

Chapter 1

Introduction

1.1 Introduction

In late September 1999 the Management Committee of Eurostat created a Task Force¹ in order to analyse the procedures that were being used for producing and publishing estimations at Eurostat. This Task Force under the leadership of Eurostat's unit A4², was given the following mandate: (1) to describe areas where estimations are used within Eurostat and (2) to establish a descriptive list of the methods that are used for calculating the estimates.

The source of the present dissertation was this Task Force. In reality this dissertation gives an analytical study of some specific estimation domains that the Task Force just describes. One aim of this dissertation is to investigate how some aspects of the statistical science are applied in practice in order to produce results, which in many cases are being used for the adoption of policies. In this dissertation we have chosen to present and compare methods that belong to three estimation domains that are being either applied or discussed inside Eurostat. These domains involve: (1) the micro-aggregation techniques for creating confidential data, (2) the backward calculation techniques for obtaining homogeneous time series and (3) the sampling procedures in Eurostat and in Member States and especially a summary, in a theoretical and applied manner, of the most frequently used sample designs and weighting procedures. Due to the multinational character of the third domain and in order to trace our targets, we used as exploratory tools three sample surveys that are being applied in all Member States.

With regard to each estimation domain and apart from the description and the comparison of the different estimation procedures, we investigate criteria for assessing the quality of the results.

¹ The term Task Force refers to groups that are formed internally to Eurostat for the study of a statistical problem.

² Unit A4 is responsible for the Research and Development in Statistics.

A further scope is to investigate the progress that has been made towards the over space harmonisation³ of the estimation procedures that are being applied at the Member State level, and the different roles of Eurostat in this harmonisation procedure. We have decided to involve also the aspect of harmonisation because this has a central position in one of the most important aspects of statistics, i.e. the quality of the results. Consequently, for the estimation domains that are applied in the country level i.e. the backward calculation methods and the sampling methods, we have studied the harmonisation attempts and the roles of Eurostat in relation to those attempts even if they refer to common concepts of measurement or to common methods of measurement.

1.2 Micro-aggregation Techniques

Chapter 2 is devoted to the procedures for obtaining confidential data by using micro-aggregation procedures. The micro-aggregation techniques are applied internally to Eurostat by Unit A4 (R&D in statistics). These methods are applied to the micro (individual) data that are being transmitted by the Member States to the Statistical Office of the European Union. The Statistical Office is responsible for transforming the transmitted data sets into confidential data sets, ready for publication and analysis by the independent research centres and analysts. In other words Eurostat is the intermediate between the Member States who wish their data to be confidential and the analysts who wish to have the “real” data.

It is apparent that by applying the micro-aggregation methods, there is a perturbation of the original data sets. Consequently, during the micro-aggregation procedure we have to think in two dimensions: (1) to select an appropriate micro-aggregation procedure and (2) to select and use criteria for evaluating how severe the modification of the data set is. The second chapter investigates these two dimensions. More specifically, the first part of the chapter describes micro-aggregation methods suitable for quantitative and qualitative variables.

For quantitative variables, some simple techniques like the single axis technique, the first principal component method and the sum of Z-scores (Anwar 1993) are initially described. Then we proceed into some more complex methods such as the

³The term over space harmonisation refers to the adoption of common measurement procedures by the Member

modification of Hanani's algorithm (Defays et. al.(2000)) and the adaptation of a modified Ward's algorithm (Domingo-Ferrer and Mateo-Sanz, 1998). The description concerning the methods applied to quantitative variables finishes with the description of two methods that are being used in practice a lot. These are the individual ranking method (Strudler, Oh and Scheuren, 1986) and the weighted moving average method. Focusing more on the individual ranking method, we examine the variance loss due to the application of this method (Baeyens and Defays, 1998).

Regarding qualitative variables, after their separation into nominal and ordinal variables, three methods are examined. Firstly, the snake method (first and second Community innovation survey) applied to ordinal variables is being described. Subsequently, the calculation of entropy both for ordinal and nominal variables is studied. Finally, the similarity of distributions method (first and second Community innovation survey) applied to nominal variables is being analysed.

The second part of this chapter is devoted to the evaluation of the results obtained after the application of the micro-aggregation methods. This part is of major importance as it is the basis for negotiation between Eurostat and the Member States. Two types of criteria are distinguished: i.e. (1) those that assess the confidentiality aspect⁴ of the modified data set and (2) those that evaluate the preservation of the structure⁵ of the initial data set. Criteria described from the first category are the following: the value of the threshold, the concentration or predominance rule and the indicator of data perturbation. Criteria analysed from the second category are the following: the comparison of statistics between the original and the micro-aggregated data set (e.g. the comparison of the means, the medians, the modes, the variances, the deciles, the correlation coefficients), the information loss criterion and the further processing ability criterion.

The description on this estimation domain finishes by giving a summary table of the micro-aggregation procedures and the evaluation criteria that are being used in Eurostat and in other Member States. Last but not least, we make some proposals for the adoption of better practices.

States.

⁴ Study Report For the Development of a System of Micro-aggregation of Confidential Data, Arianne II (1999).

⁵ Study Report For the Development of a System of Micro-aggregation of Confidential Data, Arianne II (1999) and the Small Aggregates Method by Anwar (1993).

1.3 Backward Calculation Techniques

Chapter 3 is devoted to the backward calculation techniques. The backward calculation techniques (retropolations) are not applied internally to Eurostat. Whether they are applied, this is done at the Member State level. However, Eurostat's unit B2⁶ is revising at that time the most frequently used backward calculation methods for two reasons: i.e. (1) in order to make proposals to the Member States, that are not using backward calculation techniques, to develop a relevant methodology and (2) in order to develop in the future backward calculation procedures inside Eurostat.

This chapter can therefore be divided into two parts. The first part deals with three real cases where there is need for the application of backward calculation methods. These cases are: (1) the changes that were caused due to the introduction of EURO, (2) the changes that were caused due to the 1993 System of National Accounts Regulation and (3) the changes due to the 1995 European System of Accounts Regulation⁷.

The second part is devoted to the description of the backward calculation methods as well as to the presentation of two cases where the backward calculation techniques are applied in practice: The Dutch case and the French case. More specifically the backward calculation techniques are distinguished in two categories⁸: (1) the annual backward calculation methods and (2) the benchmark years and interpolation methods. In the first category the full revision method, the revision by superposition of corrections, the growth rates method and the simple proportional method are described. In the second category the full benchmark year method and the layer correction method are described. Subsequently, the models that have been adopted by Netherlands and France are studied.

⁶ Unit B2 is responsible for Economic Accounts, International Markets; Production and Analyses; Quarterly Accounts and Statistical Coordination of Euro-Indicators.

⁷ Backward Calculation of National Account Data, Roberto Barcellan, Eurostat, Unit B2 (Internal Report).

⁸ For a general description of both categories and of the backward calculation methods, see Backward Calculation of Dutch National Accounting Data. Lessons From the Past Towards a New Approach, by Den Bakker and Van Rooijen Department of National Accounts, Statistics Netherlands (1997).

Starting with the Dutch model (Kazemier, 1997), we have come to recognise that this is a variant of the layer correction method belonging to the benchmark years and interpolation category.

The French model⁹ is different from the Dutch model with regard to the interpolation method. More specifically, the interpolation method is based on the Kalman-filter algorithm (Kalman, 1960). A thorough description of the aspects of the Kalman-filter algorithm is given. Furthermore, a short description of the French software, concerning the backward calculation method, is given. Finally, some concluding remarks concerning the backward calculation methods are presented.

1.4 Sampling Procedures in Eurostat and in The Member States

Chapter 4 is devoted to a huge domain, the sampling procedures, that are discussed in Eurostat and applied in the Member States. The primary motive for writing this chapter was the investigation and the description both in a theoretical and applied manner of the most common sample designs and weighting procedures used at national level. A further motive was the discussion on the quality of statistics that is of high interest for Eurostat at that time. The sample designs, the weighting procedures and the definitions of the survey concepts that are used by the Member States, are strongly connected to the idea of the over space comparability which is one of the most important quality indicators. In this chapter, wherever possible, we focus on the proposals for the adoption of common sample designs and weighting procedures and also on attempts that have been made for the adoption of common ways of measuring the various survey concepts.

However, our description becomes more difficult due to the multinational character of the surveys. Consequently in order to clarify our targets we have chosen as exploratory tools three sample surveys that are applied in all Member States. These surveys are the labour force, the European Community household panel and the household budget survey.

The first part describes in a theoretical way the most frequently used sample designs¹⁰. We begin with a fundamental one, the stratified random sample. The

⁹Backward Calculation of National Accounts, Department des Comptes Nationaux (1997).

¹⁰For a description of sample designs see Sampling Techniques by Cochran (1977).

estimations of this design under proportionate and disproportionate allocation of the sample are studied and best practices of forming the strata and increasing the efficiency of the sample are described. In the sequel, we describe the systematic sampling and more specifically the stratified sampling with systematic selection of the units within each stratum. This design is described because it is applied in practice for example in the labour force surveys in Sweden and Finland. A large amount of this part is devoted to the multistage cluster sampling. From a theoretical point of view, we have distinguished between multistage cluster sampling with equal clusters and multistage cluster sampling with unequal clusters. Especially in the multistage cluster sampling with unequal clusters, we describe some of the alternative ways for selecting¹¹ the primary units. A large number of surveys that have been conducted according to the multistage cluster sampling are also given.

The second part is devoted to two frequently used weighting procedures. These are the post-stratification or stratification after selection and the raking ratio adjustment (Deming and Stephen 1940).

The third and last part describes these three surveys that are conducted in every Member State. In all surveys we start by describing their purposes i.e. why they are conducted and what they wish to measure. Then we focus on some harmonization attempts. For example, for the labour force survey and the household budget survey we describe attempts that have been made for defining some common survey concepts and the ways of measuring these concepts. Great emphasis is given to some proposals made by Eurostat concerning the sample design and especially a step by step weighting procedure that can be applied in the European Community household panel and in the household budget survey. In some cases we study the design of the surveys in Greece as well as in other Member States. Finally, we give some concluding remarks of the main findings in this estimation domain.

¹¹ Such methods are the selection with equal probabilities and the selection with probabilities proportional to the estimated size.