



Bridging the micro-macro gap in  
population forecasting

Contract no. SP23-CT-2005-006637

**Deliverable D14**

An analytical summary of the current practices of  
definition of assumption making in population  
projections

Work Package 3  
Uncertainty, expert knowledge

April 2006

Authors:  
Isolde Prommer and Chris Wilson



International Institute for  
Applied Systems Analysis  
Schlossplatz 1  
A-2361 Laxenburg, Austria

Tel: +43 2236 807 0  
Fax: +43 2236 71313  
E-mail: [info@iiasa.ac.at](mailto:info@iiasa.ac.at)  
Web: [www.iiasa.ac.at](http://www.iiasa.ac.at)

# Summary of the questionnaires on the use of expert opinions in assumption making for population projections

*Isolde Prommer and Chris Wilson*

## Introduction

Assumptions drive projections. The arithmetic of making cohort-component population projections has essentially been unchanged since Edwin Cannan proposed it in 1895. However, the way in which demographic forecasters make their assumptions concerning future trends in fertility, mortality and migration is always potentially changing. The report reviews the current practice of statistical agencies in Europe (EU-25) for defining the fertility, mortality and migration assumptions in population projections and draws preliminary conclusions from the review. Perhaps the most significant discovery is that all national statistical offices that replied to a questionnaire on this topic agreed that there is need for improvement in the methods used to make assumptions. In particular, the offices charged with making population projections would welcome more structured interactions with the demographic research community. The work being carried out within the MicMac project is, therefore, both timely and important

## The Questionnaire

As one of the first steps of the European Union funded project entitled ‘*MicMac – bridging the micro-macro gap in population forecasting*’ the project collected information on the current use of external experts in defining fertility, mortality and migration assumptions. The national statistical offices (NSOs) of the European Union countries were asked to provide information on what had been done during the production of the *most recent* population projections. Each office received a questionnaire from Eurostat – designed by the International Institute for Applied Systems Analysis (IIASA) – and 21 out of 25 national statistics offices returned the completed questionnaire by late November 2005. In addition to pre-set answers to the 12 questions, the questionnaire provided space for open-ended comments on each question. Open-ended comments are given below as quotes, with no editing. In this report, all comments remain anonymous.

The aim of the questionnaire was to assess the current status of expert involvement and methodology in making population forecasts by the national offices. The second aim of the questionnaire was to evaluate what future improvements could be made in the process by which experts contribute to the definition of assumptions in population projections.

## Main Results

The majority of the offices indicated that they generally use three future pathways for fertility, mortality and migration; some used only one or two. Only one office used stochastic methods to project future population. The most common approach is to create scenarios that cover a “plausible” range. The involvement of external experts and meetings are clearly important, but there is a marked gap between “old-15” and “new-10” member states. If there are problems in finding a consensus on values, most offices make in-house decisions after consulting the experts. Three offices commissioned scientific studies from outside experts for

the explicit purpose of helping with the definition of assumptions (though one of those does not publish its own forecasts).

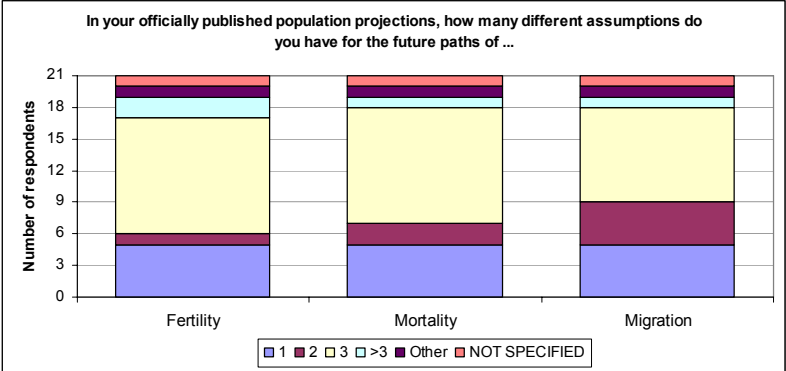
Error analysis of past assumptions is also important. The decision to carry out either a systematic or a more qualitative analysis of past errors splits the respondents into two groups. However, no statistical office provided a description on the methodology they use for the error analysis. Half of the respondents define storylines (either combined for the three components of change, or for each component separately) behind the assumptions. The other offices do not discuss storylines.

All national statistical offices agreed that there is need for improvement in the methods used to make assumptions. Generally speaking, improvements in networking and in advancing the conventional methodology of scenario-based forecasts seem to have priority. The introduction of stochastic/probabilistic forecasting methods is not a high priority for most offices. It is not clear, however, if the slow pace of adoption of stochastic/probabilistic forecasts is to do with scientific criteria, or is simply due to the non-availability of human resources with the appropriate knowledge of the methodology. But there is evidence of lack of human resources as three offices explicitly stated in question 12.

Each question is now addressed in turn.

**Question 1. In your officially published population projections, how many different assumptions do you have for the future paths of fertility, mortality, and migration**

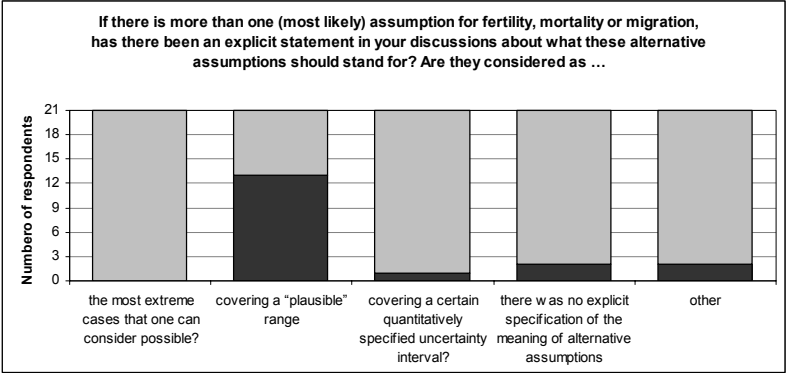
The majority of the statistical offices use the “scenario” design for the definition of the assumptions of the future paths of fertility, mortality, and migration. That means that the forecasters project the future population by defining at least one development path of future fertility, mortality and migration. This is commonly known as the “best-guess” or “most-likely” development. Roughly half of the central statistical offices prepare three different paths for each variable: fertility (52%), mortality (52%), and migration (43%). The second most common situation is that the NSOs use only one future path of each indicator; this is the case for five statistical offices. Two NSOs generated two different future developments for fertility, two NSOs for mortality, and four offices for migration. Generally speaking, the 3-3-3 version is most common, but there are some NSOs that use the 3-2-2, or the 3-1-1 composition. Only one statistical office identified more than three possible future developments of mortality and migration, while two offices do so for fertility. Using stochastic population projections methods is still rare among the central statistical office; only one institute stated that they use stochastic forecasting. Finally, one national statistical office replied that it did not officially publish projections and therefore it uses the projections published by Eurostat.



The open-ended comments give us more insight how these assumptions are used in the projections. One statistical office – that answered with a 1-1-1 assumption – “produces demographic trend-calculation projection by using the so-called demographic component model, and does this so for all municipalities”. One office made national and regional projections for the “low-central, and high hypothesis” in their latest projections. For another, the latest projections “were centred on the ventilation of those perspectives at the NUTS-3 level and calibrated them only on the former central hypothesis”. Another office uses the 1-1-1 assumption hypothesis for the short-term projections, but included two migration scenarios for the long-term projections. Another NSO published the Eurostat baseline projection as the national variant, and therefore the answers in this questionnaire refer only to the procedures that took place during the discussion and harmonization of the assumptions for the three variants of population projections regarding fertility, mortality and migration for 2004 to 2050. One NSO that answered that they use the “standard” three variants (high, principal, low) also produce projections of a few special case scenarios, e.g., replacement fertility, no mortality improvement, and zero migration.

**Question 2. If there is more than one (most likely) assumption for fertility, mortality or migration, has there been an explicit statement in your discussions about what these alternative assumptions should stand for? Are they considered as ...**

Thirteen national offices stated that the assumptions described cover a “plausible range”. The office that uses the stochastic forecast methodology specifies intervals (usually 95% intervals) together with the type of distribution, etc. Two NSOs did not make any specification in the meaning of the alternative variants.

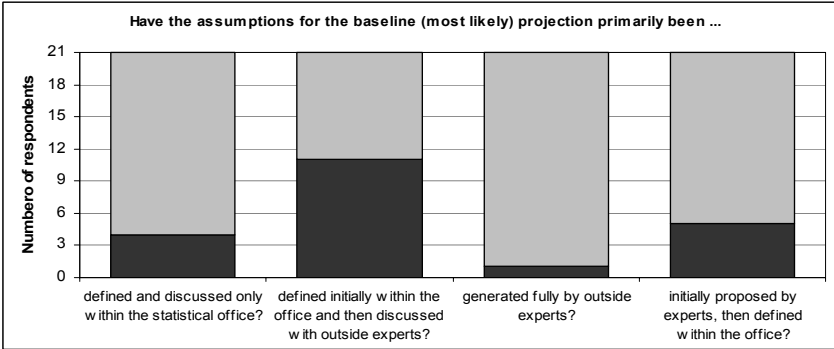


Black stands for “yes”

Some offices described the alternative variants, or how the “plausible range” was defined by filling in the open-ended comments: For instance, in one case the variants are considered as scenarios and extreme uncertainty and future international migration development is explained. Another NSO states that, “... the high level of TFR (2.1) is explained by the fact that it is the symbolic value of the replacement level of fertility. As the baseline level was 1.8, the low level retained is 1.5 because it is 0.3 lower than the baseline one (2.1 is 0.3 higher). It is as being the mean EU-15 level. For mortality, the various assumptions are explained by the expected trend of the future decrease in sex and age mortality rates (future trend is the same as past three decade trends / slow down in the trend at all ages / faster decrease at old ages). For migration balance, the level retained as baseline is explained as the mean level observed over the past two decades. A scenario ‘without migration’ is investigated but this assumption is only combined with the baseline assumptions on mortality and fertility and not with all assumptions (...). The high assumption on migration was 100 000 (+50 000 in comparison to the baseline), which was considered as a reasonable value by experts. The extra migration balance is supposed to consist in immigration only.” One office defined the standard variants as follows: “These are intended as plausible alternative scenarios and not to represent upper or lower limits for future demographic behaviour. For the special case scenarios we say ‘It is also sometimes useful to prepare special case scenarios, or ‘what if’ projections, to illustrate the consequences of a particular, but not necessarily realistic, set of assumptions.’ ” There are variations of the definition when we consider the definition of another office. “For fertility the alternative assumptions are considered as covering a certain quantitatively specified uncertainty interval; for mortality alternative assumptions are considered as covering a ‘plausible’ range; and, for migration, behind the null scenario, the other assumption is based on values considered possible.”

**Question 3. Have the assumptions for the baseline (most likely) projection primarily been ...**

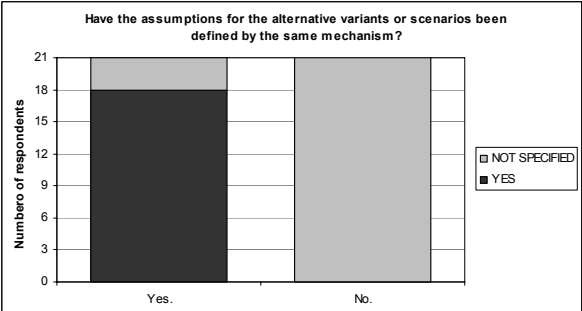
The baseline projection, or the “most-likely” or “best-guess” forecast, generally, is first discussed within the national statistical offices, and then discussed with outside experts (11 of 21 offices, or 52% of the respondents). The second most common approach is that the baseline forecast is initially proposed by experts and then discussed within the office (24%). Four NSOs (19%) discussed and defined it only within the office, and for one NSO the baseline projection was defined fully by outside experts. The one national statistical office that uses the Eurostat projections answered that both answers c) and d) applied. In spite of appearances, this answer is not in fact contradictory, as Eurostat produced the population projections in co-operation with the scientists of the country and the Central Statistical Bureau.



Typical comments on the procedure are: “The assumptions were drawn up by an expert group chaired by a member of the NSO and attended by outside experts as well as NSO experts.” Or, the answer b) “is closest to the ... situation. However, our initial meeting with six ... academic experts was largely based on the assumptions used for the previous projections and their views were part of the evidence we took into account in preparing new assumptions.”

**Question 4. Have the assumptions for the alternative variants or scenarios been defined by the same mechanism?**

The absolute majority of the respondents (86%) answered that, in case they defined more projection variants for fertility, mortality and migration, they used the same mechanism to define the alternative scenarios. However, one bureau states that “the mechanism is not applied for each new forecast round for each component; this depends on whether new evidence is available or striking developments have taken place for a specific component.”



**Question 5. In the case that external experts were involved in this process:**

This question refers to the number of experts involved in the decision process, in the number of consultations, and if separate meetings took place with different experts for fertility, mortality and migration.

In total, 76% of the national offices answered that they involved external experts to define the future paths of the model determinants. Of those 16 institutes, 11 told us that they involved 10 or more outside experts,<sup>1</sup> two institutes consulted between five and nine experts, and two offices one to four external experts. One bureau responded that, “there is no fixed number of experts; mainly for migration”.

The number of consultation meetings with such experts as a group is below 10 meetings in general. Some answers are vague, such as 1-10 meetings. Nine offices recorded fewer than five meetings. Eight of the 21 NSOs stated that there were separate meetings with different experts for fertility, mortality and migration, possibly explaining the relatively high number of meetings. One institute stated that there are separate meetings with external experts, but did not indicate how many are generally involved in the definition process of the assumptions of the vital rates.

Higher numbers of experts involved and a larger number of meetings were mostly seen in the statistical offices of the “old-15” countries of the European Union than in the “new-10” member states.

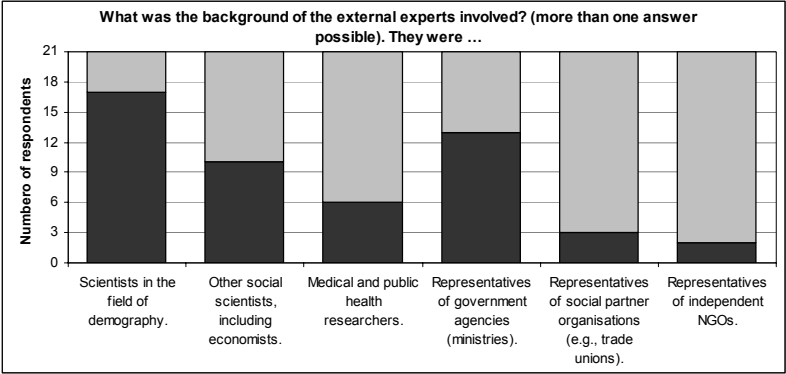


Here are three examples how such consultation meetings were organized: (1) “one per year; 7 meetings (seminars) and several consultations; other sent their opinion by e-mail; not more than 5 consultations; we had opinions from several experts (5-6) and then one meeting was organized for discussing and defining the set of final assumptions.” (2) “For this purpose a special working group was formed ... consisting of 6 members (narrow group) or 12 members (wider group.” (3) “We have a two stage process .... Initially, we consulted six leading ... academic experts on the ... assumptions at one meeting. Following this we prepared detailed papers with proposals for the assumptions. ... Three additional meetings took place including a total of around 40 people. The consultation on the ... assumptions included many experts whose interest was at [regional] ... level and was therefore effectively additional consultation on the national [projections]....”

<sup>1</sup> Many offices gave us a range of experts they involved, e.g., 6-10. To generate the plot we entered the highest numbered of experts stated in the questionnaire. In any event, the groups specified are usually the same as we used for the plot.

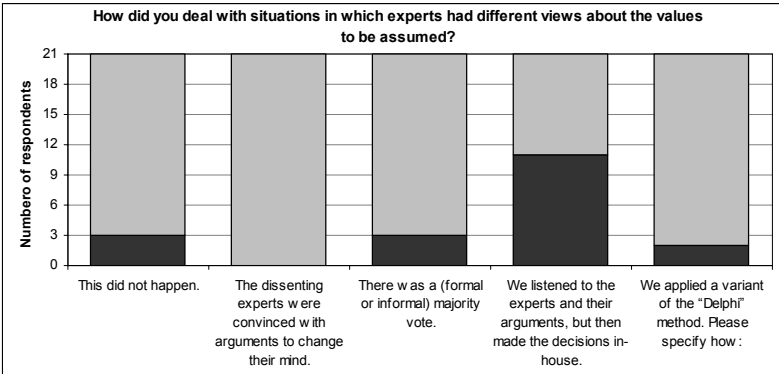
**Question 6. What was the background of the external experts involved? (more than one answer possible). They were ...**

Most of the external experts have their background in demography (17 respondents or 81%), followed by representatives of government agencies (13 or two-thirds), other social scientists including economists (10 or 48%), and medical and public health researchers (6 or 29%). Representatives of social partner organizations (such as trade unions) and independent NGOs play a minor role (three NSOs involved them). The “new” EU countries include usually only the two first groups. That fits in with the previous view that “old-15” EU countries tend to involve more external experts than the “new-10” countries. One NSO added an additional category through its comment: “Important users of projections”.



**Question 7. How did you deal with situations in which experts had different views about the values to be assumed?**

Three statistical offices told us that they were able to agree on common values, and hence they did not need any specific way to handle discrepancies. In cases where the experts could not reach a consensus for the model input, there is no clear policy. Around 50% of the national offices listen first to the experts but then take the final decisions in-house. Only three national statistical offices chose the way of majority vote, and two offices applied a variant of the “Delphi” method. To our understanding there is a clear need in the methods used to reach agreement in case there are some problems among the external and/or internal experts. A vote is a fast procedure and is a good tool for generating quick, democratic decisions, but may not be applicable for scientific decision making procedures.



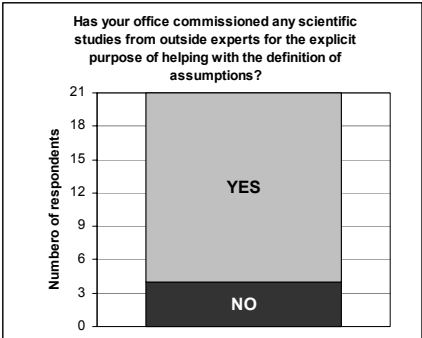
One of the three bureaus that did not have a need to deal with a “consensus mechanism” reacted as follows: “This was a common discussion to understand everyone’s argument.” Another NSO that answered with a) and d) answered that, “We base our assumption on facts and reasoning. We try to present as much [sic] facts as possible and we also try to specify where we are uncertain and show how and why we have decided in a



certain way. We also try to describe the reasoning behind the assumptions thoroughly in the publication about the population projection.” One office that answered that there was a majority vote describes it in this way: “Assumptions are defined initially within the office. Papers are prepared to justify these assumptions. The experts usually agree with the basic assumptions.” The in-house decision choice could be interpreted as the following possibility as described here. “The discussion on assumptions should finish by selection [of] the most likely variant for each component or by suggestion of verification. Conclusions from the meeting are implemented by NSO in calculation of official projection.”

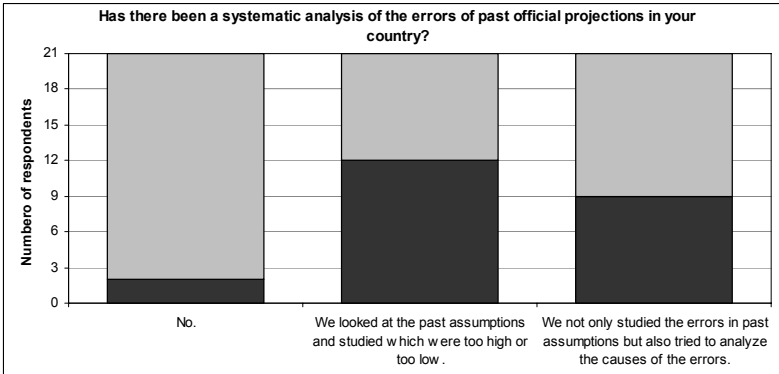
**Question 8. Has your office commissioned any scientific studies from outside experts for the explicit purpose of helping with the definition of assumptions?**

Only four of the 21 respondents answered with no. We do not know what types of outside scientific studies are used. They may be national studies, but also studies from other European Union countries, universities, or central statistical offices. Only one office replied that they are working with a university professor on a project to deliver stochastic population projections.



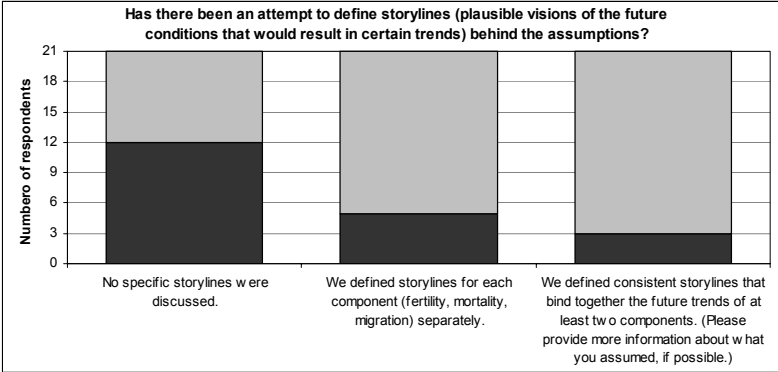
**Question 9. Has there been a systematic analysis of the errors of past official projections in your country?**

Research into the errors of past official projections is a key issue of 19 of the 21 NSOs. The statistical offices are aware of projection errors in terms of wrong assumptions. More than half of bureaus (57%) stated that they looked at the past assumptions and studies which of those assumptions have been too high or too low. Almost half (43%) told us that they study not only the scale of errors in past assumptions, but also the causes of the errors. No NSO provided any comment on what methodology they use to study systematically errors and the causes of errors of their assumptions.



**Question 10. Has there been an attempt to define storylines (plausible visions of the future conditions that would result in certain trends) behind the assumptions?**

Over half the institutes (12 or 58%) do not use storylines to describe the reasoning behind the assumptions of the future paths of fertility, mortality and migration; seven institutes do use them. Two NSOs did not indicate any of the listed answers, and another office was unsure what was meant by “storylines”. Five out of the eight offices that answered with yes, define storylines for all three components; and three of them defined consistent storylines to bind together at least two components. One of the three noted that they use both variants with more focus on the definition of the storylines for each component separately. The second didn’t specify, and the third defined the storylines for low fertility and mortality jointly.

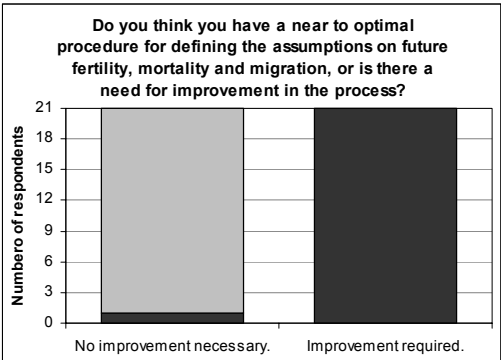


One NSO defines in detail the “binding together” of the storyline and thus provides insights into what probably happens in many of the NSOs. “The main variant is based on what are considered to be the most probable, and therefore reliable, trends for the future: a further fall in mortality, a slight increase in period fertility, inter-regional migration showing a constant probability, international migration at around levels experienced in the ’90s. In addition to the main variant, two alternative scenarios have been considered regarding the development for each demographic component. The two alternative assumptions are intended to define the range of variation within which the future population will develop. The scenario imagined in the low variant is marked by minimal economic growth and limited attention paid to social problems. Given such a context, improvements in life expectancy would slow down and there would be no recovery in the fertility rate. Regarding migration, inter-regional and international flows would exhibit modest levels, resulting in a kind of stagnation owing to the low level of attraction exerted by the destinations concerned. Such a scenario would give rise to the lowest projected population level, characterised by the most unbalanced age structure. In the high variant the scenario assumes lively economic growth, providing the opportunity to increase investments also in the social and health fields. This would lead to a higher life expectancy than in the main variant and a considerable recovery in fertility rate. Furthermore, this scenario is also marked by a more intense population movement among regions and an increase in the attractiveness of ... as a destination for immigrants from abroad. All of the foregoing factors would lead to the highest projected population level together with a more balanced age structure.” One office describes the need to define separate storylines for all these variables: “On some aspects the storylines are consistent, example: Many young [immigrants] ... in the country look for a partner in their country of origin. The rising number of young ... will have an upwards effect on the number of marriage migrants. As marriage migrants are rather traditional in behaviour these migrants will have an upwards effect on the fertility level of the ... in the country, and of course also on overall fertility.”

**Question 11. Do you think you have a near to optimal procedure for defining the assumptions on future fertility, mortality and migration, or is there a need for improvement in the process?**

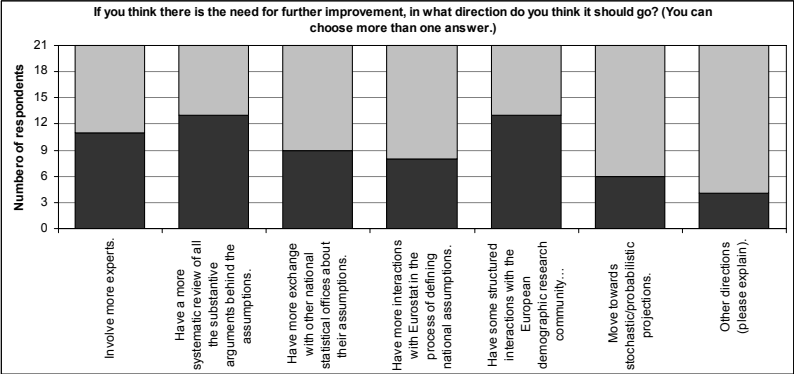
There is clear common agreement among all respondents – there is a need for improvement to define the assumptions on future fertility, mortality and migration.

One office appeared to indicate that improvement was not necessary, but then stated: “We are satisfied with our procedures, but of course improvements can always be made, so we are continuously looking for improvements.” Suggested improvements are: “In the sense that the analysis done on the data and the justification of the options should be more released in the publication.” And “Everything can be improved. We are always open to discuss improvements. However we investigate new procedures carefully before we accept them as an improvement.”



**Question 12. If you think there is the need for further improvement, in what direction do you think it should go? (You can choose more than one answer.)**

The most widely chosen improvement options were a), c), d) and e). These represent the interactions among agencies, experts, or the involvement of more experts. These were supported by 11, 9, 8 and 13 offices, respectively. This does not necessarily mean that only the statistical offices that involve currently no or only few experts answered this with yes. In fact the responses are split approximately evenly between the institutes with low and high expert involvement. The institutes who already consult relatively large numbers of external experts wish to have more interactions with other statistical offices about their assumptions. It is clear that the highest ranking goes to structured interactions with the European demographic research community. This is true for both the state of the art of their knowledge and about future demographic trends.



The second thematic group (only answer b) that includes a systematic review of all substantive arguments behind the assumptions is listed by two of the previous 13 offices that responded that they study the causes of past assumption errors (Question 9). This indicates that they are broadly satisfied with their skills and results. But it is evident that there is some need to improve the reviewing process of the arguments behind the assumptions.

Third, the interest in introducing a new methodology, in our case it would be the introduction of stochastic/probabilistic projections (that is currently in use by only one of the respondents), was indicated by six of the offices. And this seems to be more a phenomenon of northern and central Europe.

Fourth, other directions that were formulated are: (1) “More resources for analyzing the past”; (2) “We want to find a better way to present uncertainty. Which method stochastic/probabilistic or chaotic is not yet decided”; (3) “Have more human resources for carrying out an international migration flows analysis”; and (4) “Prepare more detailed projections, and have national projection as an aggregate of projections of multistate/multiregional type. Which method stochastic/probabilistic or ‘other’ is not yet decided.”

The improvements that are suggested for the answers a), c), d) and e) are: “more experts (Scientists in the field of demography) should be involved”; “there should be more cooperation with other national statistical offices”; “the goal should be that projections both made by national offices and Eurostat would be congruent if possible”; and “all kind of cooperation with European demographic research community which could provide better projection models and increase quality of projections can be considered”.

## THE ANSWERED QUESTIONNAIRES (anonymous)

ST = stochastic forecasts are made; M = more

QUESTION / NSO id.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
<b>1 In your officially published population projections, how many different assumptions do you have for the future paths of ...</b>																					
a. Fertility	3		3	3	3	1	2	1	3	1	3	M	3	3	ST	1	3	1	M	3	3
b. Mortality	3		3	3	1	1	2	1	3	1	3	M	3	3	ST	1	3	3	2	3	3
c. Migration	3		3	3	2	1	2	1	3	1	3	M	3	1	ST	1	2	3	2	3	3
<b>2 If there is more than one (most likely) assumption for fertility, mortality or migration, has there been an explicit statement in your discussions about what these alternative assumptions should stand for? Are they considered as ...</b>																					
a. the most extreme cases that one can consider possible?																					
b. covering a "plausible" range?	X		X	X	X		X	X	X		X	X	X	X				X			X
c. covering a certain quantitatively specified uncertainty interval (such as 67% or 80% of all possible future paths)?															X						
d. There was no explicit specification of the meaning of alternative assumptions.																X					X
e. Other (please explain).																	X		X		
<b>3 Have the assumptions for the baseline (most likely) projection primarily been ...</b>																					
a. defined and discussed only within the statistical office?							X			X								X	X		
b. defined initially within the office and then discussed with outside experts?			X	X	X	X			X			X	X	X	X	X					X
c. generated fully by outside experts?		X																			
d. initially proposed by experts, then defined within the office?	X	X									X						X			X	
<b>4 Have the assumptions for the alternative variants or scenarios been defined by the same mechanism?</b>																					
a. Yes.	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X
b. No. (By what mechanism: a, b, c, d from above list for Question 3?)																					
<b>5 In case that external experts were involved in this process:</b>																					
a. How many external experts were involved all together?	11	10		5	14	11		12	5		14	3	20	X	20	4	12			12	40
b. How many consultations (meetings) with such experts were there all	7			10	4	2		1	1		5	5	4	1	1	1	?			8	4



