

CONFERENCE OF EUROPEAN STATISTICIANS

Eurostat/UNECE Work Session on Demographic Projections
organized in cooperation with Istat
(Rome, 29-31 October 2013)

**REPORT OF THE WORK SESSION
ON DEMOGRAPHIC PROJECTIONS**

Draft

I. Attendance

1. The joint Eurostat-UNECE Work Session on Demographic Projections was held in Rome (Italy) on 29-31 October 2013, at the invitation of Istat – National Statistical Institute of Italy. It was attended by participants from national statistical offices, demographic research institutes, universities, and other institutions representing the following countries: Austria, Belgium, Canada, Croatia, Czech Republic, Denmark, Estonia, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Republic of Korea, Latvia, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States of America. The European Commission was represented by Eurostat. The United Nations Population Division, the Kosovo Statistical Agency, the Wittgenstein Centre for Demography and Global Human Capital (IIASA, VID/ÖAW, WU) were also represented.

II. Organization of the meeting

2. Mr. Saverio Gazzelloni (Istat), Mr. Eduardo Barredo Capelot (Eurostat), and Mr. Paolo Valente (UNECE) opened the meeting and welcomed the participants.
3. The meeting adopted the agenda of the work session, and elected Ms. Marianne Tonnessen (Statistics Norway) as Chairperson.
4. Keynote lectures were given by Mr. Nico Keilman (University of Oslo) on “Probabilistic demographic projections”, and Mr. Tommy Bengtsson (University of Lund) on “Population Ageing - A Threat to the Welfare State?”.
5. The meeting included sessions on the following substantive topics:
 - a) Assumptions on future migration
 - b) Assumptions on future mortality
 - c) Actual and potential use of demographic projections at national and international level
 - d) National and international population projections out of the EU region
 - e) Assumptions on future fertility
 - f) Stochastic methods in population projections
 - g) Household projections
 - h) Demographic sustainability and consistency with macroeconomic assumptions

- i) Bayesian approaches (1) and (2)
 - j) Multiregional projections
 - k) Beyond population projections by age and sex: inclusion of additional population characteristics
 - l) Population projections by age, sex and level of education
5. The following participants and members of the Scientific Committee acted as session chairs: Mr. Valerio Terra Abrami (Italy) for topic (a) and (j), Ms. Graziella Caselli (Italy) for topics (b) and (e) (1), Ms. Maria Graça Magalhaes (Portugal) for topics (c), and (e), Mr. Giampaolo Lanzieri (Eurostat) for topic (d), Ms. Rebecca Graziani (Italy) for topics (f) and i) (2), Mr. Marco Marsili (Italy) for topic (g), Ms. Elisabetta Barbi (Italy) for topics (h) and (k), Ms. Anne Clemenceau (Eurostat) for topic (l).
6. The discussion in the substantive sessions was based on 50 papers, that were available on the meeting web page (<http://www.unece.org/stats/documents/2013.10.projections.html>) maintained by the UNECE Statistical Division. Presentations will be made available on the same web page shortly after the meeting. A summary of the discussion in the substantive sessions, prepared after the meeting, is presented in an annex to this report.

III. Conclusions

7. The participants recommended that the next meeting take place in about three years time. A list of possible topics for discussion is as follows:
- a) Assumptions on future migration
 - b) Assumptions on future mortality
 - c) Actual and potential use of demographic projections at national and international level
 - d) National and international population projections out of the EU region
 - e) Assumptions on future fertility
 - f) Stochastic methods in population projections
 - g) Experiences on how the results of projections are presented to and accepted by the users
 - h) Household projections
 - i) Demographic sustainability and consistency with macroeconomic assumptions
 - j) Bayesian approaches
 - k) Multiregional projections
 - l) Beyond population projections by age and sex: inclusion of additional population characteristics
 - m) Projections and National Transfer Accounts (NTA)
8. The participants expressed their great appreciation to the members of the Scientific, Organizing and Coordination Committees for their work, and to Istat – National Statistical Institute of Italy - for hosting the meeting and providing excellent facilities.

IV. Adoption of the report of the meeting

9. The present report of the meeting was adopted during the closing session.

ANNEX.
SUMMARY OF THE DISCUSSION ON SUBSTANTIVE TOPICS

Item 4. ASSUMPTIONS ON FUTURE MIGRATION (Chair: *Valerio Terra Abrami*)

1. Jean Louis Rallu (INED-France) developed a model to project return migration of aging foreign born immigrated population. Although the migration component is very difficult to forecast, projections of ageing immigrants are more reliable because at older ages migration is much smaller and most of future elderly migrants are already in country.

2. In the population projection model of Statistics Sweden (Adreas Ranke), immigration and emigration are broken down by seven different groups of country of birth (background), which Swedish-born persons are one out of. A specific group of Swedish-born Living-abroad persons is created (using historical administrative data) to complete the immigration-emigration based model. The model has been further developed by adding the background (parent country of birth) of Swedish-born Living-abroad group in order to verify its impact on projected return migration.

3. Projecting international migration involves intrinsically more uncertainty than projecting the natural components due to the unpredictability of many external factors (like the influence of high economic instability). The traditional deterministic models, setting variants in the medium and long-run, are not able to face such instability and do not provide prediction intervals for the forecasted variants. On the other hand, classical regression type models are not reliable due to the auto-correlated and non-stationary character of the time series involved in migration processes. Statistics Iceland (Violeta Calian) applies from 2011 dynamical, or auto-regressive distributed lag (ARDL), models that incorporate auto-correlation and non-stationarity in the model, in order to obtain short time predictions for the number of immigrants/emigrants of Icelandic and foreign citizenships as functions of several time series predictors: unemployment, change in GDP values, number of graduating students and dummy variables mirroring the EEA resizing in time and the Icelandic economic boom which ended in 2008.

4. Before the discussion opening, it has been briefly summarized the contribution of DREAM (Danish Rational Economic Agents Model, Marianne Frank Hansen), that could not have been presented in the Session. During the past decade an increase is being observed in immigration, leading to a shift in the pattern of residence permits, which are recently being granted mostly for work or study reasons, rather than for asylum and family reunification. The former residence permits are associated with a duration of stay shorter than the latter, resulting in a corresponding shift in the composition of the immigrant population by duration of stay. Thus migration rates, currently estimated for 10 different origin groups, have been further broken down by duration of stay (five year-groups of duration), taking into account the inverse relation (the shorter duration, the higher propensity) between duration of stay and propensity to return migration. Finding that a shift in immigration behavior severely challenges projection accuracy when taking duration into account, it is suggested that duration dependent re-emigration should be used with caution.

5. In migration projections, the variable country-of-birth may be considered as the most explicative, especially when considering return migration, that is emigration of foreign-born population to their country of origin. In the projection exercises of France, Sweden and Denmark, taking into account this variable leads in principle to improve accuracy of population projections. Different solution for clustering the origin-groups have been chosen in the three cases mentioned above, also according to the different history and time-patterns of the related immigration. Sweden takes into account the further break down by Swedish- and Non-Swedish-born persons, while Denmark use Danish and Non-Danish citizenship. The inclusion of further breakdown variables, like background (country of birth of parents) of born-in-country persons or duration of stay of foreign born, seems less promising, at the current stage of investigation. On the other hand, the more immigration from different groups of countries tends to become stable, the more country of origin tends to be correlated with duration of stay and in this cases migrant population aging process tends to become more and more relevant for the aging of the whole population.

6. The use of dynamical ARDL (auto regressive distributed lag) time-series models, presented by Iceland, seems a promising approach to incorporate short-term migration projections in the first 5 years of the forecasting horizon,

into the classical cohort component model to project migration, as well population itself, at mid- and long-run. On the other hand, while ARDL models are an ideal solution to incorporate macroeconomic aggregates, like GDP, into short-term projections of net and gross migration flows, their use should never be done automatically, but carefully taking into account the specific situation of past trends used to feed the models.

Item 5. ASSUMPTIONS ON FUTURE MORTALITY (Chair: *Graziella Caselli*)

7. The paper by Portugal explores the presence of cohort effects as a possible reason behind the structural changes. They make use of several model specifications, namely the classical log-linear age-period-cohort (APC) model as well as more complex models with age-period and age-cohort interactions. A simulation study allowed them to understand the impacts of ignoring important features in mortality modeling.

8. In the Korean paper, the authors examine how to overcome the shortage of historical data on mortality at the older ages (75+) and to find the best model for forecasting Korean mortality. Four stochastic forecasting models are fitted to the period from 1970-2010 and the forecasts (2060) are compared to actual mortality for that period. The results of this evaluation show that the Coherent Lee-Carter Model is consistently more accurate in forecasting Korean mortality than other compared models.

9. The French paper explores a different approach to disaggregation (i.e. mortality by cause) and combination. The $d(x)$ values by cause are converted to log-ratios with a common denominator for each period across all decrements. It can be shown that, because of the unit sum constraint, the results are independent of the value chosen for the common denominator and the original values can always be recovered by back-transformation. Once the death densities have been transformed into the real space, the full range of multivariate statistics can be applied. In this paper, both singular value decomposition and regression are employed to obtain forecasts.

10. Finally, in the Swedish paper the authors show that the LC-model is suitable in forecasting Swedish women's mortality but not as suitable for men's mortality. The predicted mortality change in men differed by length of the base-period, in particular at ages 65 years and over. Findings also suggested that LC-models incorporating all ages 0-100 years tend to underestimate the mortality decline in age groups 50 and older as compared with the simple age-specific trend.

11. In the discussion it was noted that the four papers drew attention to some of the more controversial points in mortality forecasts: a) the importance of the choice of the most suitable for interpreting past (and, hence, also future) development of mortality; b) the reference period used for fitting the model; c) the need to take the cause of death into consideration.

12. No one has paid attention to setting a target for the future evolution of mortality in terms of life expectancy, with reference to the most recent debate on behavioral, social and environmental risk factors and the limits of human survival.

13. Two presentations considered the importance of having a good knowledge of epidemiological processes for improving understanding of the development of life expectancy at different ages, with particular reference to adult and ancient ages.

14. None of the forecasts, projecting male and female mortality independently, paid attention to the future decrease in gender differences in life expectancy. Some comments have suggested this important decrease will be controlled, considering that men reduce their disadvantage no further than the strict minimum imposed by biology.

Item 6. ACTUAL AND POTENTIAL USE OF DEMOGRAPHIC PROJECTIONS AT NATIONAL AND INTERNATIONAL LEVEL (Chair: *Maria Graça Magalhães*)

15. The Netherlands has presented the main results from the 2012 stochastic population projections, which have considered a new mortality projection model, developed in collaboration with the University of Groningen. This new mortality projection model meets better to requirements as those resulting from the indexation procedure of the pension age to life expectancy, recently implemented, where future increases in life expectancy would automatically result in adjustments of the pension age.

16. Portugal (WP 6.2) has presented a set of population projections, where three alternative scenarios has been developed. Focusing in the potential future student enrolment in higher education, they found out that the number of young people in Portugal will decrease significantly in the next 25 years. Considering that the demand of higher education in Portugal will be strongly influenced by this trend, these results should lead to informed policy decisions, namely to support a redefinition of the national higher education institutional network.

17. Portugal (WP 6.3) presented an application of seasonal forecasting methods to model national and regional birth and deaths data as inputs to a calendar quarter sample population to LFS, since the needs of data are incompatible with the current production of annual population estimates. In order to capture the seasonal behaviour of the data, three alternative methodologies have been considered: ARIMA models with a seasonal component, Holt-Winters exponential smoothing models, and state-space models. The methodology that provides the best forecasting performance for the majority of the regions is adopted.

18. In the discussion, questions were raised to clarify some aspects of the pension system in The Netherlands, which is based on two “pillars” and therefore different from other countries.

19. Considering the application of the projections results as input to support a redefinition of the higher education network, it was suggested to enlarge the scope of analysis to other age groups, namely because educational systems are not equal across countries.

20. Although the application of seasonal forecasting methods was only apply to births and deaths, it was questioned what is done with the migratory component and was briefly explained.

Item 7. NATIONAL AND INTERNATIONAL POPULATION PROJECTIONS OUT OF THE EU REGION (Chair: *Giampaolo Lanzieri*)

21. Georgia presented two contributions. The first presentation stressed the importance for projections of good quality input data and drew the attention on the deterioration of population, vital events and migration statistics in Georgia since its independence in 1991. The second contribution presented assumptions and main results of the latest projections exercise for the population in Georgia.

22. Israel presented its experience of estimation of size and vital events of a population sub-group (the Haredim), relevant for policy purposes, in order to analyse their demographic dynamic projected in the long-term. This exercise required some restrictive assumptions, but highlighted the usefulness of a disaggregation by population sub-groups in population projections.

23. In the last presentation, Netherlands reported on a projections exercise concerning the South and East Mediterranean Countries (included in the European Neighbourhood Policy of the European Union) based on population and development scenarios and distinct migration system. This work showed how these

countries may experience different demographic changes compared with EU Member States and, in particular, addressed issues of labour migrations.

24. During the discussion, questions were addressed on the latest population census in Georgia as source of emigration data for that country, in particular enumerating the persons absent from the households for more than one year. Although this is not a recommended practice at international level, it is one of the tools countries with important lacks of emigration data sometimes adopt.

25. The input data quality was mentioned as one element which should enter in the overall evaluation of the uncertainty of projections, in particular as regards the population base. This may become even more relevant when population sub-groups are explicitly taken into account in the projections computations.

26. It was also noted that the use of scenarios, while fundamental for the users' comprehension of the rationale behind the projections assumptions, may still lack an explicit link to the quantification of the assumptions. In fact, although based on the qualitative arguments there may be a general agreement on the future direction of a demographic component, the actual size of the projected population will depend on quantitative assumptions whose exact values may be defined almost arbitrarily.

Item 8. ASSUMPTIONS ON FUTURE FERTILITY (Chair: *Maria Graça Magalhães*)

27. Austria (WP 8.1) presented a study that aims to improve understanding of the role of different ingredients of fertility projections through a comparative analysis of importance of model choice and of the three main fertility parameters (TFR, MAB, and SDAB) in projecting the number of births.

28. Sweden presented a paper with two studies based on analysis using logistic regression on register data of all children in Sweden living with their biological parents 1999–2011 and register data of all children born in Sweden from 1970. Results show that percentage of children who experience a separation of their parents have decreased during the 2000s and that higher levels of education and postponement of family formation are two explanatory factors of the declining impact of stepfamily fertility.

29. Previous fertility projections for Austria have considered linear increase on TFR and MAC until a certain time horizon and held constant for the rest of the projection period. Those sudden stops may cause inconsistencies due to the model of tempo-adjusted fertility. To overcome the explained inconsistencies, Statistics Austria (WP 8.3) reformulated its fertility assumptions for the new population projection in a more consistent framework of TFR, TFR* and MAC, using a modified Hadwiger function that estimate age-specific fertility rates by four parameters: TFR, MAC, the mode and the variance of the fertility distribution.

30. In the discussion, reference was made to different results that may emerge when considering different populations in the analysis of the indicators used to test the models.

31. The role of changes in variables such as gender equality with fertility behaviour, particularly in terms of projections, was discussed.

32. It was discussed the pertinence of ensure the convergence of fertility indicators at sub national level and the possibility of being adding uncertainty to projections by adding regions results.

Item 9. STOCHASTIC METHODS IN POPULATION PROJECTIONS (Chair: *Rebecca Graziani*)

33. The presentation by the University of California focused on the use of Hamilton-Perry model for deriving stochastic forecasts of population based on the forecasts of cohort-change ratios. The method is applied for projecting the population of the states of Georgia, Minnesota, New Jersey and Washington. Forecasts 10 year ahead are produced using as starting year the census years from 1900 to 2010.

34. The presentation by University of Rome focused on the use of Bertino and Sonnino method for the derivation of stochastic forecasts of the population of Rome Metropolitan Area, from 2009 to 2024. The method is used on micro-simulations of birth-death-emigration-immigration poisson processes. Three variant are considered based on different assumptions on fertility and immigration.

35. The presentation from Statistics Canada discussed an application of its microsimulation projection model Demosim aiming at assessing the possible future composition of the Canadian population with respect to the immigrant generation status. A new immigrant generation status is defined and mixed unions are explicitly considered.

36. The presentation by the University of Southampton discussed a semi-artificial model of population aiming at providing a bridge between micro-simulation and the agent-based approach. An extension of the 'Wedding Ring' agent-based model of marriage formation by Billari et al. 2007 is extended and a Gaussian emulator is used for analysing uncertainty.

37. During the discussion the distinction between sources of uncertainty was emphasized particularly with respect to the demographic stochasticity and the environmental stochasticity.

38. Clarifications were asked on the Demosim model, the specification of the rates of the Poisson processes used within the Bertino-Sonnino model and the sources of uncertainty in the agent-based model suggested by the University of Southampton.

39. The use of the model suggested by University of Rome in the framework of the analysis of transportation was suggested along with the consideration of spatial dependency of the forecasts.

Item 10. HOUSEHOLD PROJECTIONS (Chair: *Marco Marsili*)

40. Spain presented a methodology for the revision of household estimates for the latest intercensal years, which provides figures linked to the official demographic estimates. As regards the future households system account, Spain also presented his strategy based on a continuous census system approach, with the aim of producing now-casts on the number and type of households.

41. The main results show that Spain experienced a big increase in number and type of household at the beginning of the XXIst century, with an impact even bigger than the one in population. The number of households has grown in 3.7 million between 2002 and 2012. During the same period, the population residing in Spain has increased in 5.8 million. Single households or households inhabit of two persons show the highest increase. The number of households of three or four members show a slight increase. Households with more than four members have experienced a deep fall.

42. Belgium presented a household projection model calibrated on the Belgian population projections at the nuts 3 level. The model is based on individual membership rates, as defined through 12 LIPRO positions, and allows taking into account the living arrangements of each individual in the population. The membership rates are not taken constant in the projection. They follow a logistic or logarithmic trend. The

proposed method is static in the sense that the transition probabilities from one position within the household to another are not considered. Some consistency rules are implemented (as equal number of married men and of married women) while local heterogeneity is maintained in the whole process.

43. While most of the positions face an increasing trend up to 2060 in Belgium, the numbers of married individuals with children and of children within a married couple decrease by 30% and 24% respectively over the period 2011-2060. The number of married individuals without children increases by 14% in 2060 compared to 2011. The number of individuals within non-consensual unions and one-person families increases between 2011 and 2060, up to 77% for the number of children in families with cohabiting parents.

44. Projections of individuals in collective household are treated separately from projections of private households, to prevent an explosion of the former, in a context of a strong population ageing. The results show an increase of individuals in collective Belgian households by 111% in 2060.

45. Italy presented an original procedure that combines official statistics with data from ad hoc surveys conducted on migrants in recent years. The proposed model aims at estimating both the extra demand for caregivers of the elderly and the possible supply of migrants in the future.

46. Home caregivers are expected to be recruited particularly among immigrants, due to the lack of supply among the younger Italian generations. As a consequence of social, economic and demographic implications, the demand for caregivers for the elderly in Italy seems to increase significantly in the future. Anyway, the additional demand for caregivers due to the rise in numbers of elderly people over the next years will decrease. The extra demand for home caregivers will be expressed mainly by men, persons aged 65 and over and especially those living alone.

Item 11. DEMOGRAPHIC SUSTAINABILITY AND CONSISTENCY WITH MACROECONOMIC ASSUMPTIONS (Chair: *Elisabetta Barbi*)

47. Portugal presented the possible challenges that the country will have to face in the next future given its low level of fertility and the deep economic crisis which will very likely lead to a massive outmigration. The tremendous evolution in the Portuguese population, estimated by a medium-term projection, highlighted the urgent need of planning equipment and resources directed to the elderly.

48. Spain presented a model integrating labour market scenarios in population projections. The approach takes into account the impact of the labour market on population through changes in the employment rate and in the immigration flows. The model is applied to five European Union countries and results are compared to the most recent Eurostat population projection of 2010. With a declining working age population, immigration emerges as the only way to allow for economic growth, especially in countries where employment rates are already high and have little margin for further increase.

49. Poland presented an alternative method of preparing migration assumptions in population projections which takes into account long-term projections of economic variables. Results for selected EU countries show that differences in unemployment matters in short-term forecasts whereas in the case of long-term forecast it is difficult to identify a universal model and explanatory variables.

50. In the discussion, it was noted that it is important to distinguish between receiving and sending countries: In the short term, unemployment is a relevant factor for sending countries whereas, for receiving countries, this can assume an important role in the long-term.

51. Economic crisis highlighted the role of economic factors in flows and direction of migration. However, while preparing demographic assumptions for population forecasts, the impact of economic crisis on mortality should also be considered, especially for the elderly segment of the population.

52. The urgent need of planning a common migration policy among EU countries was also highlighted in the discussion.

Item 12. BAYESIAN APPROACHES (1) (Chair: *Graziella Caselli*)

53. In the paper by the University of Southampton, the authors explore for the United Kingdom in 2010-2030 the functional modeling approach to population forecasting within the wider context of Bayesian predictions and model uncertainty. They conclude that given the regularities in age profiles of fertility, mortality and migration, disaggregating of the relevant data by age and sex provides important additional information for the forecasts.

54. In “Towards stochastic forecasts of the Italian population: an experiment with conditional expert elicitations” (WP.12.2), the authors report on the whole process developed to produce an expert-based stochastic forecast of the Italian population for the period 2011-2065, applying the method proposed by Billari et al. (2012). Authors discuss the problems that can arise in the collection of expert opinions and the solutions that can be implemented in order to avoid inconsistencies in the calculation of the parameters.

55. In “Expert-based stochastic population forecasting: a Bayesian approach to the combination of the elicitations” (WP12.3), authors suggest a method that derives expert-based stochastic population forecasts in such a way as to account for relationships both between demographic components and between experts. Starting from so-called Supra-Bayesian approach, introduced by Morris, the authors suggest resorting to a mixture model approach. An application to the forecast of the Italian Population from 2010 up to 2065 is proposed.

56. Referring to the first presentation, the authors’ attention was drawn to some important points, i.e., when a forecast is based on the hypothesis that past trends will continue into the future, it is crucial to define not only the method used to estimate trends, but also the length of the data series involved, and the year selected to start the forecast. These choices greatly influence the final outcome, so much so that they overshadow even the efficacy of more sophisticated methods.

57. The processes developed to produce expert-based stochastic population forecasting were much appreciated, as was the Bayesian Approach to the Combination of the Elicitations. The wide-ranging debate that followed strongly suggested that the authors should increase the number of experts and reconsider *ex post* the various responses received, improving them with the suggestions of some experts chosen on the basis of their deep knowledge of each specific demographic phenomenon.

Item 13. BAYESIAN APPROACHES (2) (Chair: *Rebecca Graziani*)

58. The first presentation by the University of Washington (WP 13.1) discussed a method for deriving stochastic forecasts of Net Migration Rates. A bayesian hierarchical model is fitted to past data for all countries of the world and the forecasts of net migration are calibrated so to ensure the respect of the requirement of zero global net migration. An evaluation of the method is provided using an out-of sample validation.

59. The second presentation from University of Washington (WP 13.2) provided a detail description of four R packages implementing the methodology used by UN for the derivation of probabilistic projections for the population of all countries of the world.

60. The presentation by the University of Rostock discussed a Bayesian method for deriving stochastic forecasts of mortality for several European countries, based on the forecast of rates of mortality improvement. In-sample and out-sample forecasts were provided.

61. During the discussion it was emphasized the need of considering the role of politics in shaping the future changes when making projections along with the relevance of the communication of the results.

62. It was emphasized that the correlation between age and time has to be considered in the forecast of Net Migration.

63. The flexibility of the R packages was discussed with respect to several aspects as the incorporation of different age-schedules and consideration of the two phases in the description of behaviour of the Total Fertility Rate.

Item 14. MULTIREGIONAL PROJECTIONS (Chair: *Valerio Terra Abrami*)

64. International projection-making agencies (UNPD) commonly use simplistic assumptions of net-migration measures derived as residuals from demographic accounting. On the other hand, the rise in influence of migration on demographic change is likely to increase and to spread to more countries, while fertility and mortality rates keep on decreasing in the developing world. Thus net migration measures are becoming more and more inadequate to face the challenge of projecting migration at global level. VID and WCD (Guy Abel, Vienna) propose their “flows-from-stock” method to estimate global bi-lateral migration, preserving the constraint that the estimated migration flows in a period $[t-(t+n)]$ match the change in migrant stocks from t to $(t+n)$, thus ensuring that the total inflows equal the total outflows.

65. Subnational population projections of Turkey (Sebnem Bese Canpolat) have been officially produced first in 2013 up to the year 2023 (centenary of the Republic of Turkey) and released for the 81 Turkish provinces. Important improvements have been made in terms of basic data availability and quality, incorporating in these new projections data from the recently developed ABPRS (Address Based Population Registration System) and the former CCRS (Central Civil Registration Registration System). The outcomes show that Turkish population will reach around 84 million in 2023, as a result of an increase in 61 provinces versus a decrease in 21. The “dream” of 100 million people will never be reached.

66. Statistics Canada (Patrice Dion) has a longstanding tradition, since 1984, in producing population projections of Provinces by using the multiregional model, in the classical cohort-component frame. The multiregional model has many advantages, among them those of allowing to project simultaneously a multiregional system as a whole and of allowing to apply the out-migration rates to the corresponding population at risk. Nonetheless, the multiregional model has the basic limitation that migration flows are determined only by out-migration rates and origin-region size, while in reality migration is destination-driven, thus flows tend to vary in proportion to both regions of origin and destination. Statistics Canada proposes the NMRP (net migration rate preservation) model, in which origin-destination migration rates are corrected by a composition ratio allowing to account for the size of the destination-region, as a proxy of the attractiveness factors driving migration flows.

67. Scalone and Greco (University of Bologna) propose a statistical method to forecast age-specific mortality rates for the Italian provinces (NUTS-3) by combining Lee-Carter model and Bayesian approach. In general, relatively small and closely related populations have similar mortality patterns that do not diverge in the long run, thus standard mortality forecasting poorly performs, when working on single limited small areas separately, especially considering some specific (five-year) age-groups, resulting in large variance residuals. In order to overcome this problem, a spatial-temporal extension of the classical Lee-Carter model is presented, in which areal estimates borrow strength from each other introducing spatial association of provincial mortality rates.

68. When projecting a multi-areal population system, the major problems arise in data availability and in the assumption setting process, especially when the number of the areas of the system is relatively high or/and the average population size of the areas is relatively small, resulting in a number of demographic events very small accordingly. Although this applies as well as to both mortality and fertility, difficulties are much bigger for migration component, whose assumption setting process, and projection process itself, is heavily affected by lacking or volatility of data. When data availability is scarce, handling net migration is often the only possibility to set assumptions. In these cases, there is not a real possibility to set solid and reliable migration assumptions, only provided that estimation and correction methods are incorporated in the projection model.

69. On the other hand, when data availability is rich or full, migration rates may be incorporated in a multiregional model, that however requires a number of correction and/or aggregation procedures, the smaller the average population size of the areas is. In these latter cases, migration assumption setting step may well performs only if the methodological handling of “data-dusting” is suitably calibrated (aggregation procedures) and if the nature of internal migration, that is substantially destination-driven, it is adequately taken into consideration. In fact full multiregional models, although lead to intrinsically consistent results, neglect completely the destination pull-factors, because age-specific out-migration flows result entirely from the action of out-migration rates on the origin area population vector. This leads to conclude that full multiregional models should be suitably balanced by incorporating correction procedures in order to guarantee both push- and pull-factors that, in the real life, shape migration flows and that these correction procedures must be adapted to the specific situation of the areal system to project.

Item 15. BEYOND POPULATION PROJECTIONS BY AGE AND SEX: INCLUSION OF ADDITIONAL POPULATION CHARACTERISTICS (Chair: *Elisabetta Barbi*)

70. Belgium presented an analysis of changes in income distribution and inequality between 2011 and 2031 in Flanders showing how these changes are related to population changes. Assuming absence of economic progress, the authors demonstrate that the relation between population changes and the income distribution involves different components that may act in different directions. Ageing has a negative impact on the income distribution and inequality but other covarying population characteristics, namely household composition and education, may have a counteracting effect on income.

71. Canada presented how the Canadian immigrant selection policy may have an impact on future imbalances in labour force supply by broad skill levels (WP 15.2).

72. A second presentation by Canadian researchers (WP 15.3) presented the results of a microsimulation model projecting language characteristics in multilingual regions with high immigration. Results show that immigration has a much larger impact on the linguistic equilibrium of a multilingual region like Quebec than in a largely monolingual region like the rest of Canada. The estimated increase in the proportion of

people having a non-official mother tongue calls for increasing investment in language training in order to maximize their contribution to the country's future prosperity.

73. Spain presented a new method for projecting economically active population. The model is a cohort parametric model, which is based on cohort changes of women's willingness to work and explicitly models the convergence process of female activity rates towards those of men. Results of the projection show that pure-demographic ratios on dependency and sustainability might be misleading highlighting thus the importance of economically active population projections.

74. In the discussion it was noted that, in periods of economic crisis, the convergence between male and female labour market behaviours may be caused not only by a cohort effect, with younger generations of women showing an increasingly similar behaviour to that of men, but it may be also affected by a period effect, namely the economic collapse, with men showing more difficult labour-market behaviours which are close to those experienced by women.

Item 16. POPULATION PROJECTIONS BY AGE, SEX AND LEVEL OF EDUCATION (1)

(Chair: Anne Clemenceau)

75. All papers presented in this session were prepared by the Wittgenstein Centre for Demography and Global Human Capital in Austria

76. Wolfgang Lutz, the Founding Director of the Centre, presented a new, scientific based approach to help defining assumptions on fertility, mortality and migrations. The approach is based on an evaluation of 500 international expert views.

77. Anne Goujon summarised the assumption making process for the global population projections by levels of education to be released by the Wittgenstein Centre in 2014. These projections are specific as they include educational attainment on a systematic basis and scientific input of hundreds of source experts are taken into account for the assumptions about future trends in fertility, mortality and migration.

78. Nikola Sander presented a new set of population projections carried out using directional migration probabilities and with the addition of the education dimension into a multi-regional cohort-component framework. The projections do not confirm the common perception of a rapid increase in the number of migrants and suggest a shift in the education composition of migrants toward higher level of education attainment.

79. The discussion highlighted that while differentials in education are clear for mortality, the issue is more complicated for fertility. Sensitivity of the results to assumptions and assessment of the performance of the projections were also discussed.

Item 17. POPULATION PROJECTIONS BY AGE, SEX AND LEVEL OF EDUCATION (2)

(Chair: Anne Clemenceau)

80. Bilal Barakat presented his paper on estimating transition age schedules for long-term projections of global education attainment. The approach consists of first fitting a model of educational development trajectories to the empirical development of attainment over the course of recent decades; and then projecting attainment by extending these trajectories into the future.

81. Samir K.C's presentation focussed on the results of new population projections by age, sex and level of education for 171 countries showing that the world population would peak in 2070 and that a significant increase in the average educational attainment of the world population would take place. The paper also includes alternative education scenarios using two approaches to measuring ageing (conventional approach based on chronological age and alternative approach that takes life expectancy into account) and concludes that population ageing over the 21st century is less rapid when using the alternative approach.

82. Elke Loichinger presented labour force projections by age, sex and highest level of educational attainment based on data from the EU Labour Force Survey for 26 Member States. The paper shows that the labour force in Europe is likely to be older, and to contain a higher share of women, and will overall be composed of people that are on average higher educated than today.

83. The issue was raised among participants whether the projects were to be considered as forecast projects or more as analytic projects to alert policy makers. Clarification was required on the output of the first paper and explanation about the diverging results compared to the US World Population projections was asked for the second paper.

84. For the Labour force projections, taking account of the skills which associated with education increased after the age of 30 and of the retirement age of each country was recommended.
