex and ambiguous so that quantification is difficult and few observers would derive the same implications from observing any one of them. Nor should you construe my remarks to suggest that political disorders from time to time are not necessary. Sometimes only a real riot will lead deaf rulers to get the message. And the right of revolution has a long and honorable pedigree.

My remarks have been directed to a rather narrow but important problem: how do markedly enlarged youth cohorts affect political life? You will have gathered my underlying assumption: they are likely to produce political instabilities of various kinds. I hope these thoughts will have opened a broad field for discussion.

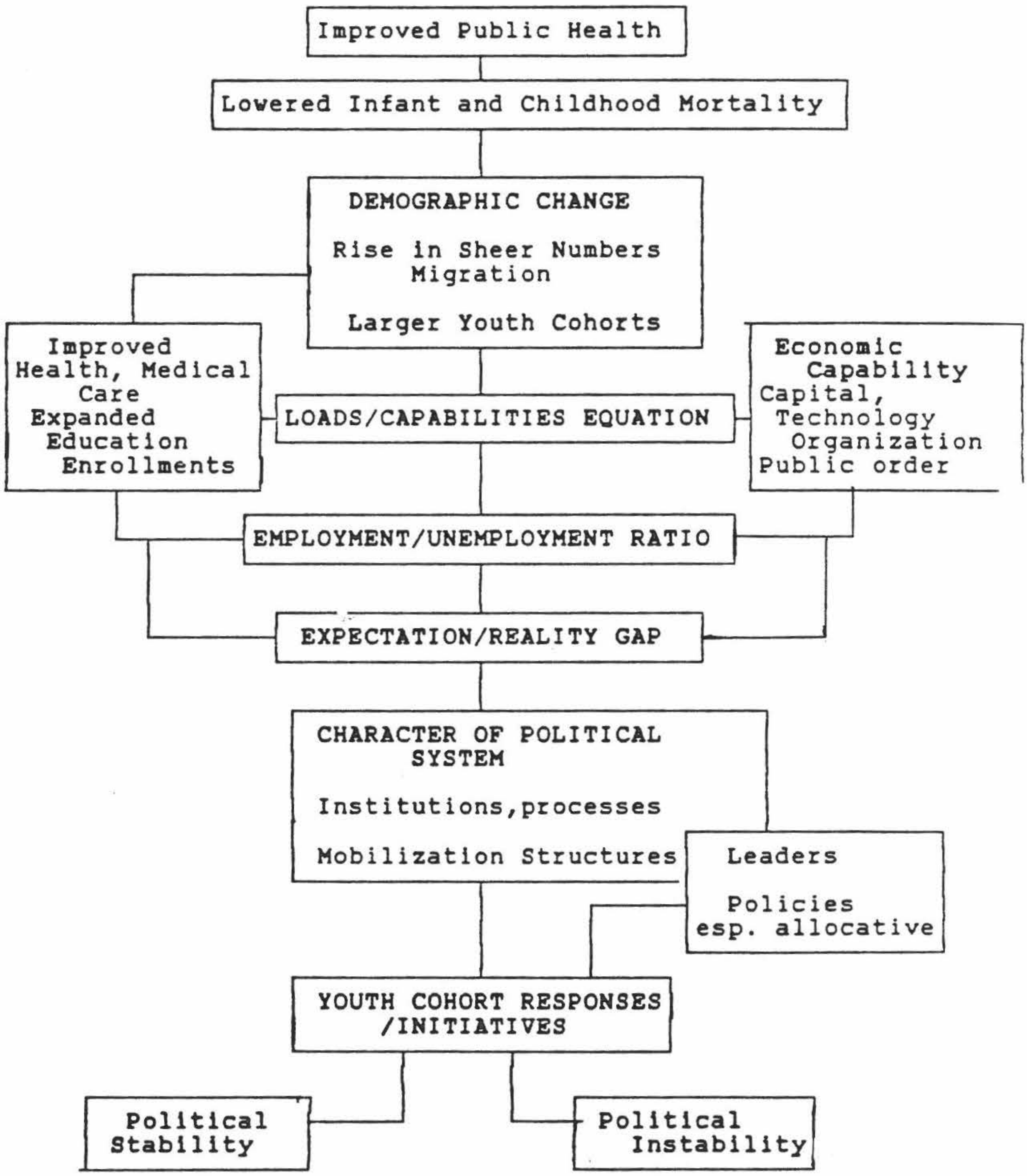
Fortunately, Nathan Keyfitz has asked a number of my fellow speakers to address particular cases in greater detail than I have in these rather sketchy observations. We can then see by observations whether these are the variables that matter, or whether there are other, more critical variables to observe and measure.

Thank you.

EXHIBIT I

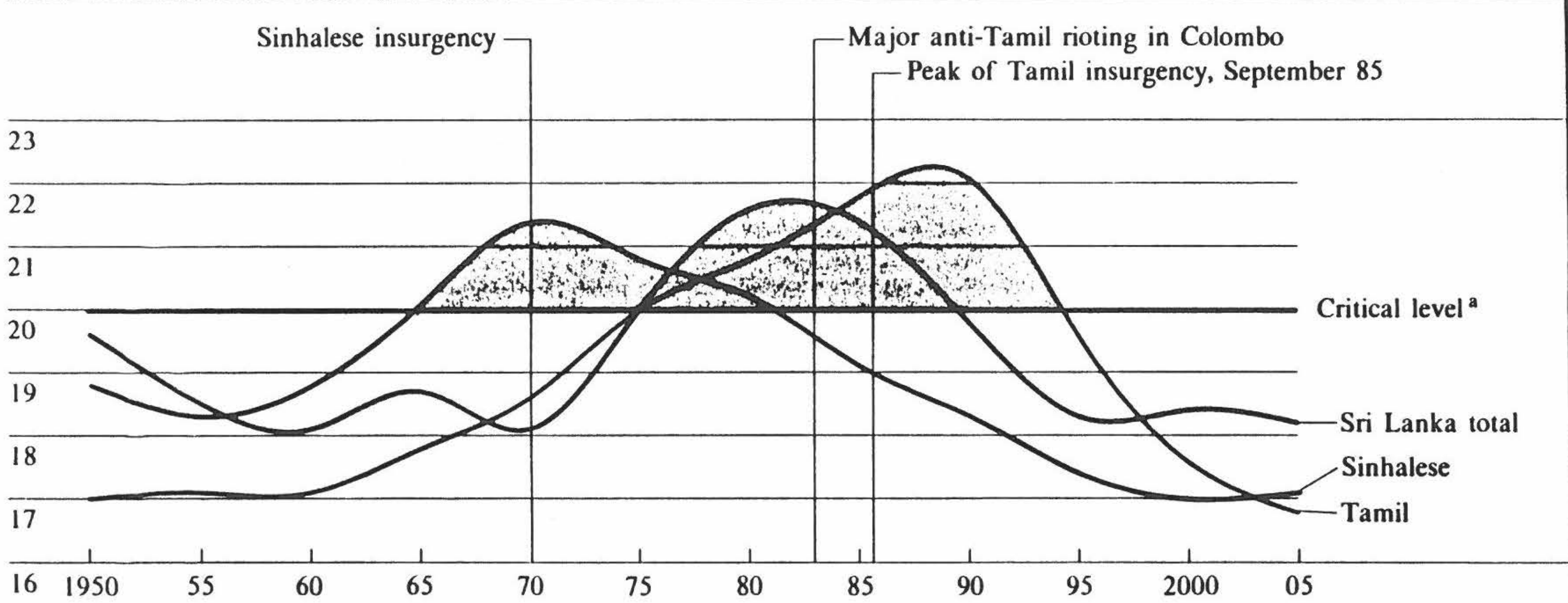
DEMOGRAPHIC CHANGE AND POLITICAL STABILITY:

INTERVENING VARIABLES



Sri Lanka: Youth Bulge

Percentage of total population, age 15-24



[a] The critical level is the point at which youths make up 20 percent or more of the population.

Chart by Gary Fuller, University of Hawaii
Department of Geography

Based on 1984 UN projections. "Sinhalese" refers to Wet Zone only; "Tamils" refers to Dry Zone only.

At a Departmnent of State conference on "Demograpbic Pressure and Instability", July 1986.

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Name: Dallas F.S. Fernando

Title of Paper: Economic, social and political consequences the youth cohort has had and will have on societies: the case of Sri Lanka

Summary: This paper attempts to document the enormous problems the youth of age 15-24 have created for society by its size, growth and misfortunes during 1960-82. It uses data from the postwar censuses of 1946, 1953, 1963, 1971 and 1981. Due to the introduction of Free Education from the kindergarten to the University in 1945, the achievement of Independence in 1948, and the implementation of progressive programmes and policies by successive Governments in the areas of health, education and general welfare; the youths who were 15-24 at the 1963, 1971 and 1981 censuses grew up with tremendous optimism as to their future economic well-being. To appreciate their problems in proper perspective, their size and growth must be studied in the context of the severe and persistent economic crisis the island suffered between 1960 and 1982. By the latter year, she had only attained a GNP per capita of 320 U.S.$ and had grown at the average annual rate of only 2.6% between these years. It is assumed that the 15-24 age group approximately represents those entering the working ages. Annual additions to the numbers of potential young workers doubled between intercensal 1953-63 in relation to 1946-53. The doubling process was again repeated between 1963-71 in relation to 1953-63. Between 1946 and 1953, those of age 15-24 grew at 1.5%, this rose to 2.5% between 1953 and 1963 and then rocketed to 3.9% between 1963 and 1971. However, it abated to 1.8% between 1971 and 1981. Among the 15-19 olds, the unemployment rate catapulted from 19.7 in 1963 to 40.4 and 43.4% in 1971 and 1981 respectively. For those of age 20-24, it shot up dramatically from 16.5 in 1963 to 35.3 in 1971 and then fell slightly to 34.8% in 1981. The frustrations suffered by youth in their job hunting ventures compounded with political interference in securing suitable jobs demoralized their family members, relatives and friends and naturally spread to society at large. The intensity of youth frustration was so pronounced that it found political expression. The youth insurrection of 1971 - an uprising triggered off largely by unemployed youth - had an adverse impact on society and hindered to a great extent the sluggishly moving economy. The new market-oriented and liberalized economy initiated by the new Government in 1977 has given rise to accelerating inflation during 1978-82 and resulted in the perpetuation and accentuation of poverty. Among the 15-24 olds, the suicide rate rose steeply between 1963 and 1981. The severity of the impact youth misfortunes in the areas of unemployment, political interference in securing suitable jobs, drug addiction, crime and suicide has had on society could hardly be overstressed. In the light of growing economic, social and political instability, the impact youth problems will have on society is expected to worsen in the future.

Census Year	Youth of Age (15 - 24)	% of Total Population	Annual Changes in Absolute Numbers	Average Annual Growth Rate (%)
1946	1,322,185	19.9		
1953	1,471,316	18.2	21,304	1.5
1963	1,907,213	18.0	43,590	2.5
1971	2,630,652	20.7	87,690	3.9
1981	3,129,650	21.1	52,916	1.8

Name: Henk J. Heeren, University of Utrecht

Title of Paper: Youth Cohorts in the Netherlands: Cohorts or Generations?

Summary:

1. Figures on Five Year Birth Cohorts in the Netherlands over the period 1945-1985 do not show irregularities, except the 1945 baby boom. The decline sets in after 1965, reaches a low level with a TFR of 1.5 in 1980 and stays on that level. Projections made in 1987 show a slight increase, indicating that we may have reached a plateau. Conclusion: there is no specific large or small birth cohort in any year.

2. Some sociologists prefer to study generations instead of birth cohorts. Generations are clusters of birth cohorts, encompassing between 10 to 15 cohorts. They are united by common experiences as they move through time. The generation concept originated in Art History, has been elaborated sociologically by Karl Mannheim, and been reintroduced recently by Henk Becker. It has some interesting aspects for demographers, because it avoids the narrowness of the cohort approach, which is based on one-year age groups only.

3. The demographic question thus arises: can differences between generations be explained by demographic causes ? For instance, does the difference in size between a large and a small birth cohort offer some explanation for its experiences and encounters later in life ? Norman Ryder has discussed this issue and has offered evidence that large cohorts have at different times entered a school system that was not prepared to receive them. The result: insufficient attention to individuals, lowering of educational standards, the precipitate construction of new universities, and the expansion of the educational system in general. With the smaller cohorts, entering the universities in the 80's, the reverse is the case, and the educational system is in for shrinking operations.

4. Easterlin has advanced a hypothesis on the basis of cohort size:small generations entering the labour market in the late 80's were supposed to have better chances than the large ones that entered that labour market in the 60's and early seventies. This hypothesis does not hold for the Netherlands.This means that the difference in size between cohorts does not sufficiently explain the subsequent experiences of these cohorts on the labour market.
The Becker thesis in its essential form states that the differences between generations have become more pronounced, and social inequalities between these generations have increased. Each young cohort entering the labour market has more difficulty in finding employment than its predecessor. Hence the Lost Generation.

Name: GORAN PENEV

Title of Paper: SOCIAL AND ECONOMIC CONSEQUENCES OF DEMOGRAPHIC EXPLOSION IN KOSOVO (YUGOSLAVIA)

Summary:

The Yugoslav province of Kosovo (1.9 million of inhabitants) has the highest population growth (in 1987 the rate stood at 2,5%) and the youngest age structure in Europe (52% of the population is below the age of 2o and only 6.4% above the age of 6o). Kosovo is the least developed part of Yugoslavia and due to its unfavourable economic structure and a stron pressure of the generations of the working age entering the labour market it has high unemployment. The unemployment stands at 35% while the economic activity, in particular of women, is very low (in 1981 the overall activity rate was 23.9% and female activity rate was 7.6%). According to the population projections it is anticipated that during the 1986-2oo1. period aroud 465 thousand people will seek jobs in the non-acricultural sector of economy in addition to the 125 thousand currently unemployed. At the same time it is exprected that only loo thousand persons will cease to be active. The economy of Kosovo will not be able to provide over 45o thousand jobs in the forthcoming decade and consequently the unemployment problem will become increasingly acute. Solutions will be difficult to find at the national Yugoslav level due to the overall economic crisis and the low degree of spacial mobility of the Kosovo´s population.

Numerous, unfavourable social and economic consequences of the demographic explosion in Kosovo (severe social and economic problems of the youth, low status of women and slowdewn in the economic growth and the standard of life of the whole population) give rise also to political problems in the province and in Yugoslavia. This in particular due to the fact that higlt population growth in Kosovo is characteristic only for the ethnic Albanians resuting thus in ethnic homogenization of the province (the share of Albanians has increased from 65% to 8o% ower a 4o year period). There is also in increase in the lagging behind of this largest ethnic minurity group the Albanians in respect to the economic development of the rest of the Yugoslav population resulting thus is further intensification of ethnic conflicts in the country.

Name: P. Ramachandran & (Mrs).D. Usha Rani

Title of Paper: SOCIO-ECONOMIC AND DEMOGRAPHIC IMPLICATIONS OF YOUTH IN INDIA

Summary: Youth constitute a substantial and growing proportion of the Indian Population. It is estimated that the largest addition to the youth population (aged 15-24) will be during 1981-91 (44 million), while in the last decade of this century the net addition will be relatively small (18 million). The size of youth population will be 190 million in 2001. In the years to come it is estimated that mortality differentials by sex may narrow down and keep the sex ratio of youthful ages in reasonable limits. In India, mortality among youth is the lowest and females had higher mortality relative to males. Over the years, the age at marriage of youth was increasing. The literacy rate among the adolescents (aged 15-19) increased from 32 to 55 per cent relative to 33 to 52 per cent among the young adults (aged 20-24) during 1961-1981. In absolute size the illiterate youth were 21.2 million males and 35 million females in 1981. The work force participation rate (WFPR) have been declining in general. The results of the case study in South Central Andhra Pradesh in India are more or less consistent with thesocio-economic and demographic profile of youth based on census data. The analysis implicates that unemployment, availability of suitable jobs for the educated and spread of universal education are the most crucial problems faced by Indian youth. Indian Planners not only have to ensure higher employment opportunities for youth but also have to improve the quality of education which profoundly influence various socio-economic and psychological factorswith demographic import.

Name: Mesbah-us-Saleheen, A.H.M. Raihan Sharif,& S.M. Monzurul Huq

Title of Paper: The Present Trends of Youth Cohort and its Socio-economic Consequences in Bangladesh

Summary:

Bangladesh is one of the underdevelop countries which have overwhelming youth population. About 71.10 per cent of the population of Bangladesh belong to 10-29 years of age group. This characteristics of population exert impacts on the socio-economic condition of the country, which are manifested as unemployment problem, education problem, rural to urban migration and various other socio-economic and cultural problems. These problems jeoperdize the total socio-economic environment of the country.

The present study ~~study~~ aims to analyse the urban youth cohort, its trend vis a vis analysing the social and economic environmen--tal problems originated by the population within this cohort in Bangladesh. The study observes that the present socio-economic problems of the urban areas in Bangladesh are very much related to the demographic structure of the population, which is comprised mainly of youth population.

This study has two major implications, (1) determining the nature of the youth cohort in Bangladesh and (2) the effects of this cohort on the socio-economic system, which will in turn help to formulate proper planning to alleviate the problems of the urban areas in Bangladesh.

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7 October 1988

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